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INC.

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SUPPLEMENTAL STORMWATER REPORT

For

“3127 Cranberry Highway Site Development”

3127 Cranberry Highway
Wareham, MA

Prepared for

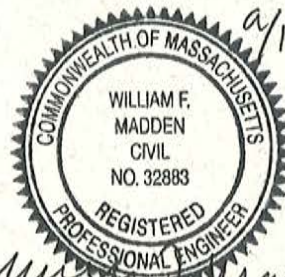
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Prepared by

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266 Main Street
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September 11, 2023

G.A.F. Job No.: 22-9890

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DRAINAGE NARRATIVE

General Description

This Supplemental Drainage Report has been prepared in response to review comments provided by Allen & Major Associates by letter dated September 6, 2023. Under item #14 it was requested that the area of the property adjacent to Cranberry Highway be separately evaluated and removed from the area contributing to the underground infiltration chambers and landscaped depression proposed along the southern lot line.

Existing Conditions

The lot is entirely surfaced with pavement or concrete. The drainage system consists of a single catch basin at a low point in the center of the lot on the south side approximately 40 feet from the property line with the railroad. The catch basin discharges to an underground storage and infiltration system of undetermined capacity and performance. The area of the property which contributes runoff to the existing catch basin has been modeled as sub-catchment 1S in the calculations.

A very small area (530 sf) of pavement at the north end of the property adjacent to Cranberry Highway is slightly higher than the sidewalk in the state highway layout. This area has been modeled as sub-catchment 2S in the calculations.

Soils as mapped by the USDA Natural Resources Conservation Service consist of Carver – Urban land complex (637B), 0 to 8 percent slopes. These soils have a Hydrologic soil group (HSG) rating “A”.

The volumes input for each storm event are as listed in the Point Precipitation Frequency Estimates published by NOAA Atlas 14, Volume 10, Version 3.

Proposed Conditions

Revisions to the post-development drainage calculations consist of the delineation of sub-catchment 3S adjacent to Cranberry Highway which consists of the portions of landscaping and pavement at the entrance which are slightly higher than the sidewalk in the state highway layout.

Sub-catchment 3S is compared with existing sub-catchment 1S for confirmation that peak storm rates and volumes are reduced for the minor flows directed toward Cranberry Highway.

Drainage Summary

Table 1 – Pre-Development vs. Post-Development to Catch Basin (1S/1S)

Storm Event	Pre		Post		Pre vs. Post changes	
	Peak Discharge (cfs)	Volume (ac-ft.)	Peak Discharge (cfs)	Volume (ac-ft.)	Peak Discharge (cfs)	Volume (ac-ft.)
2 yr	1.18	0.094	0.77	0.055	-0.41	-0.039
10 yr	1.73	0.141	1.23	0.090	-0.50	-0.051
25 yr	2.08	0.170	1.51	0.113	-0.57	-0.057
100 yr	2.61	0.215	1.94	0.147	-0.67	-0.068

Table 2 – Pre-Development vs. Post-Development to Cranberry Hwy (2S/3S)

Storm Event	Pre		Post		Pre vs. Post changes	
	Peak Discharge (cfs)	Volume (ac-ft.)	Peak Discharge (cfs)	Volume (ac-ft.)	Peak Discharge (cfs)	Volume (ac-ft.)
2 yr	0.04	0.003	0	0	-0.04	-0.003
10 yr	0.06	0.005	0	0.001	-0.06	-0.004
25 yr	0.07	0.006	0.01	0.001	-0.06	-0.005
100 yr	0.09	0.007	0.02	0.002	-0.07	-0.005



To Cran Hwy



To CB DP 1



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Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2 Year Storm	Type III 24-hr		Default	24.00	1	3.44	2
2	10 Year Storm	Type III 24-hr		Default	24.00	1	5.03	2
3	25 Year Storm	Type III 24-hr		Default	24.00	1	6.02	2
4	100 Year Storm	Type III 24-hr		Default	24.00	1	7.55	2

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.352	98	Paved parking, HSG A (1S)
0.012	98	Pavement (2S)
0.365	98	TOTAL AREA

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Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.352	HSG A	1S
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.012	Other	2S
0.365		TOTAL AREA

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Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.352	0.000	0.000	0.000	0.000	0.352	Paved parking	1S
0.000	0.000	0.000	0.000	0.012	0.012	Pavement	2S
0.352	0.000	0.000	0.000	0.012	0.365	TOTAL AREA	

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Type III 24-hr 2 Year Storm Rainfall=3.44"

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Summary for Subcatchment 1S: To CB DP 1

Runoff = 1.18 cfs @ 12.08 hrs, Volume= 0.094 af, Depth= 3.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Storm Rainfall=3.44"

Area (sf)	CN	Description
15,351	98	Paved parking, HSG A
15,351		100.00% 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 2S: To Cran Hwy

Runoff = 0.04 cfs @ 12.08 hrs, Volume= 0.003 af, Depth= 3.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Storm Rainfall=3.44"

	Area (sf)	CN	Description
*	530	98	Pavement
	530		100.00% 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 Year Storm Rainfall=5.03"

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Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 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 1S: To CB DP 1

Runoff Area=15,351 sf 100.00% Impervious Runoff Depth=4.79"
Tc=6.0 min CN=98 Runoff=1.73 cfs 0.141 af

Subcatchment 2S: To Cran Hwy

Runoff Area=530 sf 100.00% Impervious Runoff Depth=4.79"
Tc=6.0 min CN=98 Runoff=0.06 cfs 0.005 af

Total Runoff Area = 0.365 ac Runoff Volume = 0.146 af Average Runoff Depth = 4.79"
0.00% Pervious = 0.000 ac 100.00% Impervious = 0.365 ac

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Type III 24-hr 10 Year Storm Rainfall=5.03"

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Summary for Subcatchment 1S: To CB DP 1

Runoff = 1.73 cfs @ 12.08 hrs, Volume= 0.141 af, Depth= 4.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Storm Rainfall=5.03"

Area (sf)	CN	Description
15,351	98	Paved parking, HSG A
15,351		100.00% 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 Year Storm Rainfall=5.03"

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Summary for Subcatchment 2S: To Cran Hwy

Runoff = 0.06 cfs @ 12.08 hrs, Volume= 0.005 af, Depth= 4.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Storm Rainfall=5.03"

	Area (sf)	CN	Description
*	530	98	Pavement
	530		100.00% 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 25 Year Storm Rainfall=6.02"

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Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 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 1S: To CB DP 1

Runoff Area=15,351 sf 100.00% Impervious Runoff Depth=5.78"
Tc=6.0 min CN=98 Runoff=2.08 cfs 0.170 af

Subcatchment 2S: To Cran Hwy

Runoff Area=530 sf 100.00% Impervious Runoff Depth=5.78"
Tc=6.0 min CN=98 Runoff=0.07 cfs 0.006 af

Total Runoff Area = 0.365 ac Runoff Volume = 0.176 af Average Runoff Depth = 5.78"
0.00% Pervious = 0.000 ac 100.00% Impervious = 0.365 ac

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Type III 24-hr 25 Year Storm Rainfall=6.02"

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Summary for Subcatchment 1S: To CB DP 1

Runoff = 2.08 cfs @ 12.08 hrs, Volume= 0.170 af, Depth= 5.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Year Storm Rainfall=6.02"

Area (sf)	CN	Description
15,351	98	Paved parking, HSG A
15,351		100.00% 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 2S: To Cran Hwy

Runoff = 0.07 cfs @ 12.08 hrs, Volume= 0.006 af, Depth= 5.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Year Storm Rainfall=6.02"

	Area (sf)	CN	Description
*	530	98	Pavement
	530		100.00% 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 100 Year Storm Rainfall=7.55"

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Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 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 1S: To CB DP 1

Runoff Area=15,351 sf 100.00% Impervious Runoff Depth=7.31"
Tc=6.0 min CN=98 Runoff=2.61 cfs 0.215 af

Subcatchment 2S: To Cran Hwy

Runoff Area=530 sf 100.00% Impervious Runoff Depth=7.31"
Tc=6.0 min CN=98 Runoff=0.09 cfs 0.007 af

Total Runoff Area = 0.365 ac Runoff Volume = 0.222 af Average Runoff Depth = 7.31"
0.00% Pervious = 0.000 ac 100.00% Impervious = 0.365 ac

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Type III 24-hr 100 Year Storm Rainfall=7.55"

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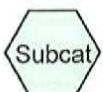
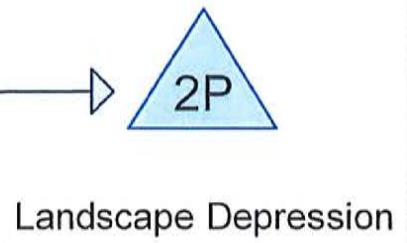
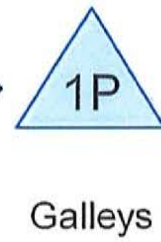
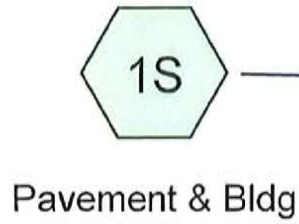
Summary for Subcatchment 1S: To CB DP 1

Runoff = 2.61 cfs @ 12.08 hrs, Volume= 0.215 af, Depth= 7.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Storm Rainfall=7.55"

Area (sf)	CN	Description
15,351	98	Paved parking, HSG A
15,351		100.00% Impervious Area

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



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Project Notes

Rainfall events imported from "9890PRE.hcp"

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Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2 Year Storm	Type III 24-hr		Default	24.00	1	3.44	2
2	10 Year Storm	Type III 24-hr		Default	24.00	1	5.03	2
3	25 Year Storm	Type III 24-hr		Default	24.00	1	6.02	2
4	100 Year Storm	Type III 24-hr		Default	24.00	1	7.55	2

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.121	39	>75% Grass cover, Good, HSG A (1S, 2S, 3S)
0.002	98	Basin bottom (2S)
0.239	98	Paved parking, HSG A (1S)
0.002	98	Pavement (3S)
0.365	78	TOTAL AREA

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Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.361	HSG A	1S, 2S, 3S
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.004	Other	2S, 3S
0.365		TOTAL AREA

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Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.121	0.000	0.000	0.000	0.000	0.121	>75% Grass cover, Good	1S, 2S, 3S
0.000	0.000	0.000	0.000	0.002	0.002	Basin bottom	2S
0.239	0.000	0.000	0.000	0.000	0.239	Paved parking	1S
0.000	0.000	0.000	0.000	0.002	0.002	Pavement	3S
0.361	0.000	0.000	0.000	0.004	0.365	TOTAL AREA	

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Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 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 1S: Pavement & Bldg	Runoff Area=12,090 sf 86.27% Impervious Runoff Depth=2.39" Tc=6.0 min CN=90 Runoff=0.77 cfs 0.055 af
Subcatchment 2S: Landscaping	Runoff Area=3,191 sf 2.82% Impervious Runoff Depth=0.02" Tc=6.0 min CN=41 Runoff=0.00 cfs 0.000 af
Subcatchment 3S: To Cran Hwy	Runoff Area=600 sf 11.67% Impervious Runoff Depth=0.09" Tc=6.0 min CN=46 Runoff=0.00 cfs 0.000 af
Pond 1P: Galleys	Peak Elev=35.44' Storage=559 cf Inflow=0.77 cfs 0.055 af Outflow=0.19 cfs 0.055 af
Pond 2P: Landscape Depression	Peak Elev=40.50' Storage=0 cf Inflow=0.00 cfs 0.000 af Outflow=0.00 cfs 0.000 af

Total Runoff Area = 0.365 ac Runoff Volume = 0.056 af Average Runoff Depth = 1.83"
33.32% Pervious = 0.121 ac 66.68% Impervious = 0.243 ac

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Summary for Subcatchment 1S: Pavement & Bldg

Runoff = 0.77 cfs @ 12.09 hrs, Volume= 0.055 af, Depth= 2.39"
Routed to Pond 1P : Galleys

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Storm Rainfall=3.44"

Area (sf)	CN	Description
10,430	98	Paved parking, HSG A
1,660	39	>75% Grass cover, Good, HSG A
12,090	90	Weighted Average
1,660		13.73% Pervious Area
10,430		86.27% 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 2S: Landscaping

Runoff = 0.00 cfs @ 20.74 hrs, Volume= 0.000 af, Depth= 0.02"
 Routed to Pond 2P : Landscape Depression

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
 Type III 24-hr 2 Year Storm Rainfall=3.44"

Area (sf)	CN	Description
* 90	98	Basin bottom
3,101	39	>75% Grass cover, Good, HSG A
3,191	41	Weighted Average
3,101		97.18% Pervious Area
90		2.82% 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 3S: To Cran Hwy

Runoff = 0.00 cfs @ 14.58 hrs, Volume= 0.000 af, Depth= 0.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
 Type III 24-hr 2 Year Storm Rainfall=3.44"

	Area (sf)	CN	Description
*	70	98	Pavement
	530	39	>75% Grass cover, Good, HSG A
	600	46	Weighted Average
	530		88.33% Pervious Area
	70		11.67% 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 Pond 1P: Galleys

Inflow Area = 0.278 ac, 86.27% Impervious, Inflow Depth = 2.39" for 2 Year Storm event
 Inflow = 0.77 cfs @ 12.09 hrs, Volume= 0.055 af
 Outflow = 0.19 cfs @ 12.48 hrs, Volume= 0.055 af, Atten= 76%, Lag= 23.5 min
 Discarded = 0.19 cfs @ 12.48 hrs, Volume= 0.055 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 35.44' @ 12.48 hrs Surf.Area= 800 sf Storage= 559 cf

Plug-Flow detention time= 17.6 min calculated for 0.055 af (100% of inflow)
 Center-of-Mass det. time= 17.6 min (821.7 - 804.1)

Volume	Invert	Avail.Storage	Storage Description
#1	34.00'	912 cf	20.00'W x 40.00'L x 5.50'H Prismatic 4,400 cf Overall - 2,120 cf Embedded = 2,280 cf x 40.0% Voids
#2	35.00'	1,596 cf	Concrete Galley 4x4x4 x 36 Inside #1 Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf 36 Chambers in 4 Rows
		2,509 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	34.00'	8.270 in/hr Exfiltration over Wetted area

Discarded OutFlow Max=0.19 cfs @ 12.48 hrs HW=35.44' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.19 cfs)

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Summary for Pond 2P: Landscape Depression

Inflow Area = 0.073 ac, 2.82% Impervious, Inflow Depth = 0.02" for 2 Year Storm event
Inflow = 0.00 cfs @ 20.74 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 20.79 hrs, Volume= 0.000 af, Atten= 0%, Lag= 2.9 min
Discarded = 0.00 cfs @ 20.79 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 40.50' @ 20.79 hrs Surf.Area= 90 sf Storage= 0 cf

Plug-Flow detention time= 2.9 min calculated for 0.000 af (100% of inflow)
Center-of-Mass det. time= 2.9 min (1,182.1 - 1,179.2)

Volume	Invert	Avail.Storage	Storage Description
#1	40.50'	375 cf	1.00'W x 90.00'L x 1.00'H Prismatic Z=3.0

Device	Routing	Invert	Outlet Devices
#1	Discarded	40.50'	2.410 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.01 cfs @ 20.79 hrs HW=40.50' (Free Discharge)
↑-1=Exfiltration (Exfiltration Controls 0.01 cfs)

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Type III 24-hr 10 Year Storm Rainfall=5.03"

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Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 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 1S: Pavement & Bldg	Runoff Area=12,090 sf 86.27% Impervious Runoff Depth=3.91" Tc=6.0 min CN=90 Runoff=1.23 cfs 0.090 af
Subcatchment 2S: Landscaping	Runoff Area=3,191 sf 2.82% Impervious Runoff Depth=0.28" Tc=6.0 min CN=41 Runoff=0.01 cfs 0.002 af
Subcatchment 3S: To Cran Hwy	Runoff Area=600 sf 11.67% Impervious Runoff Depth=0.50" Tc=6.0 min CN=46 Runoff=0.00 cfs 0.001 af
Pond 1P: Galleys	Peak Elev=36.51' Storage=1,159 cf Inflow=1.23 cfs 0.090 af Outflow=0.21 cfs 0.090 af
Pond 2P: Landscape Depression	Peak Elev=40.51' Storage=1 cf Inflow=0.01 cfs 0.002 af Outflow=0.01 cfs 0.002 af

Total Runoff Area = 0.365 ac Runoff Volume = 0.093 af Average Runoff Depth = 3.05"
33.32% Pervious = 0.121 ac 66.68% Impervious = 0.243 ac

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Summary for Subcatchment 1S: Pavement & Bldg

Runoff = 1.23 cfs @ 12.09 hrs, Volume= 0.090 af, Depth= 3.91"
 Routed to Pond 1P : Galleys

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
 Type III 24-hr 10 Year Storm Rainfall=5.03"

Area (sf)	CN	Description
10,430	98	Paved parking, HSG A
1,660	39	>75% Grass cover, Good, HSG A
12,090	90	Weighted Average
1,660		13.73% Pervious Area
10,430		86.27% 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 2S: Landscaping

Runoff = 0.01 cfs @ 12.40 hrs, Volume= 0.002 af, Depth= 0.28"
 Routed to Pond 2P : Landscape Depression

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
 Type III 24-hr 10 Year Storm Rainfall=5.03"

Area (sf)	CN	Description
* 90	98	Basin bottom
3,101	39	>75% Grass cover, Good, HSG A
3,191	41	Weighted Average
3,101		97.18% Pervious Area
90		2.82% 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 3S: To Cran Hwy

Runoff = 0.00 cfs @ 12.16 hrs, Volume= 0.001 af, Depth= 0.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Storm Rainfall=5.03"

Area (sf)	CN	Description
* 70	98	Pavement
530	39	>75% Grass cover, Good, HSG A
600	46	Weighted Average
530		88.33% Pervious Area
70		11.67% 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 Year Storm Rainfall=5.03"

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Summary for Pond 1P: Galleys

Inflow Area = 0.278 ac, 86.27% Impervious, Inflow Depth = 3.91" for 10 Year Storm event
 Inflow = 1.23 cfs @ 12.09 hrs, Volume= 0.090 af
 Outflow = 0.21 cfs @ 12.55 hrs, Volume= 0.090 af, Atten= 83%, Lag= 27.7 min
 Discarded = 0.21 cfs @ 12.55 hrs, Volume= 0.090 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 36.51' @ 12.55 hrs Surf.Area= 800 sf Storage= 1,159 cf

Plug-Flow detention time= 36.7 min calculated for 0.090 af (100% of inflow)
 Center-of-Mass det. time= 36.6 min (827.2 - 790.5)

Volume	Invert	Avail.Storage	Storage Description
#1	34.00'	912 cf	20.00'W x 40.00'L x 5.50'H Prismatic 4,400 cf Overall - 2,120 cf Embedded = 2,280 cf x 40.0% Voids
#2	35.00'	1,596 cf	Concrete Galley 4x4x4 x 36 Inside #1 Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf 36 Chambers in 4 Rows
		2,509 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	34.00'	8.270 in/hr Exfiltration over Wetted area

Discarded OutFlow Max=0.21 cfs @ 12.55 hrs HW=36.51' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.21 cfs)

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Summary for Pond 2P: Landscape Depression

Inflow Area = 0.073 ac, 2.82% Impervious, Inflow Depth = 0.28" for 10 Year Storm event
Inflow = 0.01 cfs @ 12.40 hrs, Volume= 0.002 af
Outflow = 0.01 cfs @ 12.51 hrs, Volume= 0.002 af, Atten= 14%, Lag= 6.1 min
Discarded = 0.01 cfs @ 12.51 hrs, Volume= 0.002 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 40.51' @ 12.51 hrs Surf.Area= 97 sf Storage= 1 cf

Plug-Flow detention time= 3.0 min calculated for 0.002 af (100% of inflow)
Center-of-Mass det. time= 2.9 min (985.4 - 982.5)

Volume	Invert	Avail.Storage	Storage Description
#1	40.50'	375 cf	1.00'W x 90.00'L x 1.00'H Prismatic Z=3.0

Device	Routing	Invert	Outlet Devices
#1	Discarded	40.50'	2.410 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.01 cfs @ 12.51 hrs HW=40.51' (Free Discharge)
↑1=Exfiltration (Exfiltration Controls 0.01 cfs)

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Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 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 1S: Pavement & Bldg	Runoff Area=12,090 sf 86.27% Impervious Runoff Depth=4.87" Tc=6.0 min CN=90 Runoff=1.51 cfs 0.113 af
Subcatchment 2S: Landscaping	Runoff Area=3,191 sf 2.82% Impervious Runoff Depth=0.56" Tc=6.0 min CN=41 Runoff=0.02 cfs 0.003 af
Subcatchment 3S: To Cran Hwy	Runoff Area=600 sf 11.67% Impervious Runoff Depth=0.87" Tc=6.0 min CN=46 Runoff=0.01 cfs 0.001 af
Pond 1P: Galleys	Peak Elev=37.21' Storage=1,548 cf Inflow=1.51 cfs 0.113 af Outflow=0.23 cfs 0.113 af
Pond 2P: Landscape Depression	Peak Elev=40.63' Storage=16 cf Inflow=0.02 cfs 0.003 af Outflow=0.01 cfs 0.003 af

Total Runoff Area = 0.365 ac Runoff Volume = 0.117 af Average Runoff Depth = 3.85"
33.32% Pervious = 0.121 ac 66.68% Impervious = 0.243 ac

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Summary for Subcatchment 1S: Pavement & Bldg

Runoff = 1.51 cfs @ 12.08 hrs, Volume= 0.113 af, Depth= 4.87"
Routed to Pond 1P : Galleys

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Year Storm Rainfall=6.02"

Area (sf)	CN	Description
10,430	98	Paved parking, HSG A
1,660	39	>75% Grass cover, Good, HSG A
12,090	90	Weighted Average
1,660		13.73% Pervious Area
10,430		86.27% 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 2S: Landscaping

Runoff = 0.02 cfs @ 12.29 hrs, Volume= 0.003 af, Depth= 0.56"
 Routed to Pond 2P : Landscape Depression

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
 Type III 24-hr 25 Year Storm Rainfall=6.02"

Area (sf)	CN	Description
* 90	98	Basin bottom
3,101	39	>75% Grass cover, Good, HSG A
3,191	41	Weighted Average
3,101		97.18% Pervious Area
90		2.82% 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 3S: To Cran Hwy

Runoff = 0.01 cfs @ 12.12 hrs, Volume= 0.001 af, Depth= 0.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
 Type III 24-hr 25 Year Storm Rainfall=6.02"

Area (sf)	CN	Description
* 70	98	Pavement
530	39	>75% Grass cover, Good, HSG A
600	46	Weighted Average
530		88.33% Pervious Area
70		11.67% 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 25 Year Storm Rainfall=6.02"

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Summary for Pond 1P: Galleys

Inflow Area = 0.278 ac, 86.27% Impervious, Inflow Depth = 4.87" for 25 Year Storm event
 Inflow = 1.51 cfs @ 12.08 hrs, Volume= 0.113 af
 Outflow = 0.23 cfs @ 12.57 hrs, Volume= 0.113 af, Atten= 85%, Lag= 29.4 min
 Discarded = 0.23 cfs @ 12.57 hrs, Volume= 0.113 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 37.21' @ 12.57 hrs Surf.Area= 800 sf Storage= 1,548 cf

Plug-Flow detention time= 48.4 min calculated for 0.113 af (100% of inflow)
 Center-of-Mass det. time= 48.4 min (833.0 - 784.6)

Volume	Invert	Avail.Storage	Storage Description
#1	34.00'	912 cf	20.00'W x 40.00'L x 5.50'H Prismatic 4,400 cf Overall - 2,120 cf Embedded = 2,280 cf x 40.0% Voids
#2	35.00'	1,596 cf	Concrete Galley 4x4x4 x 36 Inside #1 Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf 36 Chambers in 4 Rows
		2,509 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	34.00'	8.270 in/hr Exfiltration over Wetted area

Discarded OutFlow Max=0.23 cfs @ 12.57 hrs HW=37.21' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.23 cfs)

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Summary for Pond 2P: Landscape Depression

Inflow Area = 0.073 ac, 2.82% Impervious, Inflow Depth = 0.56" for 25 Year Storm event
Inflow = 0.02 cfs @ 12.29 hrs, Volume= 0.003 af
Outflow = 0.01 cfs @ 12.62 hrs, Volume= 0.003 af, Atten= 53%, Lag= 19.8 min
Discarded = 0.01 cfs @ 12.62 hrs, Volume= 0.003 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 40.63' @ 12.62 hrs Surf.Area= 162 sf Storage= 16 cf

Plug-Flow detention time= 12.3 min calculated for 0.003 af (100% of inflow)
Center-of-Mass det. time= 12.3 min (954.5 - 942.2)

Volume	Invert	Avail.Storage	Storage Description
#1	40.50'	375 cf	1.00'W x 90.00'L x 1.00'H Prismatic Z=3.0

Device	Routing	Invert	Outlet Devices
#1	Discarded	40.50'	2.410 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.01 cfs @ 12.62 hrs HW=40.63' (Free Discharge)
↑1=Exfiltration (Exfiltration Controls 0.01 cfs)

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Type III 24-hr 100 Year Storm Rainfall=7.55"

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Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 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 1S: Pavement & Bldg	Runoff Area=12,090 sf 86.27% Impervious Runoff Depth=6.36" Tc=6.0 min CN=90 Runoff=1.94 cfs 0.147 af
Subcatchment 2S: Landscaping	Runoff Area=3,191 sf 2.82% Impervious Runoff Depth=1.15" Tc=6.0 min CN=41 Runoff=0.07 cfs 0.007 af
Subcatchment 3S: To Cran Hwy	Runoff Area=600 sf 11.67% Impervious Runoff Depth=1.60" Tc=6.0 min CN=46 Runoff=0.02 cfs 0.002 af
Pond 1P: Galleys	Peak Elev=38.36' Storage=2,179 cf Inflow=1.94 cfs 0.147 af Outflow=0.25 cfs 0.147 af
Pond 2P: Landscape Depression	Peak Elev=40.85' Storage=66 cf Inflow=0.07 cfs 0.007 af Outflow=0.02 cfs 0.007 af

Total Runoff Area = 0.365 ac Runoff Volume = 0.156 af Average Runoff Depth = 5.13"
33.32% Pervious = 0.121 ac 66.68% Impervious = 0.243 ac

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Type III 24-hr 100 Year Storm Rainfall=7.55"

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Summary for Subcatchment 1S: Pavement & Bldg

Runoff = 1.94 cfs @ 12.08 hrs, Volume= 0.147 af, Depth= 6.36"
 Routed to Pond 1P : Galleys

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
 Type III 24-hr 100 Year Storm Rainfall=7.55"

Area (sf)	CN	Description
10,430	98	Paved parking, HSG A
1,660	39	>75% Grass cover, Good, HSG A
12,090	90	Weighted Average
1,660		13.73% Pervious Area
10,430		86.27% 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 2S: Landscaping

Runoff = 0.07 cfs @ 12.12 hrs, Volume= 0.007 af, Depth= 1.15"
Routed to Pond 2P : Landscape Depression

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Storm Rainfall=7.55"

Area (sf)	CN	Description
*	90	98 Basin bottom
3,101	39	>75% Grass cover, Good, HSG A
3,191	41	Weighted Average
3,101		97.18% Pervious Area
90		2.82% 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 3S: To Cran Hwy

Runoff = 0.02 cfs @ 12.10 hrs, Volume= 0.002 af, Depth= 1.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
 Type III 24-hr 100 Year Storm Rainfall=7.55"

Area (sf)	CN	Description
* 70	98	Pavement
530	39	>75% Grass cover, Good, HSG A
600	46	Weighted Average
530		88.33% Pervious Area
70		11.67% 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 100 Year Storm Rainfall=7.55"

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Summary for Pond 1P: Galleys

Inflow Area = 0.278 ac, 86.27% Impervious, Inflow Depth = 6.36" for 100 Year Storm event
 Inflow = 1.94 cfs @ 12.08 hrs, Volume= 0.147 af
 Outflow = 0.25 cfs @ 12.62 hrs, Volume= 0.147 af, Atten= 87%, Lag= 32.0 min
 Discarded = 0.25 cfs @ 12.62 hrs, Volume= 0.147 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 38.36' @ 12.62 hrs Surf.Area= 800 sf Storage= 2,179 cf

Plug-Flow detention time= 66.0 min calculated for 0.147 af (100% of inflow)
 Center-of-Mass det. time= 66.0 min (843.6 - 777.6)

Volume	Invert	Avail.Storage	Storage Description
#1	34.00'	912 cf	20.00'W x 40.00'L x 5.50'H Prismatic 4,400 cf Overall - 2,120 cf Embedded = 2,280 cf x 40.0% Voids
#2	35.00'	1,596 cf	Concrete Galley 4x4x4 x 36 Inside #1 Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf 36 Chambers in 4 Rows
		2,509 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	34.00'	8.270 in/hr Exfiltration over Wetted area

Discarded OutFlow Max=0.25 cfs @ 12.62 hrs HW=38.36' (Free Discharge)
 ↳1=Exfiltration (Exfiltration Controls 0.25 cfs)

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Type III 24-hr 100 Year Storm Rainfall=7.55"

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Summary for Pond 2P: Landscape Depression

Inflow Area = 0.073 ac, 2.82% Impervious, Inflow Depth = 1.15" for 100 Year Storm event
 Inflow = 0.07 cfs @ 12.12 hrs, Volume= 0.007 af
 Outflow = 0.02 cfs @ 12.78 hrs, Volume= 0.007 af, Atten= 76%, Lag= 39.6 min
 Discarded = 0.02 cfs @ 12.78 hrs, Volume= 0.007 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
 Peak Elev= 40.85' @ 12.78 hrs Surf.Area= 286 sf Storage= 66 cf

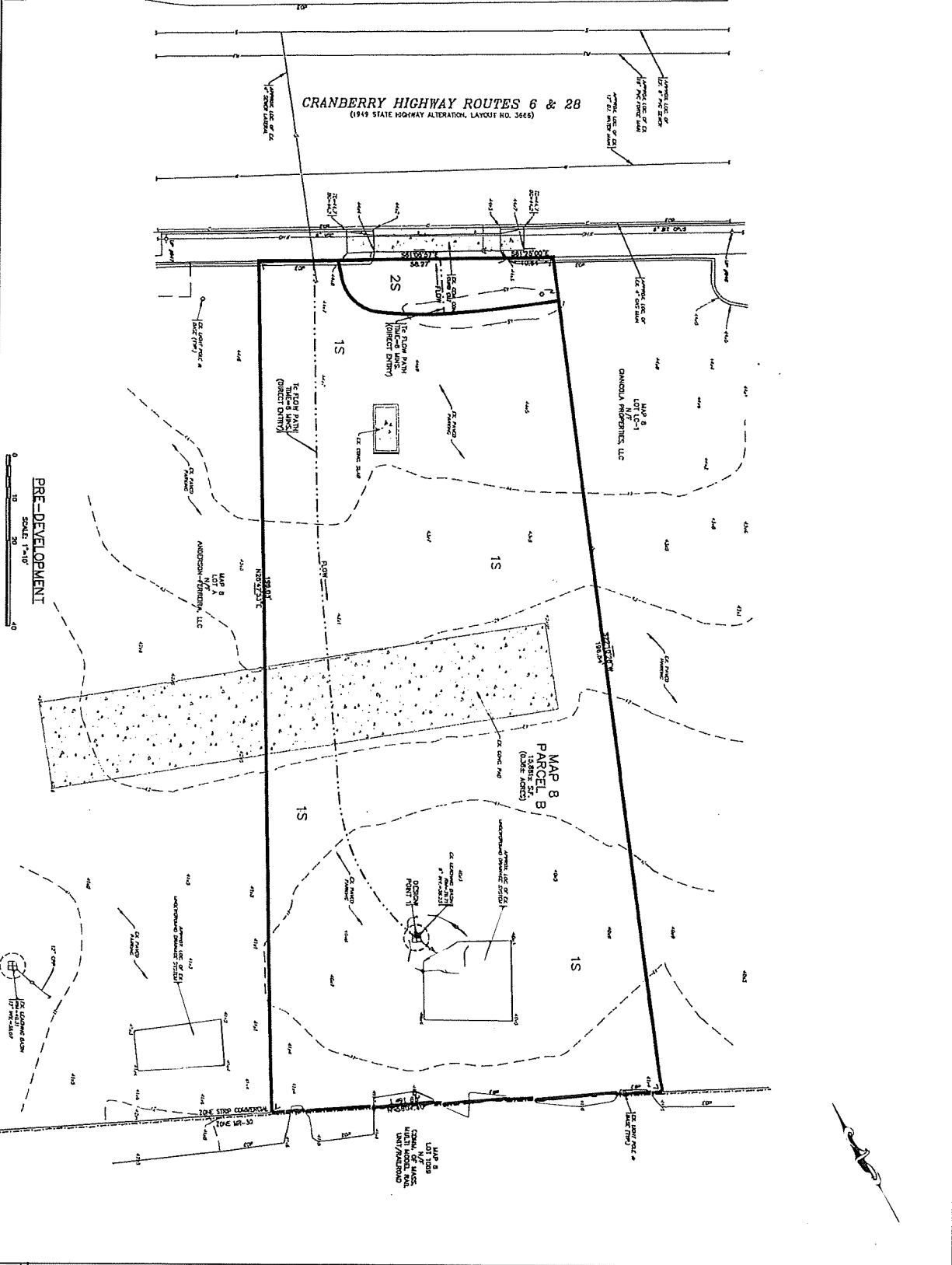
Plug-Flow detention time= 38.9 min calculated for 0.007 af (100% of inflow)
 Center-of-Mass det. time= 38.9 min (947.8 - 908.9)

Volume	Invert	Avail.Storage	Storage Description
#1	40.50'	375 cf	1.00'W x 90.00'L x 1.00'H Prismatic Z=3.0

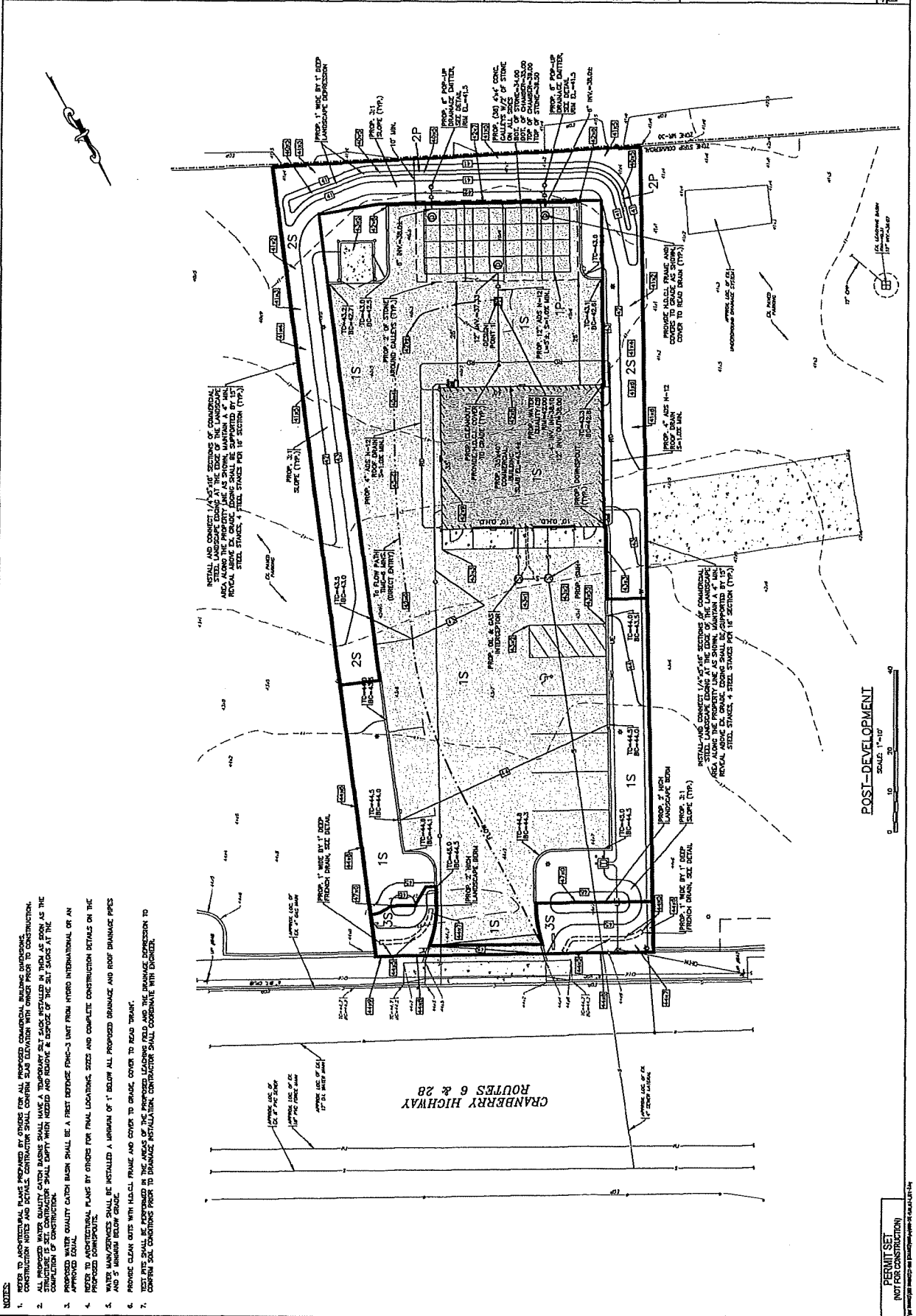
Device	Routing	Invert	Outlet Devices
#1	Discarded	40.50'	2.410 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.02 cfs @ 12.78 hrs HW=40.85' (Free Discharge)
 ↑-1=Exfiltration (Exfiltration Controls 0.02 cfs)

PERMIT SET
(NOT FOR CONSTRUCTION)



PRE-DEVELOPMENT WATERSHED PLAN WARDHAM, MA PREPARED FOR: PETER KOULOURAS P.O. BOX 891 M. FALMOUTH, MA	G.A.F. ENGINEERING, INC. PROFESSIONAL ENGINEERS & LAND SURVEYORS 265 MAIN STREET - WARDHAM, MA 02571 TEL: (508) 285-8200 FAX: (508) 285-8331 E-MAIL: bio@gafe.com	APPROVED BY:	APPROVED BY:	DATE: MAY 25, 2023
		APPROVED BY: _____ APPROVED BY: _____	APPROVED BY: _____ APPROVED BY: _____	DATE: MAY 25, 2023 DRAWN BY: JWP CHECKED BY: WFM JOB NO.: 22-5850 SCALE: 1" = 10' REV. DATE BY APP'D DESCRIPTION



- NOTES:**
1. REFER TO ANY PREVIOUS PLANS PROVIDED BY OTHERS FOR ALL PROPOSED COMMERCIAL BUILDING CONDITIONS.
 2. ALL PROPOSED WATER QUALITY CATCH BASINS SHALL HAVE A THROUGHPUT CAPACITY OF 100 GPM AS THE STRUCTURE IS SET. CONTRACTOR SHALL VERIFY WHEN NEEDED AND REMOVE & REPLACE OF THE SET BASINS AT THE COMPLETION OF CONSTRUCTION.
 3. PROPOSED WATER QUALITY CATCH BASIN SHALL BE A FIRST EFFLUENT FINE-3 UNIT FROM HYDRO INTERSTITIAL OR AN INLET TO INTERSTITIAL PLATE BY OTHERS FOR FINAL LOCATIONS, SIZES AND COMPLETE CONSTRUCTION DETAILS ON THE PROPOSED COMPLEMENTS.
 4. WATER MAIN/SERVICES SHALL BE INSTALLED A MINIMUM OF 1' BELOW ALL PROPOSED DRAINAGE AND ROOF DRAINAGE PIPES AND 5' MINIMUM BELOW GRADE.
 5. TEST PITS SHALL BE PERFORMED IN THE AREAS OF THE PROPOSED LEACHING FIELD AND THE DRAINAGE DEPRESSION TO DETERMINE SOIL CONDITIONS PRIOR TO DRAINAGE INSTALLATION. CONTRACTOR SHALL COORDINATE WITH ENGINEER.