Stormwater Management Report

Commercial Development

Map 30A Lots 87 & 87A Bridge Street

Fairhaven, Massachusetts

Dated:

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Prepared for:

Carricorp Industries, Ltd.

275 Martine Street, Suite 110

Fall River, MA 02723

Prepared by:

Zenith Consulting Engineers, LLC

3 Main Street

Lakeville, MA 02347

ZCE

Zenith Consulting Engineers, LLC

COMMONWEALTH OF MASSACHUSETTS

JAMIE L. BISSONNETTE

CIVIL

No. 47325

REGISTERED PROFESSIONAL ENGINEER

4-9-2024

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NARRATIVE

STORMWATER NARRATIVE

Commercial Development, Map 39A Lots 87 & 87A Bridge Street, Fairhaven, Massachusetts

The storm drainage system at the proposed commercial development located at Map 39A Lot 87 Bridge Street in Fairhaven, Massachusetts, has been designed to create a reduction in the rate (all storms) and volume (up to the 10-year storm) of storm water runoff when compared to the existing site. The collection and treatment systems will be in the form of deep sump catch basins and a subsurface infiltration system. Hydrologic computations were performed in order to model the rate of flow of stormwater from the site under both existing and proposed conditions for a broad range of design storms.

1.0 STORM WATER COLLECTION SYSTEM

Throughout the proposed project, storm water will be collected from the impervious areas by deep-sump catch basins.

The collected runoff will be conveyed to the water quality components through smooth interior walled HDPE piping with corrugated exterior walls. The corrugated exterior of the piping provides for exceptional strength and bearing capacity. The smooth interior walls of the piping provide a smoothness that exceeds that of concrete pipe, thus providing increased hydraulic capacity. The piping is designed to provide self-cleansing velocities in large storm events to remain essentially maintenance free throughout its life.

Runoff from the majority of new impervious surfaces will be directed through a subsurface chamber infiltration system for removal of Total Suspended Solids (TSS). The infiltration systems, sized to capture and infiltrate runoff, will reduce the peak runoff rates from the site considerably and reduce the runoff volumes for storms up to and including the 10-year storm per town requirements.

2.0 STORM WATER MANAGEMENT FACILITIES

Current Department of Environmental Protection Policies require that the peak runoff rate after development is not more than peak runoff rate prior to development for the 2 and 10 year 24-hour storm events. Additionally, it is required that the storm water management system be evaluated for the 100-year storm projections. The town of Fairhaven further requires the analysis of the 25-year storm event.

Hydrologic modeling has been conducted for the design of the drainage system. HydroCAD Version 10.00 was utilized to perform this hydrologic and hydraulic modeling. The 2, 10, 25 and 100-year design storms were evaluated. The hydrologic and hydraulic modeling established that the stormwater management systems will effectively attenuate the full range of design storms. That is, the peak rate of flow after development will be less than under existing conditions. The drainage summary provided with this document tabulates the projected decrease in runoff rate when the site is subjected to the design storm events. The complete hydrologic and hydraulic computational output is presented in this document.

2.1 LOW IMPACT DEVELOPMENT (LID) CONSIDERATIONS

The Massachusetts Stormwater Handbook encourages the use of Low Impact Development (LID) techniques by offering design credits for their implementation. No credits are sought or required for this project and, therefore, no LID techniques are required. Nevertheless, the project design incorporates LID techniques by proposing no impacts to wetlands

3.0 WATER QUALITY CONSIDERATIONS

On November 18, 1996, The Massachusetts Department of Environmental Protection (MADEP) issued the Storm Water Management Policy. The goal of this policy is to improve water quality and address flooding problems, which are sometimes caused by development projects, by the implementation of performance standards for storm water management. These standards were issued as guidelines with the possibility that in several years, after review by design engineers, they might be implemented as regulations. The project was designed to meet and exceed all relevant standards established in the policy. The following sections describe how each of these standards will be achieved on this project by incorporating Best Management Practices into the design. In January, 2008, the revised policy was issued.

3.1 UNTREATED STORM WATER - Standard 1

Standard 1 recommends that no new storm water conveyance, such as storm drain outfalls, discharge untreated storm water directly to wetlands or waterways of the Commonwealth. Flows from woods, fields, and other undeveloped areas are to be considered uncontaminated, however, runoff from paved road surfaces should receive treatment prior to discharge.

In designing this project, provisions have been made so that the runoff from all paved surfaces will receive proper treatment prior to discharge. All the proposed improvements will be located and graded such that runoff from the parking lot and roof will be directed to a series of BMP structures. This collected runoff will receive treatment utilizing Best Management Practice (BMP) measures designed into the deep-sump catch basins and subsurface infiltration system, as further described under the discussions for Standards 2 through 9. Through the collection and treatment of all runoff from paved areas, DEP Standard 1 is satisfied.

3.2 POST DEVELOPMENT PEAK DISCHARGE RATES - Standard 2

Standard 2 prescribes that storm water management systems be implemented in order to ensure that post-development peak rates of discharge do not exceed existing rates of runoff for standard 2-year and 10-year design storms. In addition, the pre and post peak rates for the 100-year storm must be evaluated to assure that there will not be increased off-site flooding. Hydrologic calculations have been conducted in designing the storm water control measures to ensure that this standard is satisfied.

HydroCAD version 10.00, a computer aided design program, was selected for modeling the hydrology and hydraulics of storm water runoff for the site and its contributing drainage area. This program utilizes the latest techniques to predict the consequences of any given storm event and to verify that the drainage system is adequate to meet the performance standards for the area under consideration. The HydroCAD

computer model uses TR-20 and TR-55 methodologies to generate runoff hydrographs and perform hydraulic routings through the modeled project.

Runoff hydrographs were generated for each subcatchment area. For post-development, all paved areas, driveways, sidewalks, roof areas and lawn areas were considered in determining composite runoff curve numbers for each subcatchment. For pre-development, the project area was evaluated in its existing condition. The soils within the development area of this project are described as HSG Soil group C/D and D, according to the U.S.D.A., Soil Conservation Service mapping.

In evaluating the same areas under pre and post development conditions, a direct comparison can be made as to the net increase or decrease in runoff rates attributable to altered land uses. The Drainage Summary table included in this report presents a summary of the hydrologic modeling conducted for this project. As presented in this table, the drainage system successfully moderates the flow for the full range of design storms and this standard is met.

3.3 RECHARGE TO GROUNDWATER - STANDARD 3

The loss of annual recharge to groundwater will be minimized through the increase of landscaped areas for the redevelopment. The annual recharge from the post development site will approximate the annual recharge from the pre-development conditions based on an assessment of soil types. Standard 3 of the DEP Stormwater Policy prescribes that the storm water runoff volume to be recharged to groundwater should be determined using existing soil. According to the U.S.D.A. Soil Conservation Service mapping, the surficial soils are Hydrologic Soil Group HSG C/D and D. Soil observation holes shall be dug to confirm the soil conditions prior to the onset of construction. The DEP Stormwater Policy requires that a certain volume of runoff be infiltrated to groundwater based on the type of soil present and the amount of impervious area being generated by the proposed development. For Types C and D soils, the recharge rate has been established to be 0.25 and 0.1 inches of runoff respectively. Due to the project consisting of solely HSG C and D soils, Standard 3 is required to be met to the maximum extent practicable. However, the infiltration systems has been designed to capture and infiltrate runoff from impervious surfaces to fully satisfy Standard 3 as well as the Town of Fairhaven's stormwater regulation that requires that the runoff volume from up to and including the 10-year storm not increase from the existing condition. Therefore, Standard 3 is met.

The proposed additional impervious area on the site is 3,445 sf over Type C soils and 22,045 sf over Type D soil. So, the required volume of recharge is:

(3,445 sf x 0.25 in) + (22,045 sf x 0.1 in) = 254 cf

An area adjustment calculation must be made because a portion of the proposed impervious area is not directed to the proposed infiltration BMP.

254 cf x (25,490 sf / 22,605 sf) = 287 cf

As shown in the attached HydroCAD calculations the proposed infiltration chamber field has a storage volume of 0.152 acre-feet x 43,560 sf/acre = 6,621 cf.

This volume is required to drawdown within 72 hours.

Drawdown Time = (Storage Volume) / (Infiltration Rate x BMP Bottom Area)
T = 6,621 cf / (0.27 in/hr x 74.5' x 60') = 65.8 hours

3.4 REMOVAL OF 80% OF TOTAL SUSPENDED SOLIDS - Standard 4

A series of stormwater BMP's have been designed in order to improve the water quality treatment over the existing condition. These proposed measures include:

- Deep sump catch basins will collect runoff from all paved surfaces of the site.
- The infiltration systems will remove 80% TSS for the 1.25" Water Quality Volume.

The combination of the above features will result in the removal of 80% of the total suspended solids which represents a significant improvement over the existing condition. The following table depicts the proposed treatment train:

A BMP	B TSS Removal Rate*	C Starting TSS Load**	D Amount Removed (BxC)	E Remaining load (C-D)
Subsurface Infiltration with pretreatment (Deep Sump Catch Basin)	80%	1.0	0.80	0.20
TOTAL TSS REMOVAL			**0.80 x 100 = 80% Removal**	

** Equals remaining load from previous BMP (E)
* TSS Removal Rates As Published in the DEP Storm Water Policy Handbook (3/97)

Required Water Quality Volume = 1.25" x 25,490 sf = 2,655 cf
Water Quality Volume Provided = 6,621 cf (recharge volume provided in the chamber field)

The town of Fairhaven requires further treatment of stormwater runoff. For new development 90% total suspended solids (TSS) and 60% total phosphorus (TP) must be removed by the proposed stormwater system. The town's regulation says these requirements can be met by retaining the volume of runoff equal to 1" multiplied by the proposed impervious area on the site. The proposed impervious area is 25,490 sf.

25,490 sf x 1" = 2,124 cf

The proposed infiltration chamber field provides 6,621 cf of recharge volume, thus this requirement is met.

3.5 USES WITH HIGHER POTENTIAL POLLUTANT LOADS - Standard 5

The DEP Storm Water Management Policy - Standard 5 requires that storm water discharges with higher potential pollutant loads be provided with specific BMP's. This development is not considered a use with a higher potential pollutant load. As such, this standard is satisfied.

3.6 STORM WATER DISCHARGES TO CRITICAL AREAS - Standard 6

Standard 6 of the DEP Storm water Policy seeks to protect critical areas. Critical areas are specifically designated Outstanding Resource Waters (ORW's) such as shell fish beds, swimming beaches, cold water fisheries and recharge areas for public water supplies. Such areas require the use of specific BMP's. This project does not discharge to a Critical Area. Therefore, this standard is satisfied.

3.7 REDEVELOPMENT OF PREVIOUSLY DEVELOPED SITES - Standard 7

Standard 7 applies to sites which have been previously developed and are being redeveloped. Diminished performance of BMP's is allowed in these areas. This project is not a redevelopment and therefore, the design of the storm water management system meets all design standards as noted above.

3.8 EROSION AND SEDIMENT CONTROL -Standard 8

Erosion and sediment control measures have been developed for this project and are included in the construction set of drawings. These plans show the proposed locations for erosion control devices. The following supplemental provisions are also a part of this plan.

Erosion and Sedimentation Control measures which are proposed to be implemented during construction include the installation of silt sock or silt fencing which has the bottom 6 inches buried in the ground. Any extra excavated soil which is not used to bury the base of the fence will be cast up-gradient of the silt fence.

- Erosion control devices such as silt fence, haybales and silt socks shall be inspected after every major rainfall runoff event (over 1½" depth of precipitation). All damaged or misaligned devices shall be immediately repaired. Silt shall be immediately removed from all areas of the silt fence when depth of accumulation exceeds 6 inches.

- Catch Basin Sump shall be inspected after every major rainfall runoff event (over 1½" depth of precipitation). Silt shall be immediately removed from sump where the depth of accumulation exceeds 9 inches.)

- All exposed construction areas will be stabilized upon completion in order to minimize the time that these areas are not stabilized.

With the full impact of the measures presented on the Erosion and Sedimentation Control Plans, along with the provisions stipulated above, Standard 8 will be satisfied.

3.9 OPERATIONS AND MAINTENANCE PLAN - Standard 9

Standard 9 of the DEP Storm Water Policy prescribes the adoption of a formal operation and maintenance plan to ensure that the storm water management systems function properly as designed. The proposed Operations and Maintenance Plan is attached in an appendix to this report. The plan includes Stormwater operations and Maintenance procedures, Construction Period Pollution Control measures and a Source Control and Pollution Prevention Plan.

DRAINAGE SUMMARY

Proposed Commercial Development

Map 39A Lots 87 & 87A Bridge Street in Fairhaven, MA

Drainage Summary

2 YR STORM (3.40 in.)

Receptor	Pre Development		Post Development	
	Q Max (cfs)	V (AF)	Q Max (cfs)	V (AF)
Wetlands South-East	2.59	0.500	2.56	0.495

10 YR STORM (5.02 in.)

Receptor	Pre Development		Post Development	
	Q Max (cfs)	V (AF)	Q Max (cfs)	V (AF)
Wetlands South-East	4.93	0.863	4.15	0.853

25 YR STORM (6.03 in.)

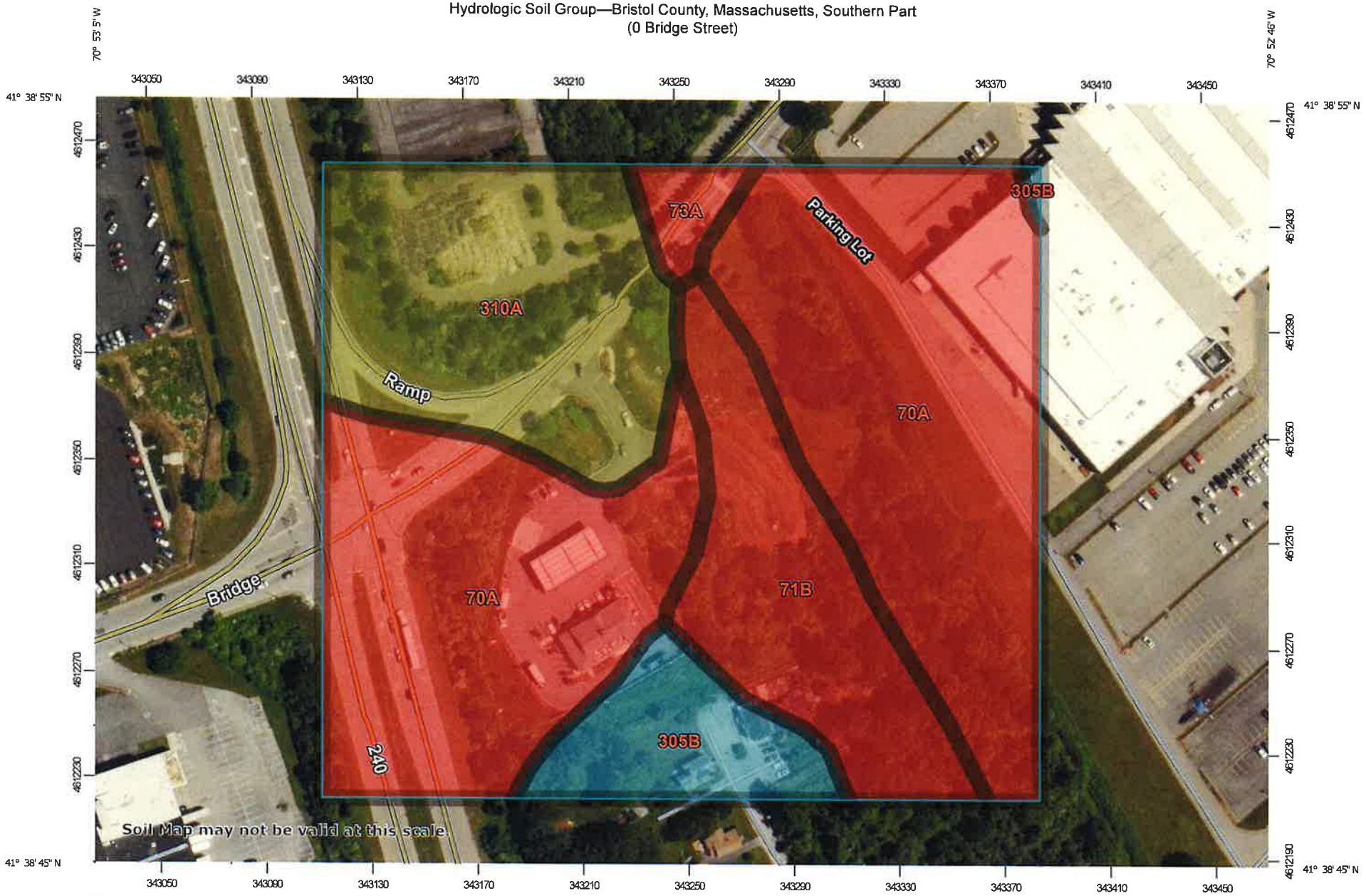
Receptor	Pre Development		Post Development	
	Q Max (cfs)	V (AF)	Q Max (cfs)	V (AF)
Wetlands South-East	6.49	1.102	5.38	1.107

100 YR STORM (7.60 in.)

Receptor	Pre Development		Post Development	
	Q Max (cfs)	V (AF)	Q Max (cfs)	V (AF)
Wetlands South-East	9.00	1.483	8.41	1.506

SOIL REPORT

Hydrologic Soil Group—Bristol County, Massachusetts, Southern Part
(0 Bridge Street)



Map Scale: 1:2,040 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 30 60 120 180

Feet: 0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

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

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Bristol County, Massachusetts, Southern Part
Survey Area Data: Version 16, Sep 9, 2022

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

Date(s) aerial images were photographed: Jun 10, 2022—Jun 30, 2022

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
70A	Ridgebury fine sandy loam, 0 to 3 percent slopes	D	8.9	54.8%
71B	Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony	D	2.4	14.9%
73A	Whitman fine sandy loam, 0 to 3 percent slopes, extremely stony	D	0.3	2.0%
305B	Paxton fine sandy loam, 3 to 8 percent slopes	C	1.2	7.4%
310A	Woodbridge fine sandy loam, 0 to 3 percent slopes	C/D	3.4	21.0%
Totals for Area of Interest			**16.2**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

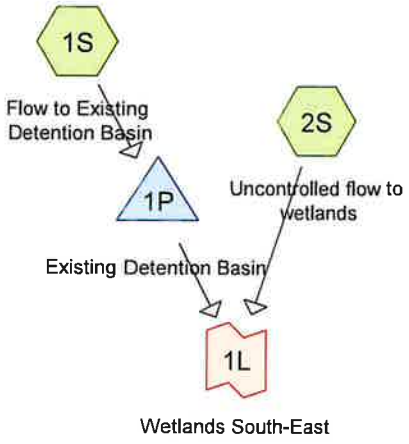
Rating Options

Aggregation Method: Dominant Condition

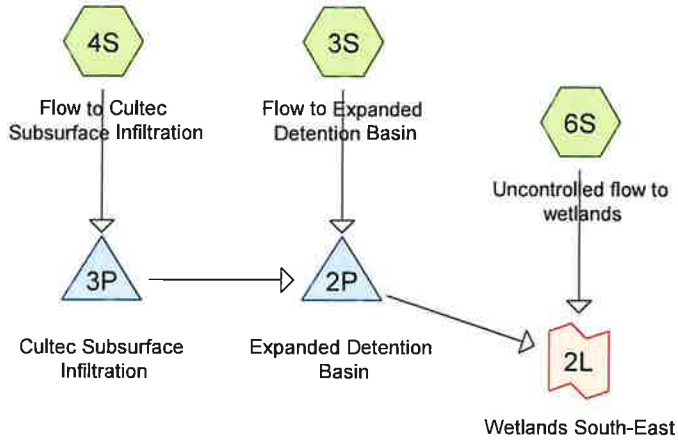
Component Percent Cutoff: None Specified

Tie-break Rule: Higher

HYDROCAD OUTPUT

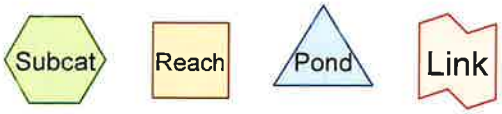


Pre-Development



Post-Development

The existing gas station roof area is not included in 1S or 3S due to the existing roof drain system which is sized for the 100-year storm.



Routing Diagram for 0 Bridge St-Pre-Post
Prepared by Zenith Consulting Engineers LLC, Printed 4/9/2024
HydroCAD® 10.00-16 s/n 09356 © 2015 HydroCAD Software Solutions LLC

Time span=0.00-100.00 hrs, dt=0.01 hrs, 10001 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: Flow to Existing Runoff Area=59,995 sf 81.64% Impervious Runoff Depth=2.84"
Tc=6.0 min CN=95 Runoff=4.32 cfs 0.326 af

Subcatchment 2S: Uncontrolled flow to Runoff Area=77,680 sf 0.00% Impervious Runoff Depth=1.17"
Flow Length=310' Tc=10.3 min CN=74 Runoff=2.02 cfs 0.174 af

Subcatchment 3S: Flow to Expanded Runoff Area=69,930 sf 76.43% Impervious Runoff Depth=2.74"
Tc=6.0 min CN=94 Runoff=4.92 cfs 0.366 af

Subcatchment 4S: Flow to Cultec Runoff Area=24,430 sf 92.53% Impervious Runoff Depth=3.06"
Tc=6.0 min CN=97 Runoff=1.83 cfs 0.143 af

Subcatchment 6S: Uncontrolled flow to Runoff Area=43,315 sf 0.00% Impervious Runoff Depth=1.56"
Flow Length=310' Tc=10.3 min CN=80 Runoff=1.56 cfs 0.129 af

Pond 1P: Existing Detention Basin Peak Elev=33.98' Storage=5,109 cf Inflow=4.32 cfs 0.326 af
Outflow=0.62 cfs 0.326 af

Pond 2P: Expanded Detention Basin Peak Elev=33.27' Storage=4,932 cf Inflow=4.92 cfs 0.366 af
Outflow=1.11 cfs 0.366 af

Pond 3P: Cultec Subsurface Infiltration Peak Elev=38.52' Storage=0.102 af Inflow=1.83 cfs 0.143 af
Discarded=0.03 cfs 0.143 af Primary=0.00 cfs 0.000 af Outflow=0.03 cfs 0.143 af

Link 1L: Wetlands South-East Inflow=2.59 cfs 0.500 af
Primary=2.59 cfs 0.500 af

Link 2L: Wetlands South-East Inflow=2.56 cfs 0.495 af
Primary=2.56 cfs 0.495 af

Total Runoff Area = 6.321 ac Runoff Volume = 1.138 af Average Runoff Depth = 2.16"
54.59% Pervious = 3.451 ac 45.41% Impervious = 2.870 ac

Summary for Subcatchment 1S: Flow to Existing Detention Basin

Runoff = 4.32 cfs @ 12.08 hrs, Volume= 0.326 af, Depth= 2.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Yr Storm Rainfall=3.40"

	Area (sf)	CN	Description
	41,780	98	Paved parking, HSG D
*	7,197	98	Basin Ponding Area
	11,018	80	>75% Grass cover, Good, HSG D
	59,995	95	Weighted Average
	11,018		18.36% Pervious Area
	48,977		81.64% Impervious Area

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

Summary for Subcatchment 2S: Uncontrolled flow to wetlands

Runoff = 2.02 cfs @ 12.15 hrs, Volume= 0.174 af, Depth= 1.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Yr Storm Rainfall=3.40"

Area (sf)	CN	Description
66,000	73	Brush, Good, HSG D
11,680	77	Woods, Good, HSG D
77,680	74	Weighted Average
77,680		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.40"
2.3	260	0.0140	1.90		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
10.3	310	Total			

Summary for Subcatchment 3S: Flow to Expanded Detention Basin

Runoff = 4.92 cfs @ 12.08 hrs, Volume= 0.366 af, Depth= 2.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Yr Storm Rainfall=3.40"

	Area (sf)	CN	Description
	44,665	98	Paved parking, HSG D
*	8,785	98	Basin Ponding Area
	16,480	80	>75% Grass cover, Good, HSG D
	69,930	94	Weighted Average
	16,480		23.57% Pervious Area
	53,450		76.43% Impervious Area

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

Summary for Subcatchment 4S: Flow to Cultec Subsurface Infiltration

Runoff = 1.83 cfs @ 12.08 hrs, Volume= 0.143 af, Depth= 3.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Yr Storm Rainfall=3.40"

	Area (sf)	CN	Description
*	16,755	98	Pavement, HSG D
	5,850	98	Roofs, HSG D
	1,825	80	>75% Grass cover, Good, HSG D
	24,430	97	Weighted Average
	1,825		7.47% Pervious Area
	22,605		92.53% Impervious Area

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

Summary for Subcatchment 6S: Uncontrolled flow to wetlands

Runoff = 1.56 cfs @ 12.15 hrs, Volume= 0.129 af, Depth= 1.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Yr Storm Rainfall=3.40"

Area (sf)	CN	Description
36,510	80	>75% Grass cover, Good, HSG D
6,805	77	Woods, Good, HSG D
43,315	80	Weighted Average
43,315		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.40"
2.3	260	0.0140	1.90		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
10.3	310	Total			

Summary for Pond 1P: Existing Detention Basin

Inflow Area = 1.377 ac, 81.64% Impervious, Inflow Depth = 2.84" for 2-Yr Storm event
Inflow = 4.32 cfs @ 12.08 hrs, Volume= 0.326 af
Outflow = 0.62 cfs @ 12.59 hrs, Volume= 0.326 af, Atten= 86%, Lag= 30.1 min
Primary = 0.62 cfs @ 12.59 hrs, Volume= 0.326 af

Routing by Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Peak Elev= 33.98' @ 12.59 hrs Surf.Area= 4,572 sf Storage= 5,109 cf

Plug-Flow detention time= 71.6 min calculated for 0.326 af (100% of inflow)
Center-of-Mass det. time= 71.6 min (850.7 - 779.1)

Volume	Invert	Avail.Storage	Storage Description
#1	31.65'	17,810 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
31.65	354	85.0	0	0	354
32.00	785	121.0	194	194	945
33.00	2,451	269.0	1,541	1,735	5,543
34.00	4,632	357.0	3,484	5,220	9,938
35.00	7,197	473.0	5,868	11,087	17,610
35.85	8,644	492.0	6,723	17,810	19,126

Device	Routing	Invert	Outlet Devices
#1	Primary	31.31'	**12.0" Round Culvert** L= 24.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 31.31' / 31.08' S= 0.0096 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	31.65'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	35.20'	**8.0' long x 12.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.57 2.62 2.70 2.67 2.66 2.67 2.66 2.64

Primary OutFlow Max=0.62 cfs @ 12.59 hrs HW=33.98' (Free Discharge)
- **1=Culvert** (Passes 0.62 cfs of 5.57 cfs potential flow)
  - **2=Orifice/Grate** (Orifice Controls 0.62 cfs @ 7.08 fps)
- **3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 2P: Expanded Detention Basin

Inflow Area = 2.166 ac, 80.60% Impervious, Inflow Depth = 2.03" for 2-Yr Storm event
Inflow = 4.92 cfs @ 12.08 hrs, Volume= 0.366 af
Outflow = 1.11 cfs @ 12.49 hrs, Volume= 0.366 af, Atten= 77%, Lag= 24.1 min
Primary = 1.11 cfs @ 12.49 hrs, Volume= 0.366 af

Routing by Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Peak Elev= 33.27' @ 12.49 hrs Surf.Area= 4,597 sf Storage= 4,932 cf

Plug-Flow detention time= 43.3 min calculated for 0.366 af (100% of inflow)
Center-of-Mass det. time= 43.3 min (828.5 - 785.1)

Volume	Invert	Avail.Storage	Storage Description
#1	31.65'	23,713 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
31.65	354	85.0	0	0	354
32.00	2,440	277.0	434	434	5,885
33.00	4,230	383.0	3,294	3,729	11,462
34.00	5,650	440.0	4,923	8,652	15,218
35.00	8,785	683.0	7,160	15,812	36,941
35.85	9,815	688.0	7,901	23,713	37,739

Device	Routing	Invert	Outlet Devices
#1	Primary	31.31'	**12.0" Round Culvert** L= 24.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 31.31' / 31.08' S= 0.0096 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	31.65'	**6.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	33.75'	**12.0" W x 24.0" H Vert. Orifice/Grate** C= 0.600
#4	Primary	34.85'	**8.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=1.11 cfs @ 12.49 hrs HW=33.27' (Free Discharge)
- **1=Culvert** (Passes 1.11 cfs of 4.57 cfs potential flow)
  - **2=Orifice/Grate** (Orifice Controls 1.11 cfs @ 5.64 fps)
- **3=Orifice/Grate** (Controls 0.00 cfs)
- **4=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 3P: Cultec Subsurface Infiltration

Inflow Area = 0.561 ac, 92.53% Impervious, Inflow Depth = 3.06" for 2-Yr Storm event
Inflow = 1.83 cfs @ 12.08 hrs, Volume= 0.143 af
Outflow = 0.03 cfs @ 7.55 hrs, Volume= 0.143 af, Atten= 98%, Lag= 0.0 min
Discarded = 0.03 cfs @ 7.55 hrs, Volume= 0.143 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs

Peak Elev= 38.52' @ 18.99 hrs Surf.Area= 0.103 ac Storage= 0.102 af

Plug-Flow detention time= 1,408.4 min calculated for 0.143 af (100% of inflow)
Center-of-Mass det. time= 1,408.5 min (2,173.1 - 764.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	37.00'	0.073 af	**60.00'W x 74.50'L x 2.54'H Field A** 0.261 af Overall - 0.079 af Embedded = 0.181 af x 40.0% Voids
#2A	37.50'	0.079 af	**Cultec R-150XLHD** x 126 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 18 rows
		0.152 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	37.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	37.30'	**12.0" Round Culvert** L= 79.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 37.30' / 36.00' S= 0.0165 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Device 2	39.20'	**4.0' long x 0.40' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s) 3.4' Crest Height

Discarded OutFlow Max=0.03 cfs @ 7.55 hrs HW=37.03' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=37.00' (Free Discharge)
↑—**2=Culvert** (Controls 0.00 cfs)
↑—**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link 1L: Wetlands South-East

Inflow Area = 3.161 ac, 35.57% Impervious, Inflow Depth = 1.90" for 2-Yr Storm event
Inflow = 2.59 cfs @ 12.16 hrs, Volume= 0.500 af
Primary = 2.59 cfs @ 12.16 hrs, Volume= 0.500 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs

Summary for Link 2L: Wetlands South-East

Inflow Area = 3.161 ac, 55.24% Impervious, Inflow Depth = 1.88" for 2-Yr Storm event
Inflow = 2.56 cfs @ 12.16 hrs, Volume= 0.495 af
Primary = 2.56 cfs @ 12.16 hrs, Volume= 0.495 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs

Time span=0.00-100.00 hrs, dt=0.01 hrs, 10001 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: Flow to Existing Runoff Area=59,995 sf 81.64% Impervious Runoff Depth=4.44"
Tc=6.0 min CN=95 Runoff=6.58 cfs 0.510 af

Subcatchment 2S: Uncontrolled flow to Runoff Area=77,680 sf 0.00% Impervious Runoff Depth=2.38"
Flow Length=310' Tc=10.3 min CN=74 Runoff=4.28 cfs 0.354 af

Subcatchment 3S: Flow to Expanded Runoff Area=69,930 sf 76.43% Impervious Runoff Depth=4.33"
Tc=6.0 min CN=94 Runoff=7.57 cfs 0.579 af

Subcatchment 4S: Flow to Cultec Runoff Area=24,430 sf 92.53% Impervious Runoff Depth=4.67"
Tc=6.0 min CN=97 Runoff=2.74 cfs 0.218 af

Subcatchment 6S: Uncontrolled flow to Runoff Area=43,315 sf 0.00% Impervious Runoff Depth=2.91"
Flow Length=310' Tc=10.3 min CN=80 Runoff=2.94 cfs 0.241 af

Pond 1P: Existing Detention Basin Peak Elev=34.66' Storage=8,794 cf Inflow=6.58 cfs 0.510 af
Outflow=0.71 cfs 0.510 af

Pond 2P: Expanded Detention Basin Peak Elev=33.95' Storage=8,350 cf Inflow=7.57 cfs 0.612 af
Outflow=1.63 cfs 0.612 af

Pond 3P: Cultec Subsurface Infiltration Peak Elev=39.25' Storage=0.140 af Inflow=2.74 cfs 0.218 af
Discarded=0.03 cfs 0.185 af Primary=0.15 cfs 0.033 af Outflow=0.18 cfs 0.218 af

Link 1L: Wetlands South-East Inflow=4.93 cfs 0.863 af
Primary=4.93 cfs 0.863 af

Link 2L: Wetlands South-East Inflow=4.15 cfs 0.853 af
Primary=4.15 cfs 0.853 af

Total Runoff Area = 6.321 ac Runoff Volume = 1.901 af Average Runoff Depth = 3.61"
54.59% Pervious = 3.451 ac 45.41% Impervious = 2.870 ac

Summary for Subcatchment 1S: Flow to Existing Detention Basin

Runoff = 6.58 cfs @ 12.08 hrs, Volume= 0.510 af, Depth= 4.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Yr Storm Rainfall=5.02"

	Area (sf)	CN	Description
	41,780	98	Paved parking, HSG D
*	7,197	98	Basin Ponding Area
	11,018	80	>75% Grass cover, Good, HSG D
	59,995	95	Weighted Average
	11,018		18.36% Pervious Area
	48,977		81.64% Impervious Area

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

Summary for Subcatchment 2S: Uncontrolled flow to wetlands

Runoff = 4.28 cfs @ 12.15 hrs, Volume= 0.354 af, Depth= 2.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Yr Storm Rainfall=5.02"

Area (sf)	CN	Description
66,000	73	Brush, Good, HSG D
11,680	77	Woods, Good, HSG D
77,680	74	Weighted Average
77,680		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.40"
2.3	260	0.0140	1.90		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
10.3	310	Total			

Summary for Subcatchment 3S: Flow to Expanded Detention Basin

Runoff = 7.57 cfs @ 12.08 hrs, Volume= 0.579 af, Depth= 4.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Yr Storm Rainfall=5.02"

	Area (sf)	CN	Description
	44,665	98	Paved parking, HSG D
*	8,785	98	Basin Ponding Area
	16,480	80	>75% Grass cover, Good, HSG D
	69,930	94	Weighted Average
	16,480		23.57% Pervious Area
	53,450		76.43% Impervious Area

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

Summary for Subcatchment 4S: Flow to Cultec Subsurface Infiltration

Runoff = 2.74 cfs @ 12.08 hrs, Volume= 0.218 af, Depth= 4.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Yr Storm Rainfall=5.02"

	Area (sf)	CN	Description
*	16,755	98	Pavement, HSG D
	5,850	98	Roofs, HSG D
	1,825	80	>75% Grass cover, Good, HSG D
	24,430	97	Weighted Average
	1,825		7.47% Pervious Area
	22,605		92.53% Impervious Area

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

Summary for Subcatchment 6S: Uncontrolled flow to wetlands

Runoff = 2.94 cfs @ 12.14 hrs, Volume= 0.241 af, Depth= 2.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Yr Storm Rainfall=5.02"

Area (sf)	CN	Description
36,510	80	>75% Grass cover, Good, HSG D
6,805	77	Woods, Good, HSG D
43,315	80	Weighted Average
43,315		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.40"
2.3	260	0.0140	1.90		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
10.3	310	Total			

Summary for Pond 1P: Existing Detention Basin

Inflow Area = 1.377 ac, 81.64% Impervious, Inflow Depth = 4.44" for 10-Yr Storm event
Inflow = 6.58 cfs @ 12.08 hrs, Volume= 0.510 af
Outflow = 0.71 cfs @ 12.76 hrs, Volume= 0.510 af, Atten= 89%, Lag= 40.8 min
Primary = 0.71 cfs @ 12.76 hrs, Volume= 0.510 af

Routing by Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Peak Elev= 34.66' @ 12.76 hrs Surf.Area= 6,259 sf Storage= 8,794 cf

Plug-Flow detention time= 110.3 min calculated for 0.510 af (100% of inflow)
Center-of-Mass det. time= 110.3 min (878.4 - 768.1)

Volume	Invert	Avail.Storage	Storage Description
#1	31.65'	17,810 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
31.65	354	85.0	0	0	354
32.00	785	121.0	194	194	945
33.00	2,451	269.0	1,541	1,735	5,543
34.00	4,632	357.0	3,484	5,220	9,938
35.00	7,197	473.0	5,868	11,087	17,610
35.85	8,644	492.0	6,723	17,810	19,126

Device	Routing	Invert	Outlet Devices
#1	Primary	31.31'	**12.0" Round Culvert** L= 24.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 31.31' / 31.08' S= 0.0096 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	31.65'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	35.20'	**8.0' long x 12.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.57 2.62 2.70 2.67 2.66 2.67 2.66 2.64

Primary OutFlow Max=0.71 cfs @ 12.76 hrs HW=34.66' (Free Discharge)
└─**1=Culvert** (Passes 0.71 cfs of 6.38 cfs potential flow)
└─**2=Orifice/Grate** (Orifice Controls 0.71 cfs @ 8.12 fps)
└─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 2P: Expanded Detention Basin

Inflow Area = 2.166 ac, 80.60% Impervious, Inflow Depth = 3.39" for 10-Yr Storm event
Inflow = 7.57 cfs @ 12.08 hrs, Volume= 0.612 af
Outflow = 1.63 cfs @ 12.49 hrs, Volume= 0.612 af, Atten= 78%, Lag= 24.6 min
Primary = 1.63 cfs @ 12.49 hrs, Volume= 0.612 af

Routing by Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Peak Elev= 33.95' @ 12.49 hrs Surf.Area= 5,568 sf Storage= 8,350 cf

Plug-Flow detention time= 56.2 min calculated for 0.612 af (100% of inflow)
Center-of-Mass det. time= 56.2 min (837.8 - 781.6)

Volume	Invert	Avail.Storage	Storage Description
#1	31.65'	23,713 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
31.65	354	85.0	0	0	354
32.00	2,440	277.0	434	434	5,885
33.00	4,230	383.0	3,294	3,729	11,462
34.00	5,650	440.0	4,923	8,652	15,218
35.00	8,785	683.0	7,160	15,812	36,941
35.85	9,815	688.0	7,901	23,713	37,739

Device	Routing	Invert	Outlet Devices
#1	Primary	31.31'	**12.0" Round Culvert** L= 24.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 31.31' / 31.08' S= 0.0096 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	31.65'	**6.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	33.75'	**12.0" W x 24.0" H Vert. Orifice/Grate** C= 0.600
#4	Primary	34.85'	**8.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=1.63 cfs @ 12.49 hrs HW=33.95' (Free Discharge)
- **1=Culvert** (Passes 1.35 cfs of 5.53 cfs potential flow)
  - **2=Orifice/Grate** (Orifice Controls 1.35 cfs @ 6.89 fps)
- **3=Orifice/Grate** (Orifice Controls 0.28 cfs @ 1.42 fps)
- **4=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 3P: Cultec Subsurface Infiltration

Inflow Area = 0.561 ac, 92.53% Impervious, Inflow Depth = 4.67" for 10-Yr Storm event
Inflow = 2.74 cfs @ 12.08 hrs, Volume= 0.218 af
Outflow = 0.18 cfs @ 13.51 hrs, Volume= 0.218 af, Atten= 94%, Lag= 85.7 min
Discarded = 0.03 cfs @ 5.67 hrs, Volume= 0.185 af
Primary = 0.15 cfs @ 13.51 hrs, Volume= 0.033 af

Routing by Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs

Peak Elev= 39.25' @ 13.51 hrs Surf.Area= 0.103 ac Storage= 0.140 af

Plug-Flow detention time= 1,607.6 min calculated for 0.218 af (100% of inflow)
Center-of-Mass det. time= 1,607.8 min (2,363.5 - 755.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	37.00'	0.073 af	**60.00'W x 74.50'L x 2.54'H Field A** 0.261 af Overall - 0.079 af Embedded = 0.181 af x 40.0% Voids
#2A	37.50'	0.079 af	**Cultec R-150XLHD** x 126 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 18 rows
		0.152 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	37.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	37.30'	**12.0" Round Culvert** L= 79.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 37.30' / 36.00' S= 0.0165 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Device 2	39.20'	**4.0' long x 0.40' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s) 3.4' Crest Height

Discarded OutFlow Max=0.03 cfs @ 5.67 hrs HW=37.03' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.15 cfs @ 13.51 hrs HW=39.25' (Free Discharge)
↑—**2=Culvert** (Passes 0.15 cfs of 4.02 cfs potential flow)
↑—**3=Sharp-Crested Rectangular Weir** (Weir Controls 0.15 cfs @ 0.73 fps)

Summary for Link 1L: Wetlands South-East

Inflow Area = 3.161 ac, 35.57% Impervious, Inflow Depth = 3.28" for 10-Yr Storm event
Inflow = 4.93 cfs @ 12.15 hrs, Volume= 0.863 af
Primary = 4.93 cfs @ 12.15 hrs, Volume= 0.863 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs

Summary for Link 2L: Wetlands South-East

Inflow Area = 3.161 ac, 55.24% Impervious, Inflow Depth = 3.24" for 10-Yr Storm event
Inflow = 4.15 cfs @ 12.15 hrs, Volume= 0.853 af
Primary = 4.15 cfs @ 12.15 hrs, Volume= 0.853 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs

Time span=0.00-100.00 hrs, dt=0.01 hrs, 10001 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: Flow to Existing Runoff Area=59,995 sf 81.64% Impervious Runoff Depth=5.44"
Tc=6.0 min CN=95 Runoff=7.98 cfs 0.625 af

Subcatchment 2S: Uncontrolled flow to Runoff Area=77,680 sf 0.00% Impervious Runoff Depth=3.21"
Flow Length=310' Tc=10.3 min CN=74 Runoff=5.81 cfs 0.477 af

Subcatchment 3S: Flow to Expanded Runoff Area=69,930 sf 76.43% Impervious Runoff Depth=5.33"
Tc=6.0 min CN=94 Runoff=9.21 cfs 0.713 af

Subcatchment 4S: Flow to Cultec Runoff Area=24,430 sf 92.53% Impervious Runoff Depth=5.67"
Tc=6.0 min CN=97 Runoff=3.30 cfs 0.265 af

Subcatchment 6S: Uncontrolled flow to Runoff Area=43,315 sf 0.00% Impervious Runoff Depth=3.81"
Flow Length=310' Tc=10.3 min CN=80 Runoff=3.83 cfs 0.316 af

Pond 1P: Existing Detention Basin Peak Elev=35.03' Storage=11,287 cf Inflow=7.98 cfs 0.625 af
Outflow=0.75 cfs 0.625 af

Pond 2P: Expanded Detention Basin Peak Elev=34.27' Storage=10,282 cf Inflow=9.21 cfs 0.791 af
Outflow=2.66 cfs 0.791 af

Pond 3P: Cultec Subsurface Infiltration Peak Elev=39.36' Storage=0.144 af Inflow=3.30 cfs 0.265 af
Discarded=0.03 cfs 0.187 af Primary=0.83 cfs 0.078 af Outflow=0.86 cfs 0.265 af

Link 1L: Wetlands South-East Inflow=6.49 cfs 1.102 af
Primary=6.49 cfs 1.102 af

Link 2L: Wetlands South-East Inflow=5.38 cfs 1.107 af
Primary=5.38 cfs 1.107 af

Total Runoff Area = 6.321 ac Runoff Volume = 2.395 af Average Runoff Depth = 4.55"
54.59% Pervious = 3.451 ac 45.41% Impervious = 2.870 ac

Summary for Subcatchment 1S: Flow to Existing Detention Basin

Runoff = 7.98 cfs @ 12.08 hrs, Volume= 0.625 af, Depth= 5.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Yr Storm Rainfall=6.03"

	Area (sf)	CN	Description
	41,780	98	Paved parking, HSG D
*	7,197	98	Basin Ponding Area
	11,018	80	>75% Grass cover, Good, HSG D
	59,995	95	Weighted Average
	11,018		18.36% Pervious Area
	48,977		81.64% Impervious Area

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

Summary for Subcatchment 2S: Uncontrolled flow to wetlands

Runoff = 5.81 cfs @ 12.14 hrs, Volume= 0.477 af, Depth= 3.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Yr Storm Rainfall=6.03"

Area (sf)	CN	Description
66,000	73	Brush, Good, HSG D
11,680	77	Woods, Good, HSG D
77,680	74	Weighted Average
77,680		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.40"
2.3	260	0.0140	1.90		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
10.3	310	Total			

Summary for Subcatchment 3S: Flow to Expanded Detention Basin

Runoff = 9.21 cfs @ 12.08 hrs, Volume= 0.713 af, Depth= 5.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Yr Storm Rainfall=6.03"

	Area (sf)	CN	Description
	44,665	98	Paved parking, HSG D
*	8,785	98	Basin Ponding Area
	16,480	80	>75% Grass cover, Good, HSG D
	69,930	94	Weighted Average
	16,480		23.57% Pervious Area
	53,450		76.43% Impervious Area

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

Summary for Subcatchment 4S: Flow to Cultec Subsurface Infiltration

Runoff = 3.30 cfs @ 12.08 hrs, Volume= 0.265 af, Depth= 5.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Yr Storm Rainfall=6.03"

	Area (sf)	CN	Description
*	16,755	98	Pavement, HSG D
	5,850	98	Roofs, HSG D
	1,825	80	>75% Grass cover, Good, HSG D
	24,430	97	Weighted Average
	1,825		7.47% Pervious Area
	22,605		92.53% Impervious Area

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

Summary for Subcatchment 6S: Uncontrolled flow to wetlands

Runoff = 3.83 cfs @ 12.14 hrs, Volume= 0.316 af, Depth= 3.81"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Yr Storm Rainfall=6.03"

Area (sf)	CN	Description
36,510	80	>75% Grass cover, Good, HSG D
6,805	77	Woods, Good, HSG D
43,315	80	Weighted Average
43,315		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.40"
2.3	260	0.0140	1.90		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
10.3	310	Total			

Summary for Pond 1P: Existing Detention Basin

Inflow Area = 1.377 ac, 81.64% Impervious, Inflow Depth = 5.44" for 25-Yr Storm event
Inflow = 7.98 cfs @ 12.08 hrs, Volume= 0.625 af
Outflow = 0.75 cfs @ 12.90 hrs, Volume= 0.625 af, Atten= 91%, Lag= 48.8 min
Primary = 0.75 cfs @ 12.90 hrs, Volume= 0.625 af

Routing by Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Peak Elev= 35.03' @ 12.90 hrs Surf.Area= 7,242 sf Storage= 11,287 cf

Plug-Flow detention time= 135.7 min calculated for 0.624 af (100% of inflow)
Center-of-Mass det. time= 135.7 min (899.2 - 763.5)

Volume	Invert	Avail.Storage	Storage Description
#1	31.65'	17,810 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
31.65	354	85.0	0	0	354
32.00	785	121.0	194	194	945
33.00	2,451	269.0	1,541	1,735	5,543
34.00	4,632	357.0	3,484	5,220	9,938
35.00	7,197	473.0	5,868	11,087	17,610
35.85	8,644	492.0	6,723	17,810	19,126

Device	Routing	Invert	Outlet Devices
#1	Primary	31.31'	**12.0" Round Culvert** L= 24.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 31.31' / 31.08' S= 0.0096 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	31.65'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	35.20'	**8.0' long x 12.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.57 2.62 2.70 2.67 2.66 2.67 2.66 2.64

Primary OutFlow Max=0.75 cfs @ 12.90 hrs HW=35.03' (Free Discharge)
- **1=Culvert** (Passes 0.75 cfs of 6.78 cfs potential flow)
  - **2=Orifice/Grate** (Orifice Controls 0.75 cfs @ 8.63 fps)
- **3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 2P: Expanded Detention Basin

Inflow Area = 2.166 ac, 80.60% Impervious, Inflow Depth = 4.38" for 25-Yr Storm event
Inflow = 9.21 cfs @ 12.08 hrs, Volume= 0.791 af
Outflow = 2.66 cfs @ 12.50 hrs, Volume= 0.791 af, Atten= 71%, Lag= 25.2 min
Primary = 2.66 cfs @ 12.50 hrs, Volume= 0.791 af

Routing by Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Peak Elev= 34.27' @ 12.50 hrs Surf.Area= 6,429 sf Storage= 10,282 cf

Plug-Flow detention time= 57.4 min calculated for 0.791 af (100% of inflow)
Center-of-Mass det. time= 57.4 min (835.4 - 778.0)

Volume	Invert	Avail.Storage	Storage Description
#1	31.65'	23,713 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
31.65	354	85.0	0	0	354
32.00	2,440	277.0	434	434	5,885
33.00	4,230	383.0	3,294	3,729	11,462
34.00	5,650	440.0	4,923	8,652	15,218
35.00	8,785	683.0	7,160	15,812	36,941
35.85	9,815	688.0	7,901	23,713	37,739

Device	Routing	Invert	Outlet Devices
#1	Primary	31.31'	**12.0" Round Culvert** L= 24.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 31.31' / 31.08' S= 0.0096 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	31.65'	**6.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	33.75'	**12.0" W x 24.0" H Vert. Orifice/Grate** C= 0.600
#4	Primary	34.85'	**8.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=2.66 cfs @ 12.50 hrs HW=34.27' (Free Discharge)
- **1=Culvert** (Passes 1.46 cfs of 5.93 cfs potential flow)
  - **2=Orifice/Grate** (Orifice Controls 1.46 cfs @ 7.41 fps)
- **3=Orifice/Grate** (Orifice Controls 1.20 cfs @ 2.31 fps)
- **4=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 3P: Cultec Subsurface Infiltration

Inflow Area = 0.561 ac, 92.53% Impervious, Inflow Depth = 5.67" for 25-Yr Storm event
Inflow = 3.30 cfs @ 12.08 hrs, Volume= 0.265 af
Outflow = 0.86 cfs @ 12.44 hrs, Volume= 0.265 af, Atten= 74%, Lag= 21.4 min
Discarded = 0.03 cfs @ 4.58 hrs, Volume= 0.187 af
Primary = 0.83 cfs @ 12.44 hrs, Volume= 0.078 af

Routing by Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs

Peak Elev= 39.36' @ 12.44 hrs Surf.Area= 0.103 ac Storage= 0.144 af

Plug-Flow detention time= 1,338.1 min calculated for 0.265 af (100% of inflow)
Center-of-Mass det. time= 1,338.4 min (2,090.4 - 752.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	37.00'	0.073 af	**60.00'W x 74.50'L x 2.54'H Field A** 0.261 af Overall - 0.079 af Embedded = 0.181 af x 40.0% Voids
#2A	37.50'	0.079 af	**Cultec R-150XLHD** x 126 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 18 rows
		0.152 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	37.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	37.30'	**12.0" Round Culvert** L= 79.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 37.30' / 36.00' S= 0.0165 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Device 2	39.20'	**4.0' long x 0.40' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s) 3.4' Crest Height

Discarded OutFlow Max=0.03 cfs @ 4.58 hrs HW=37.03' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.83 cfs @ 12.44 hrs HW=39.36' (Free Discharge)
↑—**2=Culvert** (Passes 0.83 cfs of 4.17 cfs potential flow)
↑—**3=Sharp-Crested Rectangular Weir** (Weir Controls 0.83 cfs @ 1.31 fps)

Summary for Link 1L: Wetlands South-East

Inflow Area = 3.161 ac, 35.57% Impervious, Inflow Depth = 4.18" for 25-Yr Storm event
Inflow = 6.49 cfs @ 12.14 hrs, Volume= 1.102 af
Primary = 6.49 cfs @ 12.14 hrs, Volume= 1.102 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs

Summary for Link 2L: Wetlands South-East

Inflow Area = 3.161 ac, 55.24% Impervious, Inflow Depth = 4.20" for 25-Yr Storm event
Inflow = 5.38 cfs @ 12.17 hrs, Volume= 1.107 af
Primary = 5.38 cfs @ 12.17 hrs, Volume= 1.107 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs

Time span=0.00-100.00 hrs, dt=0.01 hrs, 10001 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: Flow to Existing Runoff Area=59,995 sf 81.64% Impervious Runoff Depth=7.00"
Tc=6.0 min CN=95 Runoff=10.14 cfs 0.804 af

Subcatchment 2S: Uncontrolled flow to Runoff Area=77,680 sf 0.00% Impervious Runoff Depth=4.57"
Flow Length=310' Tc=10.3 min CN=74 Runoff=8.26 cfs 0.679 af

Subcatchment 3S: Flow to Expanded Runoff Area=69,930 sf 76.43% Impervious Runoff Depth=6.88"
Tc=6.0 min CN=94 Runoff=11.74 cfs 0.921 af

Subcatchment 4S: Flow to Cultec Runoff Area=24,430 sf 92.53% Impervious Runoff Depth=7.24"
Tc=6.0 min CN=97 Runoff=4.17 cfs 0.338 af

Subcatchment 6S: Uncontrolled flow to Runoff Area=43,315 sf 0.00% Impervious Runoff Depth=5.25"
Flow Length=310' Tc=10.3 min CN=80 Runoff=5.24 cfs 0.435 af

Pond 1P: Existing Detention Basin Peak Elev=35.37' Storage=13,876 cf Inflow=10.14 cfs 0.804 af
Outflow=2.26 cfs 0.804 af

Pond 2P: Expanded Detention Basin Peak Elev=34.74' Storage=13,665 cf Inflow=12.01 cfs 1.071 af
Outflow=4.77 cfs 1.071 af

Pond 3P: Cultec Subsurface Infiltration Peak Elev=39.54' Storage=0.152 af Inflow=4.17 cfs 0.338 af
Discarded=0.03 cfs 0.189 af Primary=2.54 cfs 0.150 af Outflow=2.57 cfs 0.338 af

Link 1L: Wetlands South-East Inflow=9.00 cfs 1.483 af
Primary=9.00 cfs 1.483 af

Link 2L: Wetlands South-East Inflow=8.41 cfs 1.506 af
Primary=8.41 cfs 1.506 af

Total Runoff Area = 6.321 ac Runoff Volume = 3.177 af Average Runoff Depth = 6.03"
54.59% Pervious = 3.451 ac 45.41% Impervious = 2.870 ac

Summary for Subcatchment 1S: Flow to Existing Detention Basin

Runoff = 10.14 cfs @ 12.08 hrs, Volume= 0.804 af, Depth= 7.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Yr Storm Rainfall=7.60"

	Area (sf)	CN	Description
	41,780	98	Paved parking, HSG D
*	7,197	98	Basin Ponding Area
	11,018	80	>75% Grass cover, Good, HSG D
	59,995	95	Weighted Average
	11,018		18.36% Pervious Area
	48,977		81.64% Impervious Area

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

Summary for Subcatchment 2S: Uncontrolled flow to wetlands

Runoff = 8.26 cfs @ 12.14 hrs, Volume= 0.679 af, Depth= 4.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Yr Storm Rainfall=7.60"

Area (sf)	CN	Description
66,000	73	Brush, Good, HSG D
11,680	77	Woods, Good, HSG D
77,680	74	Weighted Average
77,680		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.40"
2.3	260	0.0140	1.90		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
10.3	310	Total			

Summary for Subcatchment 3S: Flow to Expanded Detention Basin

Runoff = 11.74 cfs @ 12.08 hrs, Volume= 0.921 af, Depth= 6.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Yr Storm Rainfall=7.60"

	Area (sf)	CN	Description
	44,665	98	Paved parking, HSG D
*	8,785	98	Basin Ponding Area
	16,480	80	>75% Grass cover, Good, HSG D
	69,930	94	Weighted Average
	16,480		23.57% Pervious Area
	53,450		76.43% Impervious Area

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

Summary for Subcatchment 4S: Flow to Cultec Subsurface Infiltration

Runoff = 4.17 cfs @ 12.08 hrs, Volume= 0.338 af, Depth= 7.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Yr Storm Rainfall=7.60"

	Area (sf)	CN	Description
*	16,755	98	Pavement, HSG D
	5,850	98	Roofs, HSG D
	1,825	80	>75% Grass cover, Good, HSG D
	24,430	97	Weighted Average
	1,825		7.47% Pervious Area
	22,605		92.53% Impervious Area

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

Summary for Subcatchment 6S: Uncontrolled flow to wetlands

Runoff = 5.24 cfs @ 12.14 hrs, Volume= 0.435 af, Depth= 5.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Yr Storm Rainfall=7.60"

Area (sf)	CN	Description
36,510	80	>75% Grass cover, Good, HSG D
6,805	77	Woods, Good, HSG D
43,315	80	Weighted Average
43,315		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.40"
2.3	260	0.0140	1.90		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
10.3	310	Total			

Summary for Pond 1P: Existing Detention Basin

Inflow Area = 1.377 ac, 81.64% Impervious, Inflow Depth = 7.00" for 100-Yr Storm event
Inflow = 10.14 cfs @ 12.08 hrs, Volume= 0.804 af
Outflow = 2.26 cfs @ 12.48 hrs, Volume= 0.804 af, Atten= 78%, Lag= 23.9 min
Primary = 2.26 cfs @ 12.48 hrs, Volume= 0.804 af

Routing by Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Peak Elev= 35.37' @ 12.48 hrs Surf.Area= 7,814 sf Storage= 13,876 cf

Plug-Flow detention time= 142.7 min calculated for 0.804 af (100% of inflow)
Center-of-Mass det. time= 142.7 min (900.9 - 758.2)

Volume	Invert	Avail.Storage	Storage Description
#1	31.65'	17,810 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
31.65	354	85.0	0	0	354
32.00	785	121.0	194	194	945
33.00	2,451	269.0	1,541	1,735	5,543
34.00	4,632	357.0	3,484	5,220	9,938
35.00	7,197	473.0	5,868	11,087	17,610
35.85	8,644	492.0	6,723	17,810	19,126

Device	Routing	Invert	Outlet Devices
#1	Primary	31.31'	**12.0" Round Culvert** L= 24.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 31.31' / 31.08' S= 0.0096 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	31.65'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	35.20'	**8.0' long x 12.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.57 2.62 2.70 2.67 2.66 2.67 2.66 2.64

Primary OutFlow Max=2.26 cfs @ 12.48 hrs HW=35.37' (Free Discharge)
- **1=Culvert** (Passes 0.79 cfs of 7.14 cfs potential flow)
  - **2=Orifice/Grate** (Orifice Controls 0.79 cfs @ 9.08 fps)
- **3=Broad-Crested Rectangular Weir** (Weir Controls 1.46 cfs @ 1.06 fps)

Summary for Pond 2P: Expanded Detention Basin

Inflow Area = 2.166 ac, 80.60% Impervious, Inflow Depth = 5.93" for 100-Yr Storm event
Inflow = 12.01 cfs @ 12.12 hrs, Volume= 1.071 af
Outflow = 4.77 cfs @ 12.41 hrs, Volume= 1.071 af, Atten= 60%, Lag= 17.7 min
Primary = 4.77 cfs @ 12.41 hrs, Volume= 1.071 af

Routing by Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs
Peak Elev= 34.74' @ 12.41 hrs Surf.Area= 7,913 sf Storage= 13,665 cf

Plug-Flow detention time= 54.6 min calculated for 1.071 af (100% of inflow)
Center-of-Mass det. time= 54.7 min (827.7 - 773.0)

Volume	Invert	Avail.Storage	Storage Description
#1	31.65'	23,713 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
31.65	354	85.0	0	0	354
32.00	2,440	277.0	434	434	5,885
33.00	4,230	383.0	3,294	3,729	11,462
34.00	5,650	440.0	4,923	8,652	15,218
35.00	8,785	683.0	7,160	15,812	36,941
35.85	9,815	688.0	7,901	23,713	37,739

Device	Routing	Invert	Outlet Devices
#1	Primary	31.31'	**12.0" Round Culvert** L= 24.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 31.31' / 31.08' S= 0.0096 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	31.65'	**6.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	33.75'	**12.0" W x 24.0" H Vert. Orifice/Grate** C= 0.600
#4	Primary	34.85'	**8.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=4.77 cfs @ 12.41 hrs HW=34.74' (Free Discharge)
- **1=Culvert** (Passes 1.59 cfs of 6.48 cfs potential flow)
  - **2=Orifice/Grate** (Orifice Controls 1.59 cfs @ 8.12 fps)
- **3=Orifice/Grate** (Orifice Controls 3.18 cfs @ 3.20 fps)
- **4=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 3P: Cultec Subsurface Infiltration

Inflow Area = 0.561 ac, 92.53% Impervious, Inflow Depth = 7.24" for 100-Yr Storm event
Inflow = 4.17 cfs @ 12.08 hrs, Volume= 0.338 af
Outflow = 2.57 cfs @ 12.18 hrs, Volume= 0.338 af, Atten= 38%, Lag= 5.9 min
Discarded = 0.03 cfs @ 3.47 hrs, Volume= 0.189 af
Primary = 2.54 cfs @ 12.18 hrs, Volume= 0.150 af

Routing by Stor-Ind method, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs

Peak Elev= 39.54' @ 12.18 hrs Surf.Area= 0.103 ac Storage= 0.152 af

Plug-Flow detention time= 1,063.8 min calculated for 0.338 af (100% of inflow)
Center-of-Mass det. time= 1,064.0 min (1,812.0 - 748.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	37.00'	0.073 af	**60.00'W x 74.50'L x 2.54'H Field A** 0.261 af Overall - 0.079 af Embedded = 0.181 af x 40.0% Voids
#2A	37.50'	0.079 af	**Cultec R-150XLHD** x 126 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 18 rows
		0.152 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	37.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	37.30'	**12.0" Round Culvert** L= 79.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 37.30' / 36.00' S= 0.0165 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#3	Device 2	39.20'	**4.0' long x 0.40' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s) 3.4' Crest Height

Discarded OutFlow Max=0.03 cfs @ 3.47 hrs HW=37.03' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=2.53 cfs @ 12.18 hrs HW=39.54' (Free Discharge)
↑—**2=Culvert** (Passes 2.53 cfs of 4.40 cfs potential flow)
↑—**3=Sharp-Crested Rectangular Weir** (Weir Controls 2.53 cfs @ 1.92 fps)

Summary for Link 1L: Wetlands South-East

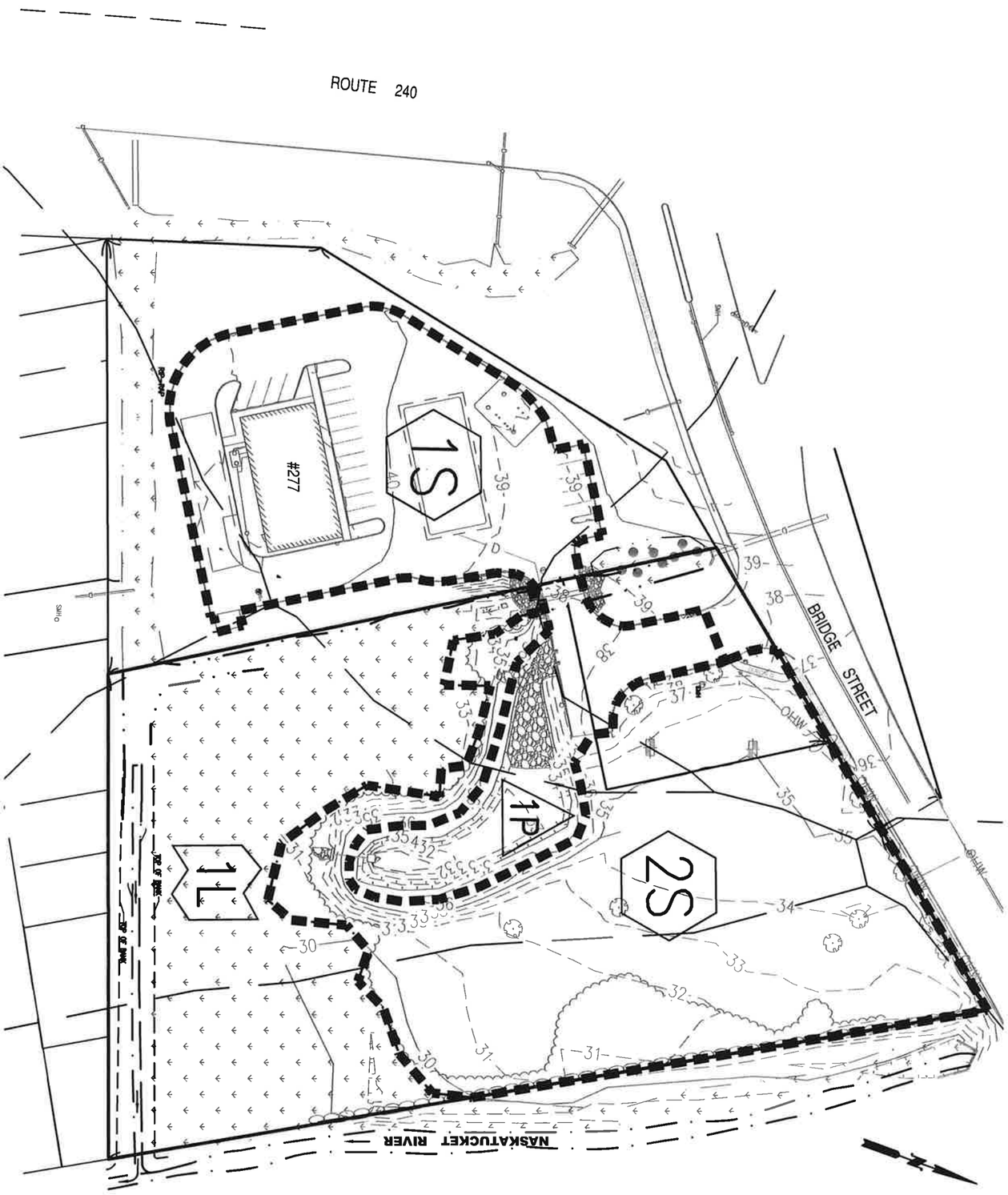
Inflow Area = 3.161 ac, 35.57% Impervious, Inflow Depth = 5.63" for 100-Yr Storm event
Inflow = 9.00 cfs @ 12.14 hrs, Volume= 1.483 af
Primary = 9.00 cfs @ 12.14 hrs, Volume= 1.483 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs

Summary for Link 2L: Wetlands South-East

Inflow Area = 3.161 ac, 55.24% Impervious, Inflow Depth = 5.72" for 100-Yr Storm event
Inflow = 8.41 cfs @ 12.18 hrs, Volume= 1.506 af
Primary = 8.41 cfs @ 12.18 hrs, Volume= 1.506 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-100.00 hrs, dt= 0.01 hrs



GRAPHICS SCALE
1 inch = 80 feet
0 80 160 240

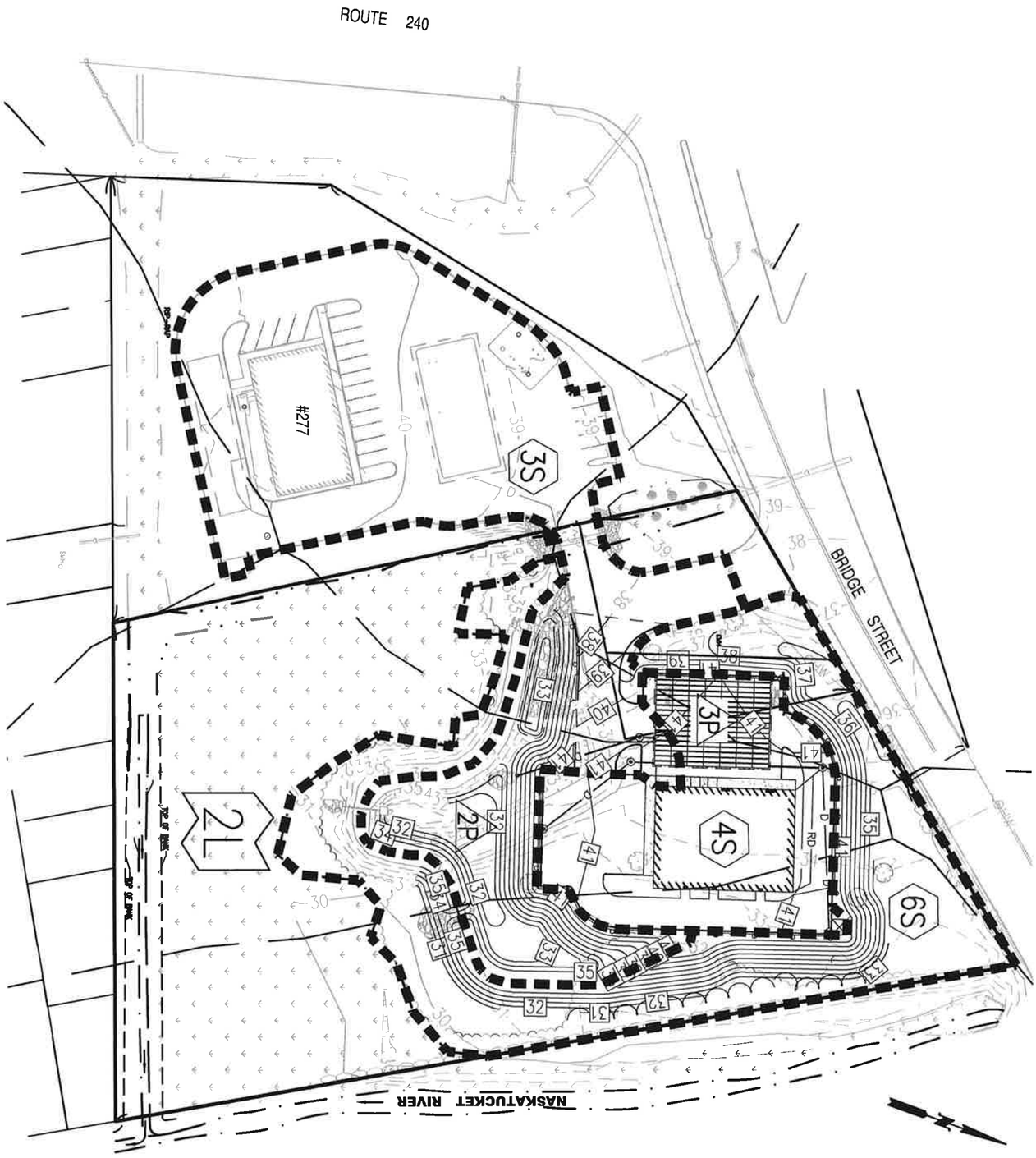
SHEET NAME:
PREDEVELOPMENT DRAINAGE PLAN

PROJECT SITE:
MAP 30A - LOT 87 BRIDGE STREET
FAIRHAVEN, MASSACHUSETTS

CLIENT INFO:
CARRICORP INDUSTRIES, LTD.
275 MARTINE STREET, SUITE 110
FALL RIVER, MA 02724

ZCE
ZENITH CONSULTING ENGINEERS, LLC
3 MAIN STREET LAKEVILLE, MA 02347
PHONE: (508) 947-4208

S:\Civil Engineering Projects\Fairhaven\Bridge St\30A-087 Bridge Street\DWG\Site Plan - 30A-087 Bridge St - Fairhaven.dwg



GRAPHICS SCALE
1 inch = 80 feet
0 80 160 240

SHEET NAME:
POSTDEVELOPMENT DRAINAGE PLAN

PROJECT SITE:
MAP 30A - LOT 87 BRIDGE STREET
FAIRHAVEN, MASSACHUSETTS

CLIENT INFO:
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275 MARTINE STREET, SUITE 110
FALL RIVER, MA 02724

ZCE
ZENITH CONSULTING ENGINEERS, LLC
3 MAIN STREET LAKEVILLE, MA 02347
PHONE: (508) 947-4208

PIPE CALCULATIONS 100-YR STORM

Input Values

SINGLE GRATE

K Values for grate R-3405-A with a transverse gutter slope of 2%	
LONGITUDINAL SLOPE (%)	K
1	19.00
1.5	20.75
2	22.50
2.5	23.75
3	25.00
3.5	26.25
4	27.50
4.5	28.75
5	30.00
5.5	31.25
6	32.50

DOUBLE GRATE

K Values for grate R-3403F-A with a transverse gutter slope of 2%	
LONGITUDINAL SLOPE (%)	K
1	22.80
1.5	25.55
2	28.30
2.5	29.55
3	30.80
3.5	32.05
4	33.30
4.5	34.55
5	35.80
5.5	37.05
6	38.30

ROADWAY PROPERTIES	
Roughness Coefficient of Bituminous Asphalt	0.016
Transverse Slope	0.02

Geometric Values for grate R-3405-A	
Square Dimention (in.)	23.6
Free Area (sq. ft.)	1.3

STORM EVENT	
100	Year

GUTTER DEPTH OF FLOW

$$D = \left(\frac{QN}{0.56Z\sqrt{S}}\right)^{\frac{3}{8}}$$

Q = Channel flow (cfs)
Z = Reciprocal of transverse slope (ft/ft)
S = Longitudinal Slope
N = Roughness Coefficient
D = Depth (ft)

GUTTER CAPACITY OF GRATE

$$Q = KD^{\frac{5}{3}}$$

Q = Grate capacity (cfs)
K = Grate coef. from "Inlet Grate Capacities Manual"
D = Depth of flow in feet (from previous equation)

ORIFICE FLOW EQUATION

$$Q = .6A\sqrt{2gh}$$

Q = Capacity (cfs)
A = Free open area (sq. ft.)
g = Acceleration of Gravity (32.2 ft/s^2)
h = Head (ft.)

WEIR EQUATION

$$Q = 3.3P(h)^{\frac{3}{2}}$$

Q = Capacity (cfs)
P = Perimeter (ft.)
h = Head (ft.)

CATCH BASINS IN DEPRESSIONS - 100 YEAR STORM

STRUCTURE	CONTRIBUTING FLOW (cfs)	CARRYOVER FLOW (cfs)	TOTAL FLOW (cfs)	SIDES ON CURB	(S)INGLE OR (D)OUBLE	P (ft)	HEAD OVER GRATE (ft)	ORIFICE		WEIR		MAX CAPACITY (cfs)	ACTUAL DEPTH (ft)	OVERFLOW (cfs)	OVERFLOW TO
								Q_{MAX} (cfs)	H (ft)	Q_{MAX} (cfs)	H (ft)				
PIPE NETWORK TO INFILTRATION CHAMBERS															
DCB-1	0.50	0.00	0.50	2	S	3.9	0.5	4.43	0.01	4.59	0.11	4.43 cfs	0.01 ft.	0.00	-
DCB-2	0.67	0.00	0.67	2	S	3.9	0.5	4.43	0.01	4.59	0.14	4.43 cfs	0.01 ft.	0.00	-
DCB-3	0.93	0.00	0.93	1	S	7.9	0.5	4.43	0.02	9.22	0.11	4.43 cfs	0.02 ft.	0.00	-
DCB-4	0.37	0.00	0.37	2	S	7.9	0.5	4.43	0.00	9.22	0.06	4.43 cfs	0.00 ft.	0.00	-

RATIONAL METHOD OF FLOWS TOWARD INLET GRATES - 100 YEAR STORM									
FROM	UNPAVED AREA	UNPAVED COEFFICIENT	PAVE/ROOF AREA	PAVE/ROOF COEFFICIENT	AREA ACRES	WEIGHTED COEFFICIENT	TOC MIN.	i	Q cfs
PIPE NETWORK TO INFILTRATION CHAMBERS									
DCB-1	725	0.20	3325	0.90	0.09	0.77	6	7.0	0.50
DCB-2	345	0.20	4550	0.90	0.11	0.85	6	7.0	0.67
DCB-3	755	0.20	6295	0.90	0.16	0.83	6	7.0	0.93
DCB-4	0	0.20	2585	0.90	0.06	0.90	6	7.0	0.37

OPEN CHANNEL FLOW CAPACITIES								
FROM	TO	PIPE DIA.	FROM INVERT	TO INVERT	PIPE LENGTH	SLOPE FT./FT.	N VALUE	Q FULL cfs
PIPE NETWORK TO BASIN 1								
DCB-1	DMH-1	8	38.30	37.80	100	0.005	0.012	0.93
DMH-1	INFIL	12	37.70	37.50	32	0.006	0.012	3.06
DCB-2	INFIL	12	37.60	37.50	5	0.020	0.012	5.47
DCB-3	DMH-2	10	38.00	37.70	66	0.005	0.012	1.60
DMH-2	INFIL	10	37.60	37.50	13	0.008	0.012	2.09
DCB-4	INFIL	12	37.60	37.50	5	0.020	0.012	5.47

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Pipe Design Calculations

PROJECT 0 Bridge St - Fairhaven MA

INLET GRATE AND PIPE ANALYSIS - 100 YEAR STORM
CALCULATED BY: RLG DATE: 7/12/23
CHECKED BY: RMF DATE: 7/12/23

LOCATION		GRATE ANALYSIS						PIPE ANALYSIS							
FROM	TO	(S)ag or (G)utter	FLOW TO GRATE	GRATE CAPACITY	OVER-FLOW	DEPTH OF FLOW	FLOW TO PIPE	PIPE SIZE DIA.	LNGTH FT.	SLOPE FT./FT.	Q CAPACITY cfs	Q ACTUAL cfs	V FULL fps	V ACTUAL fps	CHECK?
PIPE NETWORK TO SUBSURFACE INFILTRATION 2															
DCB-1	DMH-1	S	0.50	4.43	0.00	0.1"	0.50	8	100	0.005	0.93	0.50	2.66	2.69	OK
DMH-1	INFIL						0.50	12	32	0.006	3.06	0.50	3.90	2.82	OK
DCB-2	INFIL	S	0.67	4.43	0.00	0.1"	0.67	12	5	0.020	5.47	0.67	6.97	4.36	OK
DCB-3	DMH-2	S	0.93	4.43	0.00	0.3"	0.93	10	66	0.005	1.60	0.93	2.94	3.02	OK
DMH-2	INFIL						0.93	10	13	0.008	2.09	0.93	3.83	3.73	OK
DCB-4	INFIL	S	0.37	4.43	0.00	0.0"	0.37	12	5	0.020	5.47	0.37	6.97	3.48	OK

SEDIMENT FOREBAY SIZING CALCULATION

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SEDIMENT FOREBAY SIZING CALCULATIONS

RE: BRIDGE STREET, FAIRHAVEN, MA

FLOW TO EXISTING/EXPANDED BASIN

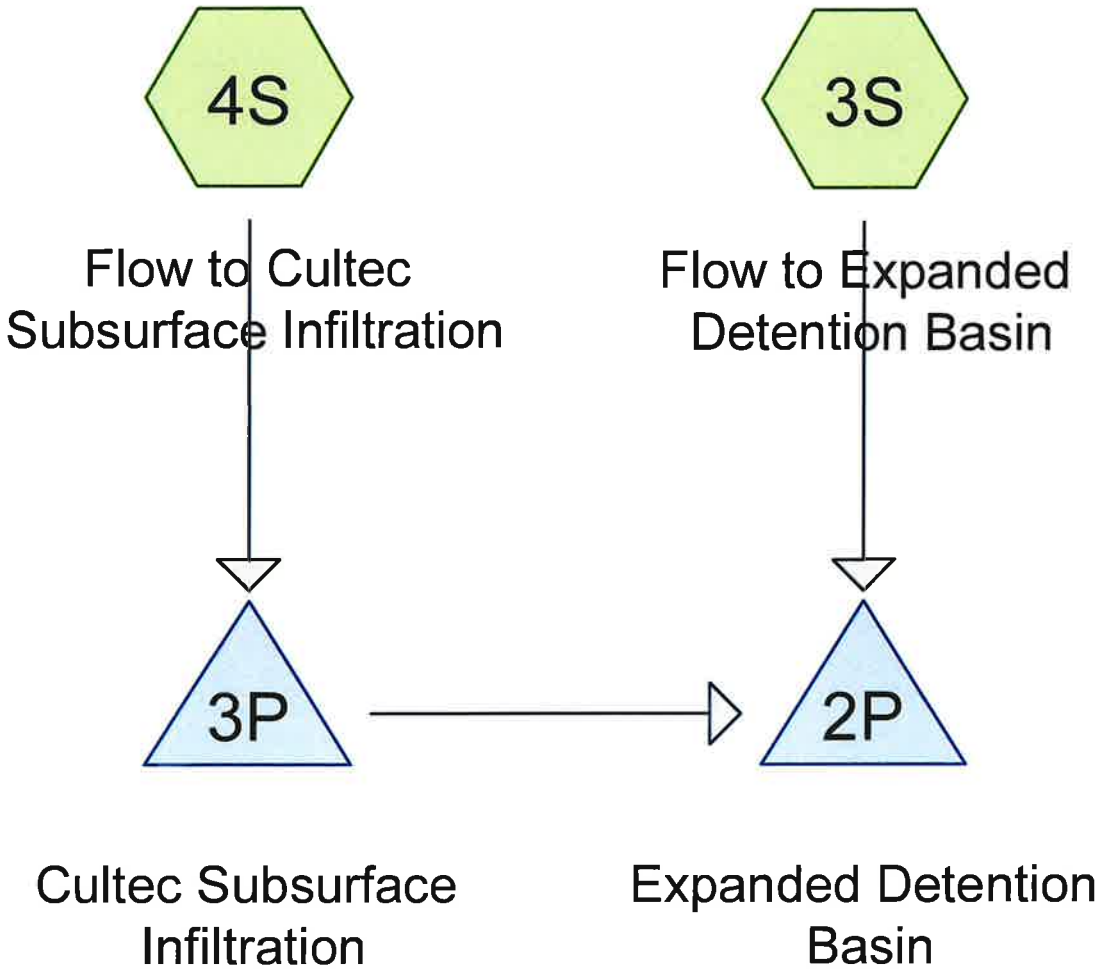
Total Impervious Flowing to Forebay: 47,150 s.f.

Forebay Volume Required: 47,150 s.f. x $\frac{1\text{ ft}}{12\text{in}}$ x 0.25in = 982 c.f.

Existing Forebay Volume provided:
Area @ elevation 33.0= 450 s.f.
Area @ elevation 34.0 = 790 s.f.
Volume = (average area) x (depth)
= (450 + 790)/2 x 1.0 = 620 c.f.

Proposed Forebay Volume provided:
Area @ elevation 33.0= 430 s.f.
Area @ elevation 34.5 = 1,150 s.f.
Volume = (average area) x (depth)
= (430 + 1,150)/2 x 1.5 = 1,185 c.f.

EMERGENCY SPILLWAY SIZING CALCULATION



Spillway Calculation

Subcat Reach Pond Link

Routing Diagram for 0 Bridge St-Spillway Calc
Prepared by Zenith Consulting Engineers LLC, Printed 3/14/2024
HydroCAD® 10.00-16 s/n 09356 © 2015 HydroCAD Software Solutions LLC

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 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 3S: Flow to Expanded Runoff Area=69,930 sf 76.43% Impervious Runoff Depth=6.88"
Tc=6.0 min CN=94 Runoff=11.74 cfs 0.921 af

Subcatchment 4S: Flow to Cultec Runoff Area=24,430 sf 92.53% Impervious Runoff Depth=7.24"
Tc=6.0 min CN=97 Runoff=4.17 cfs 0.338 af

Pond 2P: Expanded Detention Basin Peak Elev=35.38' Storage=19,244 cf Inflow=12.02 cfs 1.071 af
Outflow=9.99 cfs 1.071 af

Pond 3P: Cultec Subsurface Infiltration Peak Elev=39.54' Storage=0.152 af Inflow=4.17 cfs 0.338 af
Discarded=0.03 cfs 0.064 af Primary=2.54 cfs 0.150 af Outflow=2.57 cfs 0.214 af

Total Runoff Area = 2.166 ac Runoff Volume = 1.259 af Average Runoff Depth = 6.98"
19.40% Pervious = 0.420 ac 80.60% Impervious = 1.746 ac

Summary for Subcatchment 3S: Flow to Expanded Detention Basin

Runoff = 11.74 cfs @ 12.08 hrs, Volume= 0.921 af, Depth= 6.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Yr Storm Rainfall=7.60"

	Area (sf)	CN	Description
	44,665	98	Paved parking, HSG D
*	8,785	98	Basin Ponding Area
	16,480	80	>75% Grass cover, Good, HSG D
	69,930	94	Weighted Average
	16,480		23.57% Pervious Area
	53,450		76.43% Impervious Area

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

Summary for Subcatchment 4S: Flow to Cultec Subsurface Infiltration

Runoff = 4.17 cfs @ 12.08 hrs, Volume= 0.338 af, Depth= 7.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Yr Storm Rainfall=7.60"

	Area (sf)	CN	Description
*	16,755	98	Pavement, HSG D
	5,850	98	Roofs, HSG D
	1,825	80	>75% Grass cover, Good, HSG D
	24,430	97	Weighted Average
	1,825		7.47% Pervious Area
	22,605		92.53% Impervious Area

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

Summary for Pond 2P: Expanded Detention Basin

Inflow Area = 2.166 ac, 80.60% Impervious, Inflow Depth = 5.93" for 100-Yr Storm event
Inflow = 12.02 cfs @ 12.12 hrs, Volume= 1.071 af
Outflow = 9.99 cfs @ 12.18 hrs, Volume= 1.071 af, Atten= 17%, Lag= 3.7 min
Primary = 9.99 cfs @ 12.18 hrs, Volume= 1.071 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Starting Elev= 34.85' Surf.Area= 8,271 sf Storage= 14,533 cf
Peak Elev= 35.38' @ 12.18 hrs Surf.Area= 9,240 sf Storage= 19,244 cf (4,712 cf above start)

Plug-Flow detention time= 182.9 min calculated for 0.737 af (69% of inflow)
Center-of-Mass det. time= 15.3 min (788.4 - 773.0)

Volume	Invert	Avail.Storage	Storage Description
#1	31.65'	23,713 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
31.65	354	85.0	0	0	354
32.00	2,440	277.0	434	434	5,885
33.00	4,230	383.0	3,294	3,729	11,462
34.00	5,650	440.0	4,923	8,652	15,218
35.00	8,785	683.0	7,160	15,812	36,941
35.85	9,815	688.0	7,901	23,713	37,739

Device	Routing	Invert	Outlet Devices
#1	Primary	34.85'	**8.0' long x 1.00' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=9.98 cfs @ 12.18 hrs HW=35.38' (Free Discharge)
↑—**1=Sharp-Crested Rectangular Weir** (Weir Controls 9.98 cfs @ 2.38 fps)

Summary for Pond 3P: Cultec Subsurface Infiltration

Inflow Area = 0.561 ac, 92.53% Impervious, Inflow Depth = 7.24" for 100-Yr Storm event
Inflow = 4.17 cfs @ 12.08 hrs, Volume= 0.338 af
Outflow = 2.57 cfs @ 12.18 hrs, Volume= 0.214 af, Atten= 38%, Lag= 5.9 min
Discarded = 0.03 cfs @ 3.51 hrs, Volume= 0.064 af
Primary = 2.54 cfs @ 12.18 hrs, Volume= 0.150 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 39.54' @ 12.18 hrs Surf.Area= 0.103 ac Storage= 0.152 af

Plug-Flow detention time= 234.3 min calculated for 0.214 af (63% of inflow)
Center-of-Mass det. time= 128.6 min (876.6 - 748.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	37.00'	0.073 af	**60.00'W x 74.50'L x 2.54'H Field A** 0.261 af Overall - 0.079 af Embedded = 0.181 af x 40.0% Voids
#2A	37.50'	0.079 af	**Cultec R-150XLHD** x 126 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 18 rows
		0.152 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	37.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	36.25'	**12.0" Round Culvert** L= 20.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 36.25' / 36.00' S= 0.0125 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf,
#3	Device 2	39.20'	**4.0' long x 0.60' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s) 3.4' Crest Height

Discarded OutFlow Max=0.03 cfs @ 3.51 hrs HW=37.03' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=2.54 cfs @ 12.18 hrs HW=39.54' (Free Discharge)
↑—**2=Culvert** (Passes 2.54 cfs of 5.57 cfs potential flow)
↑—**3=Sharp-Crested Rectangular Weir** (Weir Controls 2.54 cfs @ 1.92 fps)

ILLICIT DISCHARGE STATEMENT

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ILLICIT DISCHARGE STATEMENT
(STANDARD #10)

RE: Map 30A Lots 87 & 87A, Bridge Street, Fairhaven, MA

Standard 10 of the Massachusetts Stormwater Handbook prohibits illicit discharges to stormwater management systems. The following is an illicit discharge compliance statement based on existing conditions and design conditions for the proposed project.

EXISTING CONDITIONS

The existing site is an undeveloped lot that has previously been cleared of trees and consists mostly of grass and brush. Based on all the information available to the undersigned, and therefore, to the best of my knowledge, there are no current illicit discharges to any existing storm drainage system. If during construction, an illicit discharge is discovered, it shall be removed immediately.

PROPOSED DESIGN

The proposed project design does not include any illicit discharges. There are no points in the proposed storm drainage system where illicit discharges are likely to occur.

I hereby certify that the preceding is accurate.

_____

Representative, Carricorp Industries, Ltd.

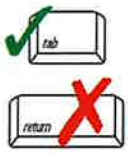
DEP STORMWATER CHECKLIST

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

A. Introduction

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the Massachusetts Stormwater Handbook. The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.[1] This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8[2]
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

[1] The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

[2] For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the item is not applicable (N.A.) and provide the reasons for that determination.

A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

Registered Professional Engineer Block and Signature

Signature and Date 4-9-2024

Checklist

Project Type: Is the application for new development, redevelopment, or a mix of new and redevelopment?

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

LID Measures: Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

- ☒ No disturbance to any Wetland Resource Areas
- ☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- ☐ Reduced Impervious Area (Redevelopment Only)
- ☒ Minimizing disturbance to existing trees and shrubs
- ☐ LID Site Design Credit Requested:
  - ☐ Credit 1
  - ☐ Credit 2
  - ☐ Credit 3
- ☐ Use of "country drainage" versus curb and gutter conveyance and pipe
- ☐ Bioretention Cells (includes Rain Gardens)
- ☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
- ☐ Treebox Filter
- ☐ Water Quality Swale
- ☐ Grass Channel
- ☐ Green Roof
- ☐ Other (describe): _____

Standard 1: No New Untreated Discharges

- ☒ No new untreated discharges
- ☒ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- ☐ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

☐ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.

☒ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.

☒ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

☐ Required Recharge volume reduced through use of the LID site Design Credits.

☒ Sizing the infiltration, BMPs is based on the following method: Check the method used.

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

☐ Runoff from all impervious areas at the site discharging to the infiltration BMP.

☒ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.

☒ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:

- ☐ Site is comprised solely of C and D soils and/or bedrock at the land surface
- ☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
- ☐ Solid Waste Landfill pursuant to 310 CMR 19.000
- ☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

☒ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.

☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

[1] 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

☐ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.

☐ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

The Long-Term Pollution Prevention Plan typically includes the following:

- Good housekeeping practices;
- Provisions for storing materials and waste products inside or under cover;
- Vehicle washing controls;
- Requirements for routine inspections and maintenance of stormwater BMPs;
- Spill prevention and response plans;
- Provisions for maintenance of lawns, gardens, and other landscaped areas;
- Requirements for storage and use of fertilizers, herbicides, and pesticides;
- Pet waste management provisions;
- Provisions for operation and management of septic systems;
- Provisions for solid waste management;
- Snow disposal and plowing plans relative to Wetland Resource Areas;
- Winter Road Salt and/or Sand Use and Storage restrictions;
- Street sweeping schedules;
- Provisions for prevention of illicit discharges to the stormwater management system;
- Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
- Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.

☒ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.

☐ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:

- ☐ is within the Zone II or Interim Wellhead Protection Area
- ☐ is near or to other critical areas
- ☐ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
- ☐ involves runoff from land uses with higher potential pollutant loads.

☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.

☒ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

☒ The BMP is sized (and calculations provided) based on:

- ☒ The ½" or 1" Water Quality Volume or
- ☐ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.

☐ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.

☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs)

☐ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.

☐ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted ***prior to*** the discharge of stormwater to the post-construction stormwater BMPs.

☐ The NPDES Multi-Sector General Permit does ***not*** cover the land use.

☐ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.

☐ All exposure has been eliminated.

☐ All exposure has ***not*** been eliminated and all BMPs selected are on MassDEP LUHPPL list.

☐ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

☐ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.

☐ Critical areas and BMPs are identified in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

☐ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:

- ☐ Limited Project
- ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
- ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
- ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
- ☐ Bike Path and/or Foot Path
- ☐ Redevelopment Project
- ☐ Redevelopment portion of mix of new and redevelopment.

☐ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.

☐ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

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

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
- Construction Period Operation and Maintenance Plan;
- Names of Persons or Entity Responsible for Plan Compliance;
- Construction Period Pollution Prevention Measures;
- Erosion and Sedimentation Control Plan Drawings;
- Detail drawings and specifications for erosion control BMPs, including sizing calculations;
- Vegetation Planning;
- Site Development Plan;
- Construction Sequencing Plan;
- Sequencing of Erosion and Sedimentation Controls;
- Operation and Maintenance of Erosion and Sedimentation Controls;
- Inspection Schedule;
- Maintenance Schedule;
- Inspection and Maintenance Log Form.

☒ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control (continued)

☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has ***not*** been included in the Stormwater Report but will be submitted ***before*** land disturbance begins.

☐ The project is ***not*** covered by a NPDES Construction General Permit.

☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.

☒ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

☒ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:

- ☒ Name of the stormwater management system owners;
- ☒ Party responsible for operation and maintenance;
- ☒ Schedule for implementation of routine and non-routine maintenance tasks;
- ☒ Plan showing the location of all stormwater BMPs maintenance access areas;
- ☒ Description and delineation of public safety features;
- ☒ Estimated operation and maintenance budget; and
- ☒ Operation and Maintenance Log Form.

☐ The responsible party is ***not*** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:

- ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
- ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

☐ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☒ An Illicit Discharge Compliance Statement is attached;

☐ NO Illicit Discharge Compliance Statement is attached but will be submitted ***prior to*** the discharge of any stormwater to post-construction BMPs.

OPERATIONS AND MAINTENANCE PLAN

OPERATIONS AND MAINTENANCE PLAN

Commercial Development, Map 30A Lots 87 & 87A Bridge Street in Fairhaven

The following is the proposed operation and maintenance plan for the storm water management systems at the commercial development located at Map 30A Lots 87 & 87A Bridge Street in Fairhaven, Massachusetts. The First Defense water quality units, sediment forebay and detention basin are shared stormwater controls with the gas station located at 277 Bridge Street. An agreement must be made in the form on a legal document to use and maintain these shared components by current and future owners of the three parcels.

- Owners: Carricorp Industries, Ltd.
  275 Martine Street, Suite 110
  Fall River, MA 02723
  (Map 30A Lot 87)

  Bridge Street Holdings LLC
  275 Martine Street
  Fall River, MA 02723
  (277 Bridge Street – Map 30A Lot 86B & Map 30A Lot 87A)

- Parties responsible for Operation and Maintenance:
  Same as above

CONTENTS

STORMWATER MANAGEMENT SYSTEMS

OPERATIONS AND MAINTENANCE PLAN

Commercial Development, Map 30A Lots 87 & 87A Bridge Street in Fairhaven

The storm water management facilities were designed to require little or no intervention in the operation and to require little or no maintenance once the project is built and stable vegetative cover is established. However, the drainage improvements shall be subject to the following maintenance schedule:

Catch Basins

Inspect or clean deep sump basins at least four times per year and at the end of the foliage and snow removal seasons. Sediments must also be removed four times per year or whenever the depth of deposits is greater than or equal to one half the depth from the bottom of the invert of the lowest pipe in the basin. If handling runoff from land uses with higher potential pollutant loads or discharging runoff near or to a critical area, more frequent cleaning may be necessary.

Clamshell buckets are typically used to remove sediment in Massachusetts. However, vacuum trucks are preferable, because they remove more trapped sediment and supernatant than clamshells. Vacuuming is also a speedier process and is less likely to snap the cast iron hood within the deep sump catch basin.

Chamber Field

Measure the water depth in the inspection port at 24- and 48-hour intervals after a storm. Calculate clearance rates by dividing the drop in water level (inches) by the time elapsed (hr). Record this information to document performance. Inspect gutters and downspouts for blockages monthly and remove debris as needed.

First Defense Water Quality Units

See the attached operation and maintenance manual and log forms from the manufacturer.

Sediment Forebay

At a minimum, inspect sediment forebays monthly and clean them out at least four times per year. Stabilize the floor and sidewalls of the sediment forebay before making it operational, otherwise the practice will discharge excess amounts of suspended sediments. After removing the sediment, clean or replace the rip-rap as needed.

Detention Basin

Inspect detention basins at least once per year to ensure that they are operating as intended. Inspect basins during and after storms to determine if the basin is meeting the expected detention times. Inspect the outlet structure for evidence of clogging or outflow release velocities that are greater than design flow. Potential problems that should be checked include: subsidence, erosion, cracking or tree growth on the embankment; damage to the emergency spillway; sediment accumulation in the micro-pool at the outlet; inadequacy of the inlet/outlet channel erosion control measures; changes in the condition of the pilot channel; and erosion within the basin and banks. Make any necessary repairs immediately. During inspections, note changes to the detention basin or the contributing watershed because these changes could affect basin performance. Mow the side slopes, embankment, and emergency spillway at least twice per year. Remove trash and debris at this time. Remove sediment from the basin as necessary, and at least once every 5 years.

Spill Isolation Outlet Control Device

The lower outlet device for the detention basin is equipped with an electric shutoff valve which is controlled from the gas station at 277 Bridge Street. All employees at this location shall be trained to operate this

device in the case of a contamination event. An action plan must be posted in clear site of the control switch to assure proper response to a contamination event. The spill isolation control device shall be tested for proper function at least 2 times per year. If it is found to not function properly it shall be remedied immediately.

Non-periodic Inspection

The storm water management system shall be inspected after two years of full operation by a Registered Professional Civil Engineer to confirm its adequacy. The inspection shall include an examination of all components of the system.

Annual Budget

The estimated annual budget for the O & M is $2,000.

OPERATION AND MAINTENANCE PLAN LOG FORM

Refer to Site Plan for details on the drainage system. Use Log Form that follows as required upon completion of inspections and maintenance tasks, and file.

Commercial Development, Map 39A Lots 87 & 87A Bridge Street in Fairhaven

STORMWATER BMP'S

STRUCTURE	DATE INSPECTED	SEDIMENT BUILDUP (YES/NO)	IF SEDIMENT BUILDUP, DATE CLEANED
DCB-1			
DCB-2			
DCB-3			
DCB-4			
DMH-1			
DMH-2			
DMH-3			
Subsurface Infiltration System			
Detention basin			
FE-1			
Outlet Control Structure and headwalls			
OTHER:			

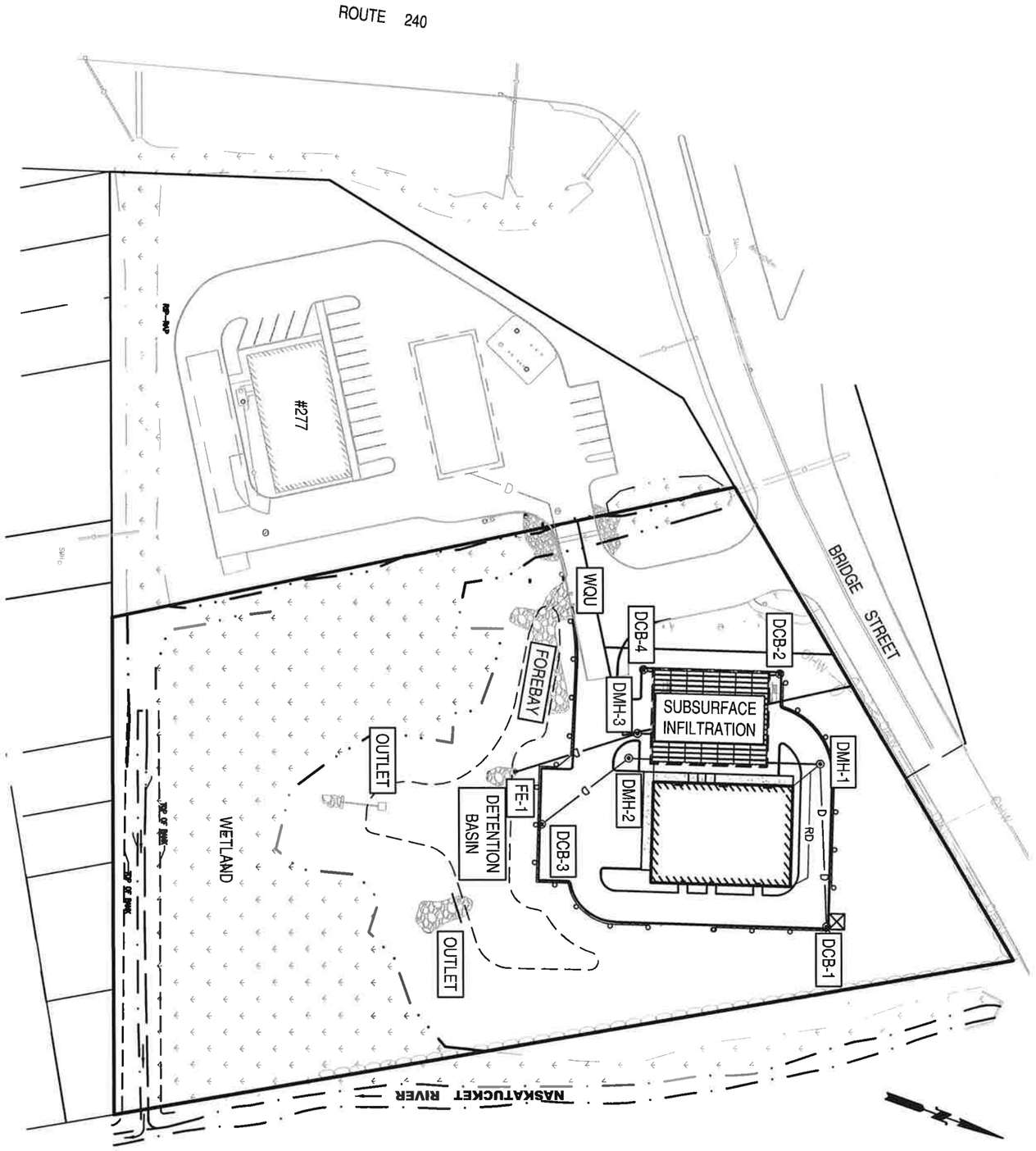
Note: Sediment to be removed from catch basins once the depth reaches 24".

REQUIRED MAINTENANCE:_____

_____

TO BE PERFORMED BY:_____ ON_____

INSPECTION BY:_____ DATE_____



GRAPHICS SCALE
1 inch = 80 feet
0 80 160 240

SHEET NAME:

BMP LOCATION PLAN

PROJECT SITE:

MAP 30A - LOT 87 BRIDGE STREET
FAIRHAVEN, MASSACHUSETTS

CLIENT INFO:

CARRICORP INDUSTRIES, LTD.
275 MARTINE STREET, SUITE 110
FALL RIVER, MA 02724

ZCE
ZENITH CONSULTING ENGINEERS, LLC
3 MAIN STREET LAKEVILLE, MA 02347
PHONE: (508) 947-4208

CONSTRUCTION PERIOD POLLUTION PREVENTION PLAN

Commercial Development, Map 39A Lots 87 & 87A Bridge Street in Fairhaven, MA

1.0 INTRODUCTION

It is proposed to construct a commercial development at the above-referenced project site. The existing site consists of a mostly-cleared field of grass and brush where the proposed 5,850 sf building and associated paved parking areas are to be built. The following erosion and sediment control program material management practices and spill control program have been developed to that end.

2.0 PRECONSTRUCTION MEASURES

Prior to the initiation of any construction, erosion control measures shall be installed as shown on the plans. In addition, silt sacks shall be placed in all existing and proposed catch basin inlets. A preconstruction conference shall then be held with the New Bedford Planning Department's Agent/ Department of Public Infrastructure in order to confirm that sediment control conditions are adequate for construction to start.

3.0 CONSTRUCTION PERIOD MEASURES

The following are the minimal measures required for erosion and sediment control, material handling and for spill control.

3.1 EROSION AND SEDIMENTATION CONTROL

The following measures shall be maintained throughout the site construction phase of the project.

Catch Basin Protection

Proposed catch basins shall be protected with silt sacks prior to the completion of paving. If excessive siltation is discovered to be entering the catch basin inlets, then hay bales shall also be placed around grates and catch basins within the construction/demolition areas to ensure that runoff entering the catch basin has been filtered through the bales prior to discharge.

Stabilized Construction Entrance

A temporary stabilized construction entrance shall be installed at the locations shown on the erosion control plan. The purpose of the construction entrance is to remove sediment attached to vehicle tires and minimize its transport and deposition onto public road surfaces. The construction entrance shall be composed of a 6-inch thick (minimum) bed of 2-inch diameter crushed stone that extends a minimum of 50 feet. The construction entrance shall be a minimum of 25 feet wide. The crushed stone bed shall be removed and replenished as necessary to maintain the proper function.

Erosion and Sediment Control - Maintenance

The project general contractor shall have primary responsibility for implementing temporary and permanent controls described in the plan and shall be responsible for assuring Contractor compliance with contract documents including all erosion and sediment control measures.

- Damaged or deteriorated items shall be repaired or replaced immediately after identification.
- The underside of haybales should be kept in close contact with the earth and reset as necessary.
- Silt Socks shall be inspected after every major rainfall runoff event (over ½" depth of precipitation) or every 14 days, whichever occurs first. All damaged or misaligned fences shall be immediately repaired. Silt shall be immediately removed from all areas of the silt fence when depth of accumulation exceeds 9 inches. Each report shall be documented on the form enclosed in Appendix E.
- Sumps shall be inspected after every major rainfall runoff event (over ½" depth of precipitation) or every 14 days, whichever occurs first. Silt shall be immediately removed from all sumps where the depth of accumulation exceeds 9 inches.
- All exposed construction areas shall be stabilized upon completion in order to minimize the time that these areas are unstabilized.

3.2 MATERIALS MANAGEMENT PRACTICES

The following are the material management practices that shall be used to reduce the risk of spills or other accidental exposure of materials and substances to stormwater runoff. The Contractor's Superintendent shall be responsible for ensuring that these procedures are followed:

1. *Good Housekeeping*

   The following good housekeeping practices shall be followed on-site during construction:

   a. An effort shall be made to store only enough products required to do the job.

   b. All materials stored on-site shall be stored in a neat, orderly manner and, if possible, under a roof or in a containment area. At a minimum, all containers shall be stored with their lids on when not in use. Drip pans shall be provided under all dispensers.

   c. Products shall be kept in their original containers with the original manufacturer's label in legible condition.

   d. Substances shall not be mixed with one another unless recommended by the manufacturer.

   e. Whenever possible, all of a product shall be used up before disposing the container.

   f. Manufacturer's recommendations for proper use and disposal shall be followed.

   g. The Contractor's Superintendent shall be responsible for daily inspections to ensure proper use and disposal of materials.

2. *Hazardous Substances*

These practices shall be used to reduce the risks associated with Hazardous Substances. Material Safety Data Sheets (MSDS's) for each product with hazardous properties that is used at the Project shall be obtained and used for the proper management of potential wastes that may result from these products. An MSDS shall be posted in the immediate area where such product is stored and/or used and another copy of each MSDS shall be maintained in the job trailer at the Project. Each employee who must handle a Hazardous Substance shall be instructed on the use of MSDS sheets and the specific information in the applicable MSDS for the product he/she is using, particularly regarding spill control techniques.

a. Products shall be kept in original containers with the original labels in legible condition.

b. Original labels and MSDS's shall be procured and used for each product.

c. If surplus product must be disposed, manufacturer's and local/state/federal required methods for proper disposal must be followed.

d. Speedy Dry shall be kept onsite in the event of a spill.

3. *Hazardous Waste*

It is imperative that all Hazardous Waste be properly identified and handled in accordance with all applicable Hazardous Waste Standards, including the storage, transport and disposal of the Hazardous Wastes. There are significant penalties for the improper handling of Hazardous Wastes. It is important that the Site Superintendent seeks appropriate assistance in making the determination of whether a substance or material is a Hazardous Waste. For example, Hazardous Waste may include certain Hazardous Substances, as well as pesticides, paints, paint solvents, cleaning solvents, pesticides, contaminated soils, and other materials, substances or chemicals that have been discarded (or are to be discarded) as being out-of-date, contaminated, or otherwise unusable, and can include the containers for those substances; other materials and substances can also be or become Hazardous Wastes, however. The Contractor's Superintendent is also responsible for ensuring that all site personnel are instructed as to these Hazardous Waste requirements and also that the requirements are being followed.

4. *Product Specific Practices*

The following product specific practices shall be followed on the job site:

<u>Petroleum Products</u>

All on-site vehicles shall be monitored for leaks and receive regular preventative maintenance to reduce the chance of leakage. Petroleum products shall be stored in tightly sealed containers which are clearly labeled. Petroleum storage tanks shall be located at minimum 100 linear feet from drainage ways, inlets and surface waters. Any petroleum storage tanks stored on-site shall be located within a containment area that is designed with an impervious surface between the tank and the ground. The secondary containment must be designed to provide a containment volume that is equal to 110% of the volume of the largest tank. Any mobile petroleum tank shall be parked in a

vehicular service area surrounded by a berm that provides a containment volume that is equal to 110% of the volume of the largest tank. Containment must provide sufficient volume to contain expected precipitation and 110% volume of the largest tank. Accumulated rainwater or spills from containment areas are to be promptly pumped into a containment device and disposed properly by a licensed Hazardous Waste transporter. Drip pans shall be provided for all dispensers. Any asphalt substances used on-site shall be applied according to the manufacturer's recommendations. The location of any fuel tanks and/or equipment storage areas must be identified on the Erosion Control Plan by the Contractor once the locations have been determined. Speedy Dry shall be kept onsite in the event of a spill.

Fertilizers

Fertilizers shall be applied only in the minimum amounts recommended by the manufacturer. Once applied, fertilizer shall be worked in the soil to limit exposure to stormwater. The contents of any partially used bags of fertilizer shall be transferred to a sealable plastic bin to avoid spills.

Cleaning Solvents

All containers shall be tightly sealed and stored when not in use. Excess solvents shall not be discharged to the storm sewer system, but shall be properly disposed of according to manufacturer's instructions or state and federal regulations. Speedy Dry shall be kept onsite in the event of a spill.

Concrete Wastes

Concrete trucks shall be allowed to wash out or discharge surplus concrete or drum wash water on the project site, but only in specifically designated diked and impervious washouts which have been prepared to prevent contact between the concrete wash and stormwater. Waste generated from concrete wash water shall not be allowed to flow into drainage ways, inlets, receiving waters or any location other than the designated concrete washout. Waste concrete may be poured into forms to make rip-rap or other useful concrete products. Concrete washouts shall be located at minimum 100 linear feet from drainage ways, inlets, surface waters and wetland resource areas.

The hardened residue from the concrete washout diked areas shall be disposed in the same manner as other non-hazardous construction waste materials or may be broken up and used on site as deemed appropriate by the Contractor. Maintenance of the washout is to include removal of hardened concrete. Facility shall not be filled beyond 95% capacity and shall be cleaned out once 75% full unless a new facility is constructed. The Contractor's Superintendent shall be responsible for seeing that these procedures are followed.Saw-cut Portland Cement Concrete (PCC) slurry shall not be allowed to enter storm drains or watercourses. Saw-cut residue should not be left on the surface of pavement or be allowed to flow over and off pavement. Residue from saw-cutting and grinding shall be collected by vacuum and disposed of in the concrete washout facility.

5. Solid and Construction Wastes

All waste materials shall be collected and disposed of at an appropriate solid waste disposal area.

6. Sanitary Wastes

A minimum of one portable sanitary unit shall be provided for every ten (10) workers on the site. All sanitary waste shall be collected from the portable units a minimum of one time per week by a licensed portable facility provider in complete compliance with local and state regulations.

All sanitary waste units shall be located in an area where the likelihood of the unit contributing to stormwater discharges is negligible. Additional containment BMPs must be implemented, such as gravel bags or specially designed plastic skid containers around the base, to prevent wastes from contributing to stormwater discharges.

7. Contaminated Soils

Any contaminated soils (resulting from spills of hazardous substances or oil or discovered during the course of construction) which may result from construction activities shall be contained and cleaned up immediately in accordance with the procedures given in the Material Management Plan and in accordance with applicable state and federal regulations. Contaminated soils not resulting from construction activities, or which pre-existed construction activities, but which are discovered by virtue of construction activities, should be reported in the same manner as spills, but with sufficient information to indicate that the discovery of an existing condition is being reported. If there is a release that occurs by virtue of the discovery of existing contamination, this should be reported as a spill, if it otherwise meets the requirements for a reportable spill.

SOURCE CONTROL AND LONG-TERM POLLUTION PREVENTION PLAN

Commercial Development, Map 39A Lots 87 & 87A Bridge Street in Fairhaven, MA

1.0 INTRODUCTION

The development of the above referenced facility has been designed to provide improved stormwater quality compared to existing conditions. In order for this to continue in the long term, it is necessary to implement the following Source Control and Pollution Prevention Plan.

2.0 RESPONSIBLE PARTY

Responsible Party: Carricorp Industries, Ltd.
275 Martine Street, Suite 110
Fall River, MA

3.0 SOURCE CONTROL MEASURES

The most effective means of providing clean runoff is to prevent pollutants from coming into contact with the stormwater in the first place. This involves the following:

1. Keeping de-icing agents, fertilizers, stockpiles, etc covered at all times. If practical, all such products shall be stored indoors or off-site.

2. All landscaping, fertilization and other grounds maintenance shall be done by professional groundkeepers who are trained at how to maintain the grounds.

3. Periodic parking lot sweeping program shall be implemented. This program shall include removal of windblown debris and litter from landscaped areas.

4. A supply of speedy dry type oil absorbent material shall be kept on-site to allow for the quick cleanup of minor spills.

4.0 SPILL PREVENTION AND RESPONSE PLAN

The Property Manager, shall train all personnel in the proper handling and cleanup of spilled Hazardous Substances or Oil. No spilled Hazardous Substances or Oil shall be allowed to come in contact with stormwater discharges. If such contact occurs, the stormwater discharge shall be contained on site until appropriate measures in compliance with state and federal regulations are taken to dispose such contaminated stormwater. It shall be the responsibility of the Property Manager to be properly trained, and to train all personnel in spill prevention and cleanup procedures.

In order to prevent or minimize the potential for a spill of hazardous substances or oil to come into contact with stormwater, the following steps shall be implemented:

a. All hazardous substances or oil (such as pesticides, petroleum products, fertilizers, detergents, chemicals, acids, paints, paint solvents, cleaning solvents, additives for soil stabilization, concrete curing compounds and additives, etc.) shall be stored in a secure

location, with their lids on, preferably under cover, when not in use.

b. The minimum practical quantity of all such materials shall be kept at the facility.

c. A spill control and containment kit (containing, for example, absorbent materials such as Speedy Dry, acid neutralizing powder, brooms, dust pans, mops, rags, gloves, plastic and metal trash containers, etc.) shall be provided at the site.

d. Manufacturer's recommended methods for spill cleanup shall be clearly posted and site maintenance personnel shall be trained regarding these procedures and the location of the information and cleanup supplies.

e. It is the Property Manager's responsibility to ensure that all hazardous waste discovered or generated at the Project site are disposed properly by a licensed hazardous material disposal company. The Property Manager is responsible for not exceeding hazardous waste storage requirements mandated by the EPA or state and local authority.

A spill contingency plan shall be implemented including the following provisions:

- Equipment necessary to quickly attend to inadvertent spills or shall be stored on-site in a secure but accessible location. Such equipment shall include:
  1. Safety goggles.
  2. Chemically resistant gloves and overshoe boots.
  3. Water and chemical fire extinguishers.
  4. Sand and shovels.
  5. Suitable absorbent materials.
  6. Storage containers.
  7. First aid equipment.

In the event of a spill of hazardous substances or oil, the following procedures must be followed:

a. All measures must be taken to contain and abate the spill and to prevent the discharge of the hazardous substance or oil to stormwater or off-site. (The spill area must be kept well ventilated and personnel must wear appropriate protective clothing to prevent injury from contact with the hazardous substances.)

b. For spills of less than five (5) gallons of material, proceed with source control and containment, clean-up with absorbent materials or other applicable means unless an imminent hazard or other circumstances dictate that the spill should be treated by a professional emergency response contractor.

c. For spills greater than five (5) gallons of material immediately contact a Massachusetts Licensed Site Professional L.S.P. Provide information on the type of material spilled, the

location of the spill, the quantity spilled, and the time of the spill and proceed with prevention, containment and/or clean-up if so desired.

d. Spills of amounts that exceed reportable quantities of certain substances specifically mentioned in federal regulations 40 CFR 110, 40 CFR 117, and 40 CFR 302 must be immediately reported to the EPA National Response Center, Telephone (800) 242-8802.

The Property Manager shall be the spill prevention and response coordinator. He shall designate the individuals who shall receive spill prevention and response training. These individuals shall each become responsible for a particular phase of prevention and response. The names of these personnel should be posted in the material storage area and in the property office.

5.0 SNOW AND ICE REMOVAL

Snow removal shall be primarily done by mechanical removal rather than chemical application. The judicious use of sand and salt without chemical additives is allowed in order to protect the safety of the public. Snow shall be primarily stored onsite within landscaped areas along the southern property line and at the front of the property.