DRAINAGE CALCULATIONS
&
SUPPLEMENTAL INFORMATION

21 OLD GLEN CHARLIE ROAD
E. WAREHAM, MA

February 7, 2022

Prepared for:

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21 OLD GLEN CHARLIE ROAD

E. WAREHAM, MA

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1. Project Description

Narrative

This project consists of the construction of 2 additional residential duplex structures (4 new units), driveway and parking areas, and associated utilities. The site has been developed to meet the Massachusetts Stormwater Standards to the maximum extent practicable and applicable Town of Wareham regulations pertaining to Stormwater Management.

Existing Conditions

The project site is known as 21 Old Glen Charlie Road and is shown as Lot 1101-C1 on Wareham Assessors Map 129. The lot consists of 81,354 square feet of land and is partially developed with a residential duplex structure, driveways, and gravel parking area. The western portion of the property slopes towards Old Glen Charlie Road, while the eastern portion of the property slopes to a wetland located at the base of a slope adjacent to Glen Charlie Road.

The property is abutted by residential properties to the north and south and is abutted by roadways to the west (Old Glen Charlie Road), north (Route 25), and east (Glen Charlie Road).

Proposed Conditions

The proposed project includes the construction of two new duplex structures with associated parking, grading, and utilities. A paved driveway will be provided with direct access off Old Glen Charlie Road. Grading has been designed to minimize significant cuts & fills across the site. Utilities will consist of connections to existing water, gas, and electric facilities located within Old Glen Charlie Road. The proposed structures will be serviced by private sewage disposal systems. Stormwater runoff will be directed to a subsurface drainage system. A majority of the proposed development will take place within previously altered areas, therefore limiting the amount of native vegetation to be removed.

Soil Description

Existing soil classifications and hydrologic soil groups for the site were obtained from the USDA Soil Conservation Service, Soil Survey of Plymouth County, Massachusetts & The Web Soil Survey. The soil types found within the limits of the drainage analysis are classified as the following:

1.) Carver Loamy Coarse Sand, 8 to 15 percent slopes (259C)

Carver Loamy Coarse Sand is considered excessively drained, exhibits a hydrological classification group “A”, and is the primary soil type over the project site.

2. Hydrologic Analysis & Stormwater Management

Methodology

Stormwater runoff was evaluated for the 2-year, 10-year, 25-year, and 100-year, Type III, 24-hour storm for both pre-development and post-development conditions. Pre-development and post-development conditions were modeled using HydroCAD software, which combines USDA Soil Conservation Service hydrology and hydraulic techniques (commonly known as SCS TR-55 and TR-20) to generate hydrographs (calculations are provided in the supplemental section of this report). The rainfall amounts used for calculating runoff for the 2-year, 10-year, 25-year and 100-year storm events were obtained from the NOAA Atlas 14 Volume 10 Frequency Estimates.

The drainage calculation provided at the end of this report identify on-site and off-site design points for both existing and proposed conditions. Under both existing and proposed conditions runoff is partially collected and infiltrated onsite, and directed offsite. **Table 1** compares the pre-development and post-development peak runoff rates and volumes for the 2-year, 10-year, 25-year, and 100-year storm events at two separate design points for the Type III, 24-hour storm events. The design points were evaluated to ensure post-development peak runoff rates and volumes do not exceed pre-development amounts.

Pre-Development Drainage Conditions

The site was modeled into two sub-catchment areas under existing conditions. Subcatchment Area 1S comprises the western portion of the site and contributes runoff to DP-1 which is a catch basin within Old Glen Charlie Road. Subcatchment Area 2S comprises the eastern portion of the site and contributes runoff to DP-2 which is a wetland pocket adjacent to the State Highway Layout of Glen Charlie Road.

Refer to the Existing Drainage Areas Plan prepared by this office at the end of this report.

Post-Development Drainage Conditions

Post-development drainage conditions and patterns were maintained to the maximum extent possible. Subcatchment Area 1S comprises the western portion of the site and contributes runoff to DP-1 which is a catch basin within Old Glen Charlie Road. Subcatchment Area 2S comprises the eastern portion of the site and contributes runoff to DP-2 which is a wetland pocket adjacent to the State Highway Layout of Glen Charlie Road. Subcatchment Area 3S contributes to onsite subsurface drainage system located beneath the driveway surface and is directly recharged.

Refer to the Proposed Drainage Areas Plan prepared by this office at the end of this report.

Table 1 compares below the pre-development and post-development peak runoff rates and volumes for the 2-year, 10-year, 25-year, and 100-year storm events at the offsite design points.

	Ex. Flow (cfs)	Prop. Flow (cfs)	Ex. Vol. (af)	Prop. Vol. (cf)
DP-1				
2-Yr Event	0.29	0.14	0.031	0.017
10-Yr Event	1.03	0.54	0.082	0.045
25-Yr Event	1.59	1.09	0.120	0.078
100-Yr Event	2.54	1.47	0.186	0.114
DP-2				
2-Yr Event	0.00	0.00	.003	.000
10-Yr Event	0.11	0.03	.026	0.014
25-Yr Event	0.30	0.15	.051	0.031
100-Yr Event	0.95	0.51	.100	0.068

Table 1 – Comparison of Off-site Stormwater Flows and Volumes

Map Scale: 1:809 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 10 20 40 60

Feet
0 35 70 140 210

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

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: Plymouth County, Massachusetts
Survey Area Data: Version 14, Sep 2, 2021

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

Date(s) aerial images were photographed: Dec 31, 2009—Nov 17, 2018

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
256B	Deerfield loamy fine sand, 3 to 8 percent slopes	0.1	2.5%
259C	Carver loamy coarse sand, 8 to 15 percent slopes	3.2	97.0%
656B	Udorthents - Urban land complex, 0 to 8 percent slopes	0.0	0.5%
Totals for Area of Interest		**3.3**	**100.0%**

Map Scale: 1:809 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 10 20 40 60

Feet: 0 35 70 140 210

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

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Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
256B	Deerfield loamy fine sand, 3 to 8 percent slopes	A	0.1	2.5%
259C	Carver loamy coarse sand, 8 to 15 percent slopes	A	3.2	97.0%
656B	Udorthents - Urban land complex, 0 to 8 percent slopes	B	0.0	0.5%
Totals for Area of Interest			**3.3**	**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

NOAA Atlas 14, Volume 10, Version 3
Location name: East Wareham, Massachusetts, USA*
Latitude: 41.7642°, Longitude: -70.6734°
Elevation: 36.47 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.294 (0.239-0.358)	0.364 (0.296-0.444)	0.479 (0.387-0.585)	0.574 (0.462-0.703)	0.705 (0.552-0.893)	0.803 (0.618-1.03)	0.907 (0.682-1.20)	1.03 (0.730-1.37)	1.21 (0.829-1.64)	1.36 (0.913-1.87)
10-min	0.417 (0.338-0.507)	0.516 (0.419-0.628)	0.678 (0.548-0.827)	0.813 (0.655-0.996)	0.999 (0.782-1.26)	1.14 (0.875-1.46)	1.29 (0.966-1.70)	1.46 (1.03-1.94)	1.71 (1.17-2.33)	1.93 (1.29-2.65)
15-min	0.490 (0.398-0.597)	0.607 (0.493-0.739)	0.798 (0.646-0.974)	0.957 (0.770-1.17)	1.18 (0.920-1.49)	1.34 (1.03-1.72)	1.51 (1.14-2.00)	1.72 (1.22-2.28)	2.02 (1.38-2.74)	2.27 (1.52-3.12)
30-min	0.707 (0.575-0.861)	0.874 (0.710-1.07)	1.15 (0.927-1.40)	1.37 (1.11-1.68)	1.69 (1.32-2.13)	1.92 (1.48-2.47)	2.17 (1.63-2.87)	2.46 (1.74-3.26)	2.89 (1.98-3.92)	3.25 (2.18-4.47)
60-min	0.925 (0.751-1.13)	1.14 (0.927-1.39)	1.50 (1.21-1.83)	1.79 (1.44-2.19)	2.20 (1.72-2.78)	2.50 (1.92-3.21)	2.82 (2.12-3.73)	3.20 (2.27-4.25)	3.76 (2.58-5.11)	4.23 (2.84-5.82)
2-hr	1.25 (1.02-1.51)	1.55 (1.26-1.87)	2.04 (1.66-2.47)	2.44 (1.98-2.97)	3.00 (2.37-3.78)	3.42 (2.65-4.37)	3.87 (2.94-5.10)	4.40 (3.15-5.80)	5.22 (3.60-7.03)	5.91 (4.00-8.06)
3-hr	1.47 (1.21-1.77)	1.82 (1.49-2.19)	2.38 (1.95-2.88)	2.86 (2.32-3.46)	3.51 (2.78-4.40)	3.99 (3.11-5.09)	4.51 (3.44-5.92)	5.14 (3.69-6.74)	6.09 (4.22-8.17)	6.90 (4.69-9.37)
6-hr	1.91 (1.58-2.29)	2.33 (1.92-2.79)	3.02 (2.48-3.62)	3.58 (2.93-4.31)	4.37 (3.48-5.43)	4.95 (3.88-6.24)	5.57 (4.27-7.24)	6.31 (4.57-8.21)	7.42 (5.19-9.86)	8.35 (5.72-11.3)
12-hr	2.42 (2.01-2.88)	2.89 (2.40-3.44)	3.66 (3.03-4.36)	4.29 (3.54-5.13)	5.17 (4.14-6.36)	5.83 (4.59-7.27)	6.52 (5.01-8.34)	7.31 (5.34-9.43)	8.45 (5.96-11.1)	9.38 (6.48-12.5)
24-hr	2.91 (2.44-3.43)	3.44 (2.88-4.07)	4.32 (3.60-5.11)	5.04 (4.18-5.99)	6.04 (4.87-7.37)	6.79 (5.38-8.39)	7.58 (5.85-9.59)	8.44 (6.22-10.8)	9.67 (6.88-12.6)	10.7 (7.42-14.1)
2-day	3.35 (2.82-3.92)	3.98 (3.35-4.66)	5.01 (4.20-5.88)	5.86 (4.90-6.91)	7.04 (5.72-8.52)	7.93 (6.32-9.72)	8.85 (6.88-11.1)	9.88 (7.33-12.5)	11.3 (8.13-14.7)	12.5 (8.79-16.4)
3-day	3.67 (3.11-4.29)	4.34 (3.67-5.07)	5.43 (4.58-6.35)	6.33 (5.31-7.43)	7.57 (6.18-9.13)	8.52 (6.82-10.4)	9.49 (7.41-11.9)	10.6 (7.88-13.3)	12.1 (8.70-15.6)	13.3 (9.38-17.4)
4-day	3.97 (3.37-4.62)	4.65 (3.94-5.41)	5.76 (4.87-6.73)	6.69 (5.63-7.83)	7.96 (6.51-9.56)	8.93 (7.16-10.8)	9.92 (7.76-12.3)	11.0 (8.24-13.8)	12.5 (9.05-16.1)	13.7 (9.72-17.9)
7-day	4.74 (4.04-5.48)	5.45 (4.64-6.31)	6.60 (5.61-7.66)	7.57 (6.40-8.81)	8.89 (7.30-10.6)	9.90 (7.98-11.9)	10.9 (8.57-13.4)	12.0 (9.05-15.0)	13.5 (9.81-17.2)	14.6 (10.4-18.9)
10-day	5.45 (4.67-6.28)	6.18 (5.29-7.13)	7.38 (6.30-8.53)	8.38 (7.11-9.71)	9.74 (8.03-11.5)	10.8 (8.73-12.9)	11.9 (9.30-14.5)	12.9 (9.79-16.1)	14.3 (10.5-18.2)	15.4 (11.0-19.8)
20-day	7.55 (6.51-8.65)	8.37 (7.21-9.59)	9.71 (8.34-11.1)	10.8 (9.25-12.5)	12.4 (10.2-14.5)	13.6 (11.0-16.0)	14.7 (11.6-17.7)	15.8 (12.1-19.5)	17.2 (12.7-21.7)	18.2 (13.1-23.2)
30-day	9.32 (8.07-10.6)	10.2 (8.83-11.7)	11.7 (10.1-13.4)	12.9 (11.1-14.8)	14.6 (12.1-17.0)	15.9 (13.0-18.7)	17.1 (13.5-20.5)	18.3 (14.1-22.4)	19.7 (14.6-24.7)	20.7 (15.0-26.2)
45-day	11.5 (10.0-13.1)	12.5 (10.9-14.2)	14.2 (12.3-16.1)	15.5 (13.4-17.7)	17.4 (14.5-20.1)	18.8 (15.4-22.0)	20.2 (16.0-24.0)	21.4 (16.5-26.2)	22.9 (17.1-28.5)	23.8 (17.4-30.0)
60-day	13.4 (11.7-15.2)	14.5 (12.6-16.4)	16.3 (14.1-18.5)	17.7 (15.3-20.2)	19.7 (16.5-22.8)	21.3 (17.5-24.9)	22.8 (18.1-26.9)	24.1 (18.7-29.3)	25.5 (19.2-31.7)	26.4 (19.4-33.3)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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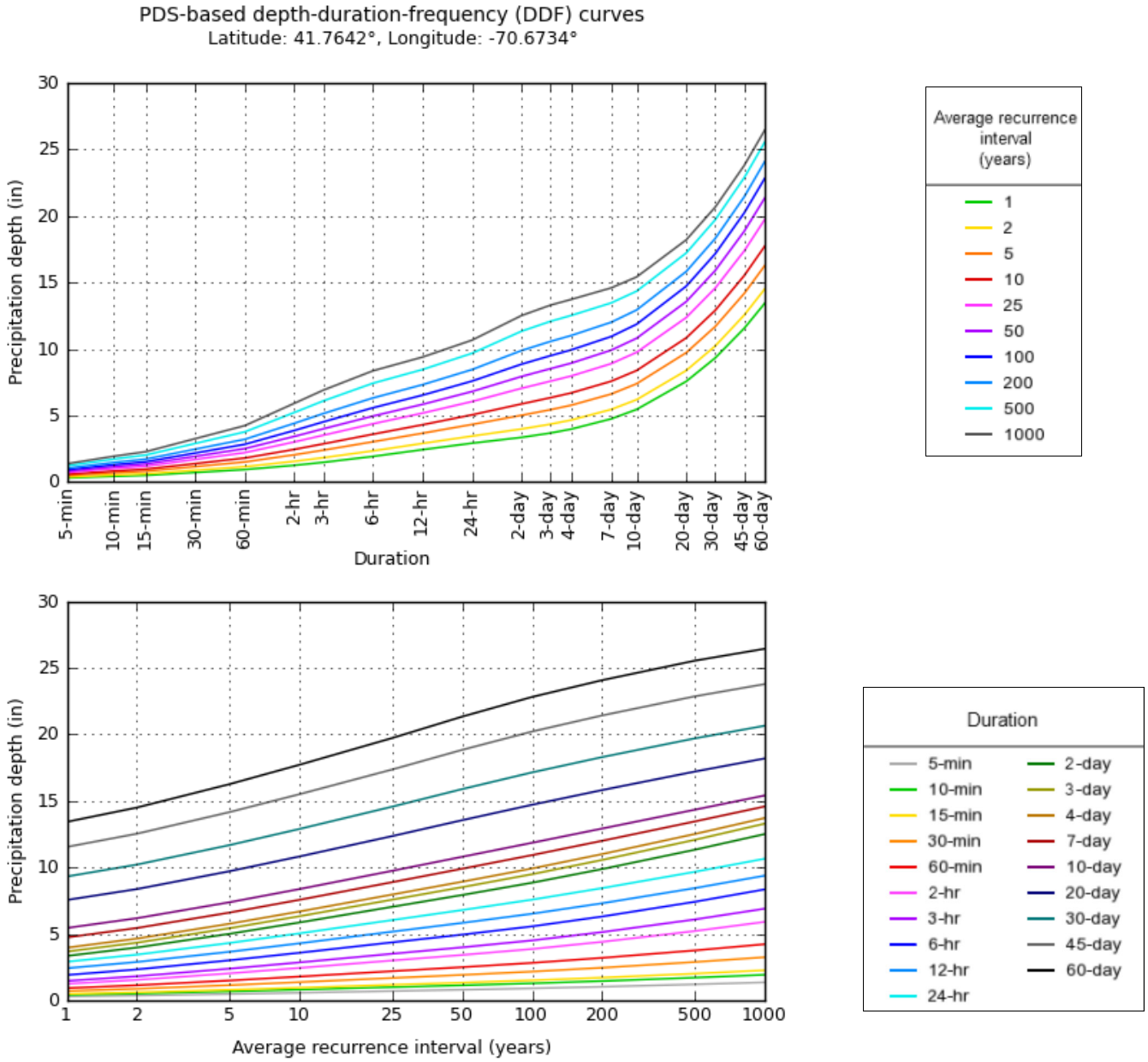
PF graphical



NOAA Atlas 14, Volume 10, Version 3 Created (GMT): Tue Dec 14 20:16:35 2021

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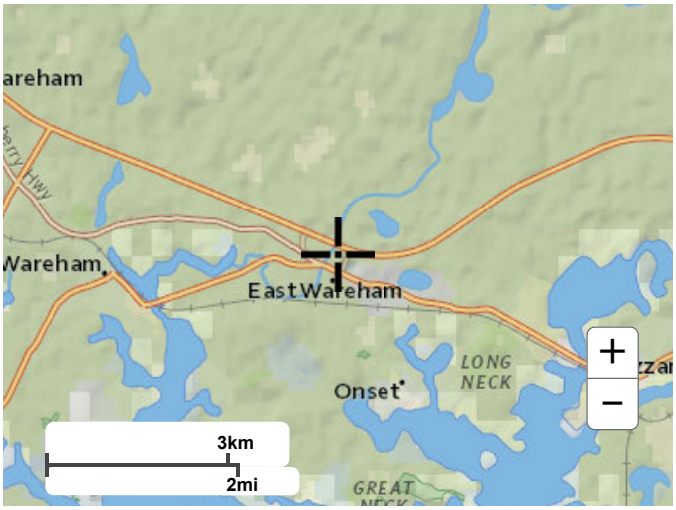
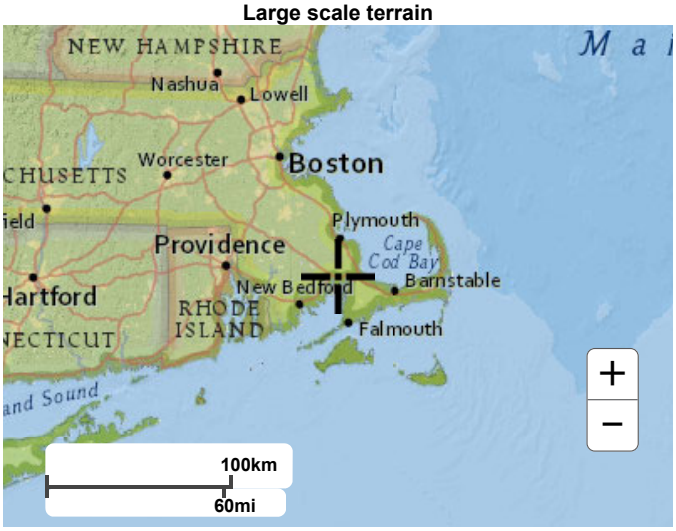
Maps & aerials

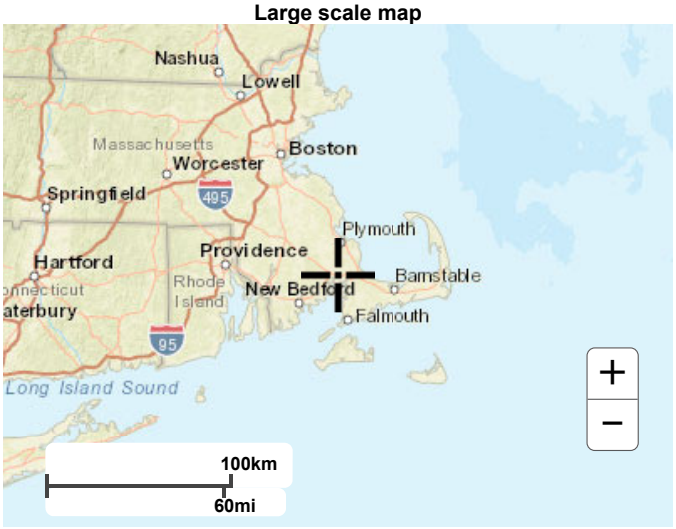
Small scale terrain



Large scale terrain



Large scale map



Large scale aerial

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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

GROUNDWATER RECHARGE VOLUME CALCULATIONS

21 OLD GLEN CHARLIE ROAD

E. WAREHAM, MASSACHUSETTS

Total Proposed Impervious Area

- New Impervious Area = 13,096 s.f.

Recharge Factor

Hydrologic Group A Soils = 0.60 inches of runoff

Groundwater Recharge Volume Required

13,096 s.f. x (0.60 inches x 1/12) = **655** c.f. required

Groundwater Recharge Volume Provided in Leaching Pits

- The storage volume is **1,115** c.f. within leaching pits and void space in stone (refer to HydroCAD output of "Pond 3P" in drainage report)

Conclusion: Total recharge volume of **1,115** c.f. provided is greater than the required recharge volume of **655** c.f.; therefore **OK**.

WATER QUALITY VOLUME CALCULATIONS
21 OLD GLEN CHARLIE ROAD
E. WAREHAM, MASSACHUSETTS

Total Proposed Impervious Area

- Impervious Area (I) = 13,096 s.f.

Water Quality Volume (WQV) Required to be Treated (1" of runoff)

- WQV = 1.0" x I (s.f.)
- WQV = 1.0"/(12 in/ft) x 13,096 s.f. = **1,048 c.f.** required

Water Quality Volume Provided

Total recharge volume of **1,115** c.f. provided from proposed leaching basins and void space in stone (see Groundwater Recharge Volume Calculations – previous pages)

Conclusion: Proposed water quality volume of **1,115** c.f. provided is greater than **1,048** c.f. required; therefore OK.

INFILTRATION DRAIN-DOWN TIME CALCULATIONS

21 OLD GLEN CHARLIE ROAD

E. WAREHAM, MASSACHUSETTS

Pond 3P:

Maximum Drain Time = 72 hours

Provided Drain Time = Storage Volume / (K x Basin Bottom Area)

= 1,115 c.f. / [(8.27 in/hr) (1ft/12 inches) x 405 s.f.]

= **4.0 hours**, which is less than max. drain time of 72 hours, therefore OK.

TSS REMOVAL CALCULATIONS

INSTRUCTIONS:

Version 1, Automated: Mar. 4, 2008

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Location: 21 Old Glen Charlie Road

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
Infiltration Basin	**0.80**	**0.75**	**0.60**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**

Total TSS Removal = **85%**

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project:

Prepared By: **JC Engineering**

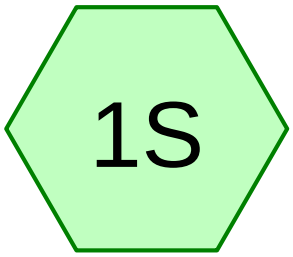
Date: **2/7/2022**

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

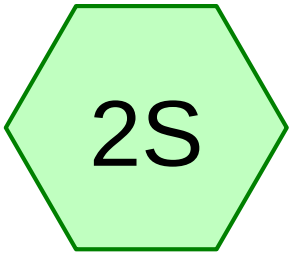
Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed

1. From MassDEP Stormwater Handbook Vol. 1

EXISTING CONDITIONS DRAINAGE CALCULATIONS



To Street



To Wetlands

Subcat Reach Pond Link

Routing Diagram for Existing Conditions
Prepared by JC Engineering, Inc., Printed 2/7/2022

Summary for Subcatchment 1S: To Street

Runoff = 0.29 cfs @ 12.12 hrs, Volume= 0.031 af, Depth> 0.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.44"

Area (sf)	CN	Description
3,516	76	Gravel roads, HSG A
2,771	49	50-75% Grass cover, Fair, HSG A
7,447	30	Woods, Good, HSG A
1,887	98	Roofs, HSG A
16,592	68	<50% Grass cover, Poor, HSG A
32,213	60	Weighted Average
30,326		94.14% Pervious Area
1,887		5.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	50	0.0400	0.23		**Sheet Flow,** Range n= 0.130 P2= 3.40"
0.5	36	0.0140	1.18		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
0.8	44	0.0170	0.91		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	42	0.0670	4.17		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.2	77	0.1300	5.80		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.3	31	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
5.7	280	Total			

Summary for Subcatchment 2S: To Wetlands

Runoff = 0.00 cfs @ 16.77 hrs, Volume= 0.003 af, Depth> 0.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.44"

Area (sf)	CN	Description
28,318	30	Woods, Good, HSG A
13,873	68	<50% Grass cover, Poor, HSG A
42,191	42	Weighted Average
42,191		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0200	0.17		**Sheet Flow,** Range n= 0.130 P2= 3.40"
0.3	52	0.1100	3.32		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
0.0	21	0.5700	7.55		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
1.7	111	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
6.9	234	Total			

Summary for Subcatchment 1S: To Street

Runoff = 1.03 cfs @ 12.10 hrs, Volume= 0.082 af, Depth> 1.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=5.04"

Area (sf)	CN	Description
3,516	76	Gravel roads, HSG A
2,771	49	50-75% Grass cover, Fair, HSG A
7,447	30	Woods, Good, HSG A
1,887	98	Roofs, HSG A
16,592	68	<50% Grass cover, Poor, HSG A
32,213	60	Weighted Average
30,326		94.14% Pervious Area
1,887		5.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	50	0.0400	0.23		**Sheet Flow,** Range n= 0.130 P2= 3.40"
0.5	36	0.0140	1.18		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
0.8	44	0.0170	0.91		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	42	0.0670	4.17		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.2	77	0.1300	5.80		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.3	31	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
5.7	280	Total			

Summary for Subcatchment 2S: To Wetlands

Runoff = 0.11 cfs @ 12.39 hrs, Volume= 0.026 af, Depth> 0.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=5.04"

Area (sf)	CN	Description
28,318	30	Woods, Good, HSG A
13,873	68	<50% Grass cover, Poor, HSG A
42,191	42	Weighted Average
42,191		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0200	0.17		**Sheet Flow,** Range n= 0.130 P2= 3.40"
0.3	52	0.1100	3.32		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
0.0	21	0.5700	7.55		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
1.7	111	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
6.9	234	Total			

Summary for Subcatchment 1S: To Street

Runoff = 1.59 cfs @ 12.10 hrs, Volume= 0.120 af, Depth> 1.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-year Rainfall=6.04"

Area (sf)	CN	Description
3,516	76	Gravel roads, HSG A
2,771	49	50-75% Grass cover, Fair, HSG A
7,447	30	Woods, Good, HSG A
1,887	98	Roofs, HSG A
16,592	68	<50% Grass cover, Poor, HSG A
32,213	60	Weighted Average
30,326		94.14% Pervious Area
1,887		5.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	50	0.0400	0.23		**Sheet Flow,** Range n= 0.130 P2= 3.40"
0.5	36	0.0140	1.18		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
0.8	44	0.0170	0.91		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	42	0.0670	4.17		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.2	77	0.1300	5.80		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.3	31	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
5.7	280	Total			

Summary for Subcatchment 2S: To Wetlands

Runoff = 0.30 cfs @ 12.21 hrs, Volume= 0.051 af, Depth> 0.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-year Rainfall=6.04"

Area (sf)	CN	Description
28,318	30	Woods, Good, HSG A
13,873	68	<50% Grass cover, Poor, HSG A
42,191	42	Weighted Average
42,191		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0200	0.17		**Sheet Flow,** Range n= 0.130 P2= 3.40"
0.3	52	0.1100	3.32		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
0.0	21	0.5700	7.55		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
1.7	111	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
6.9	234	Total			

Summary for Subcatchment 1S: To Street

Runoff = 2.54 cfs @ 12.09 hrs, Volume= 0.186 af, Depth> 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=7.58"

Area (sf)	CN	Description
3,516	76	Gravel roads, HSG A
2,771	49	50-75% Grass cover, Fair, HSG A
7,447	30	Woods, Good, HSG A
1,887	98	Roofs, HSG A
16,592	68	<50% Grass cover, Poor, HSG A
32,213	60	Weighted Average
30,326		94.14% Pervious Area
1,887		5.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.7	50	0.0400	0.23		**Sheet Flow,** Range n= 0.130 P2= 3.40"
0.5	36	0.0140	1.18		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
0.8	44	0.0170	0.91		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	42	0.0670	4.17		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.2	77	0.1300	5.80		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.3	31	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
5.7	280	Total			

Summary for Subcatchment 2S: To Wetlands

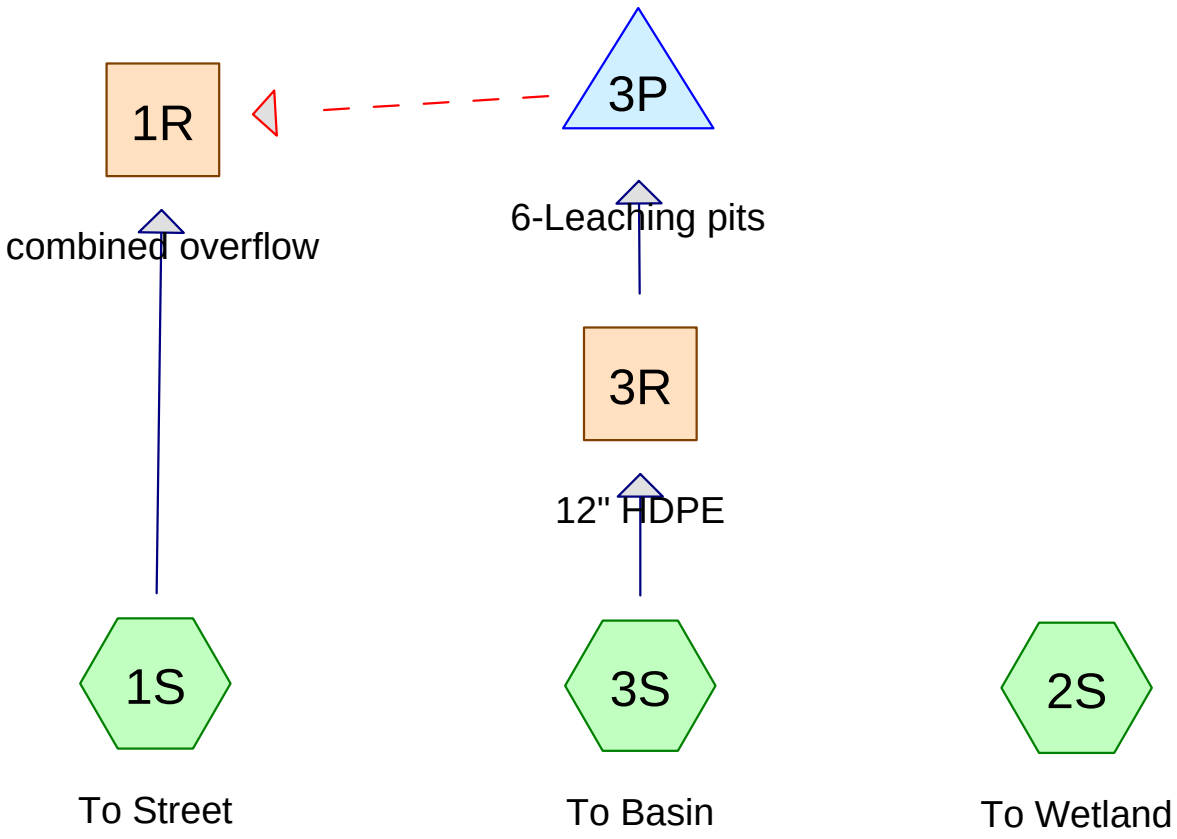
Runoff = 0.95 cfs @ 12.13 hrs, Volume= 0.100 af, Depth> 1.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=7.58"

Area (sf)	CN	Description
28,318	30	Woods, Good, HSG A
13,873	68	<50% Grass cover, Poor, HSG A
42,191	42	Weighted Average
42,191		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0200	0.17		**Sheet Flow,** Range n= 0.130 P2= 3.40"
0.3	52	0.1100	3.32		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
0.0	21	0.5700	7.55		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
1.7	111	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
6.9	234	Total			

PROPOSED CONDITIONS DRAINAGE CALCULATIONS



Subcat Reach Pond Link

Routing Diagram for Proposed Conditions
Prepared by JC Engineering, Inc., Printed 2/7/2022

Summary for Subcatchment 1S: To Street

Runoff = 0.14 cfs @ 12.14 hrs, Volume= 0.017 af, Depth> 0.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.44"

Area (sf)	CN	Description
582	76	Gravel roads, HSG A
2,496	49	50-75% Grass cover, Fair, HSG A
6,620	30	Woods, Good, HSG A
1,887	98	Roofs, HSG A
4,797	68	<50% Grass cover, Poor, HSG A
2,305	98	Paved parking, HSG A
18,687	59	Weighted Average
14,495		77.57% Pervious Area
4,192		22.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	50	0.1200	0.14		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
0.2	34	0.2900	2.69		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.4	44	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.4	128	Total			

Summary for Subcatchment 2S: To Wetland

Runoff = 0.00 cfs @ 23.08 hrs, Volume= 0.000 af, Depth> 0.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.44"

	Area (sf)	CN	Description
	6,822	49	50-75% Grass cover, Fair, HSG A
	25,563	30	Woods, Good, HSG A
*	67	67	Bulkheads, HSG A
	2,160	68	<50% Grass cover, Poor, HSG A
	1,352	98	Roofs, HSG A
	35,964	39	Weighted Average
	34,612		96.24% Pervious Area
	1,352		3.76% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	46	0.0110	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.40"
0.1	21	0.0570	2.39		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
1.7	111	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
8.3	178	Total			

Summary for Subcatchment 3S: To Basin

Runoff = 0.38 cfs @ 12.12 hrs, Volume= 0.033 af, Depth> 0.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.44"

	Area (sf)	CN	Description
*	6,200	98	Driveway
	12,200	49	50-75% Grass cover, Fair, HSG A
	1,352	98	Roofs, HSG A
	19,752	68	Weighted Average
	12,200		61.77% Pervious Area
	7,552		38.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2	50	0.0230	0.16		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.40"
1.9	85	0.0110	0.73		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
0.1	23	0.0400	4.06		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.2	60	0.0900	6.09		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
7.4	218	Total			

Summary for Reach 1R: combined overflow

Inflow Area = 0.429 ac, 22.43% Impervious, Inflow Depth > 0.47" for 2-year event
Inflow = 0.14 cfs @ 12.14 hrs, Volume= 0.017 af
Outflow = 0.14 cfs @ 12.14 hrs, Volume= 0.017 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs

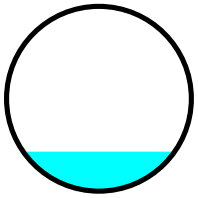
Summary for Reach 3R: 12" HDPE

Inflow Area = 0.453 ac, 38.23% Impervious, Inflow Depth > 0.87" for 2-year event
Inflow = 0.38 cfs @ 12.12 hrs, Volume= 0.033 af
Outflow = 0.38 cfs @ 12.12 hrs, Volume= 0.033 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.11 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 1.32 fps, Avg. Travel Time= 0.1 min

Peak Storage= 1 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.21'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 3.86 cfs

12.0" Round Pipe
n= 0.012 Corrugated PP, smooth interior
Length= 8.0' Slope= 0.0100 '/'
Inlet Invert= 27.50', Outlet Invert= 27.42'



Summary for Pond 3P: 6-Leaching pits

Inflow Area = 0.453 ac, 38.23% Impervious, Inflow Depth > 0.87" for 2-year event
Inflow = 0.38 cfs @ 12.12 hrs, Volume= 0.033 af
Outflow = 0.10 cfs @ 12.59 hrs, Volume= 0.033 af, Atten= 74%, Lag= 28.0 min
Discarded = 0.10 cfs @ 12.59 hrs, Volume= 0.033 af
Secondary = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 26.64' @ 12.59 hrs Surf.Area= 405 sf Storage= 313 cf

Plug-Flow detention time= 20.5 min calculated for 0.033 af (100% of inflow)
Center-of-Mass det. time= 20.3 min (898.0 - 877.7)

Volume	Invert	Avail.Storage	Storage Description
#1	25.00'	545 cf	**Custom Stage Data (Conic)**Listed below (Recalc) 2,042 cf Overall - 679 cf Embedded = 1,363 cf x 40.0% Voids
#2	26.00'	570 cf	**5.50'D x 4.00'H Vertical Cone/Cylinder** x 6 Inside #1 679 cf Overall - 3.0" Wall Thickness = 570 cf
		1,115 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
25.00	405	0	0	405
30.00	405	2,025	2,025	762
30.10	4	15	2,040	1,163
30.50	4	2	2,042	1,166

Device	Routing	Invert	Outlet Devices
#1	Discarded	25.00'	**8.270 in/hr Exfiltration over Wetted area**
#2	Secondary	30.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.10 cfs @ 12.59 hrs HW=26.64' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.10 cfs)

Secondary OutFlow Max=0.00 cfs @ 1.00 hrs HW=25.00' (Free Discharge)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Summary for Subcatchment 1S: To Street

Runoff = 0.54 cfs @ 12.11 hrs, Volume= 0.045 af, Depth> 1.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=5.04"

Area (sf)	CN	Description
582	76	Gravel roads, HSG A
2,496	49	50-75% Grass cover, Fair, HSG A
6,620	30	Woods, Good, HSG A
1,887	98	Roofs, HSG A
4,797	68	<50% Grass cover, Poor, HSG A
2,305	98	Paved parking, HSG A
18,687	59	Weighted Average
14,495		77.57% Pervious Area
4,192		22.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	50	0.1200	0.14		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
0.2	34	0.2900	2.69		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.4	44	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.4	128	Total			

Summary for Subcatchment 2S: To Wetland

Runoff = 0.03 cfs @ 12.51 hrs, Volume= 0.014 af, Depth> 0.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=5.04"

	Area (sf)	CN	Description
	6,822	49	50-75% Grass cover, Fair, HSG A
	25,563	30	Woods, Good, HSG A
*	67	67	Bulkheads, HSG A
	2,160	68	<50% Grass cover, Poor, HSG A
	1,352	98	Roofs, HSG A
	35,964	39	Weighted Average
	34,612		96.24% Pervious Area
	1,352		3.76% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	46	0.0110	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.40"
0.1	21	0.0570	2.39		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
1.7	111	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
8.3	178	Total			

Summary for Subcatchment 3S: To Basin

Runoff = 0.93 cfs @ 12.11 hrs, Volume= 0.072 af, Depth> 1.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=5.04"

	Area (sf)	CN	Description
*	6,200	98	Driveway
	12,200	49	50-75% Grass cover, Fair, HSG A
	1,352	98	Roofs, HSG A
	19,752	68	Weighted Average
	12,200		61.77% Pervious Area
	7,552		38.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2	50	0.0230	0.16		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.40"
1.9	85	0.0110	0.73		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
0.1	23	0.0400	4.06		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.2	60	0.0900	6.09		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
7.4	218	Total			

Summary for Reach 1R: combined overflow

Inflow Area = 0.429 ac, 22.43% Impervious, Inflow Depth > 1.26" for 10-year event
Inflow = 0.54 cfs @ 12.11 hrs, Volume= 0.045 af
Outflow = 0.54 cfs @ 12.11 hrs, Volume= 0.045 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs

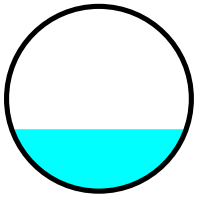
Summary for Reach 3R: 12" HDPE

Inflow Area = 0.453 ac, 38.23% Impervious, Inflow Depth > 1.91" for 10-year event
Inflow = 0.93 cfs @ 12.11 hrs, Volume= 0.072 af
Outflow = 0.93 cfs @ 12.11 hrs, Volume= 0.072 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.03 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 1.58 fps, Avg. Travel Time= 0.1 min

Peak Storage= 2 cf @ 12.11 hrs
Average Depth at Peak Storage= 0.33'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 3.86 cfs

12.0" Round Pipe
n= 0.012 Corrugated PP, smooth interior
Length= 8.0' Slope= 0.0100 '/'
Inlet Invert= 27.50', Outlet Invert= 27.42'



Summary for Pond 3P: 6-Leaching pits

Inflow Area = 0.453 ac, 38.23% Impervious, Inflow Depth > 1.91" for 10-year event
Inflow = 0.93 cfs @ 12.11 hrs, Volume= 0.072 af
Outflow = 0.14 cfs @ 12.79 hrs, Volume= 0.072 af, Atten= 85%, Lag= 40.4 min
Discarded = 0.14 cfs @ 12.79 hrs, Volume= 0.072 af
Secondary = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 29.73' @ 12.79 hrs Surf.Area= 405 sf Storage= 1,046 cf

Plug-Flow detention time= 68.8 min calculated for 0.072 af (100% of inflow)
Center-of-Mass det. time= 68.5 min (921.4 - 852.9)

Volume	Invert	Avail.Storage	Storage Description
#1	25.00'	545 cf	**Custom Stage Data (Conic)**Listed below (Recalc) 2,042 cf Overall - 679 cf Embedded = 1,363 cf x 40.0% Voids
#2	26.00'	570 cf	**5.50'D x 4.00'H Vertical Cone/Cylinder** x 6 Inside #1 679 cf Overall - 3.0" Wall Thickness = 570 cf
		1,115 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
25.00	405	0	0	405
30.00	405	2,025	2,025	762
30.10	4	15	2,040	1,163
30.50	4	2	2,042	1,166

Device	Routing	Invert	Outlet Devices
#1	Discarded	25.00'	**8.270 in/hr Exfiltration over Wetted area**
#2	Secondary	30.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.14 cfs @ 12.79 hrs HW=29.73' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.14 cfs)

Secondary OutFlow Max=0.00 cfs @ 1.00 hrs HW=25.00' (Free Discharge)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Summary for Subcatchment 1S: To Street

Runoff = 0.86 cfs @ 12.11 hrs, Volume= 0.067 af, Depth> 1.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-year Rainfall=6.04"

Area (sf)	CN	Description
582	76	Gravel roads, HSG A
2,496	49	50-75% Grass cover, Fair, HSG A
6,620	30	Woods, Good, HSG A
1,887	98	Roofs, HSG A
4,797	68	<50% Grass cover, Poor, HSG A
2,305	98	Paved parking, HSG A
18,687	59	Weighted Average
14,495		77.57% Pervious Area
4,192		22.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	50	0.1200	0.14		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
0.2	34	0.2900	2.69		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.4	44	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.4	128	Total			

Summary for Subcatchment 2S: To Wetland

Runoff = 0.15 cfs @ 12.38 hrs, Volume= 0.031 af, Depth> 0.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-year Rainfall=6.04"

	Area (sf)	CN	Description
	6,822	49	50-75% Grass cover, Fair, HSG A
	25,563	30	Woods, Good, HSG A
*	67	67	Bulkheads, HSG A
	2,160	68	<50% Grass cover, Poor, HSG A
	1,352	98	Roofs, HSG A
	35,964	39	Weighted Average
	34,612		96.24% Pervious Area
	1,352		3.76% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	46	0.0110	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.40"
0.1	21	0.0570	2.39		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
1.7	111	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
8.3	178	Total			

Summary for Subcatchment 3S: To Basin

Runoff = 1.31 cfs @ 12.11 hrs, Volume= 0.100 af, Depth> 2.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-year Rainfall=6.04"

	Area (sf)	CN	Description
*	6,200	98	Driveway
	12,200	49	50-75% Grass cover, Fair, HSG A
	1,352	98	Roofs, HSG A
	19,752	68	Weighted Average
	12,200		61.77% Pervious Area
	7,552		38.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2	50	0.0230	0.16		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.40"
1.9	85	0.0110	0.73		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
0.1	23	0.0400	4.06		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.2	60	0.0900	6.09		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
7.4	218	Total			

Summary for Reach 1R: combined overflow

Inflow Area = 0.429 ac, 22.43% Impervious, Inflow Depth > 2.18" for 25-year event
Inflow = 1.09 cfs @ 12.26 hrs, Volume= 0.078 af
Outflow = 1.09 cfs @ 12.26 hrs, Volume= 0.078 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs

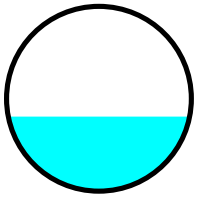
Summary for Reach 3R: 12" HDPE

Inflow Area = 0.453 ac, 38.23% Impervious, Inflow Depth > 2.65" for 25-year event
Inflow = 1.31 cfs @ 12.11 hrs, Volume= 0.100 af
Outflow = 1.31 cfs @ 12.11 hrs, Volume= 0.100 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.43 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 1.70 fps, Avg. Travel Time= 0.1 min

Peak Storage= 2 cf @ 12.11 hrs
Average Depth at Peak Storage= 0.40'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 3.86 cfs

12.0" Round Pipe
n= 0.012 Corrugated PP, smooth interior
Length= 8.0' Slope= 0.0100 '/'
Inlet Invert= 27.50', Outlet Invert= 27.42'



Summary for Pond 3P: 6-Leaching pits

Inflow Area = 0.453 ac, 38.23% Impervious, Inflow Depth > 2.65" for 25-year event
Inflow = 1.31 cfs @ 12.11 hrs, Volume= 0.100 af
Outflow = 0.83 cfs @ 12.27 hrs, Volume= 0.101 af, Atten= 37%, Lag= 9.3 min
Discarded = 0.22 cfs @ 12.27 hrs, Volume= 0.089 af
Secondary = 0.61 cfs @ 12.27 hrs, Volume= 0.011 af

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 30.08' @ 12.25 hrs Surf.Area= 39 sf Storage= 1,115 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 64.7 min (907.8 - 843.2)

Volume	Invert	Avail.Storage	Storage Description
#1	25.00'	545 cf	**Custom Stage Data (Conic)**Listed below (Recalc) 2,042 cf Overall - 679 cf Embedded = 1,363 cf x 40.0% Voids
#2	26.00'	570 cf	**5.50'D x 4.00'H Vertical Cone/Cylinder** x 6 Inside #1 679 cf Overall - 3.0" Wall Thickness = 570 cf
		1,115 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
25.00	405	0	0	405
30.00	405	2,025	2,025	762
30.10	4	15	2,040	1,163
30.50	4	2	2,042	1,166

Device	Routing	Invert	Outlet Devices
#1	Discarded	25.00'	**8.270 in/hr Exfiltration over Wetted area**
#2	Secondary	30.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.21 cfs @ 12.27 hrs HW=30.07' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.21 cfs)

Secondary OutFlow Max=0.52 cfs @ 12.27 hrs HW=30.07' (Free Discharge)
└**2=Orifice/Grate** (Weir Controls 0.52 cfs @ 0.89 fps)

Summary for Subcatchment 1S: To Street

Runoff = 1.39 cfs @ 12.10 hrs, Volume= 0.104 af, Depth> 2.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=7.58"

Area (sf)	CN	Description
582	76	Gravel roads, HSG A
2,496	49	50-75% Grass cover, Fair, HSG A
6,620	30	Woods, Good, HSG A
1,887	98	Roofs, HSG A
4,797	68	<50% Grass cover, Poor, HSG A
2,305	98	Paved parking, HSG A
18,687	59	Weighted Average
14,495		77.57% Pervious Area
4,192		22.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	50	0.1200	0.14		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
0.2	34	0.2900	2.69		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.4	44	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.4	128	Total			

Summary for Subcatchment 2S: To Wetland

Runoff = 0.51 cfs @ 12.17 hrs, Volume= 0.068 af, Depth> 0.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=7.58"

	Area (sf)	CN	Description
	6,822	49	50-75% Grass cover, Fair, HSG A
	25,563	30	Woods, Good, HSG A
*	67	67	Bulkheads, HSG A
	2,160	68	<50% Grass cover, Poor, HSG A
	1,352	98	Roofs, HSG A
	35,964	39	Weighted Average
	34,612		96.24% Pervious Area
	1,352		3.76% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	46	0.0110	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.40"
0.1	21	0.0570	2.39		**Shallow Concentrated Flow,** Nearly Bare & Untilled Kv= 10.0 fps
1.7	111	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
8.3	178	Total			

Summary for Subcatchment 3S: To Basin

Runoff = 1.94 cfs @ 12.11 hrs, Volume= 0.147 af, Depth> 3.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=7.58"

	Area (sf)	CN	Description
*	6,200	98	Driveway
	12,200	49	50-75% Grass cover, Fair, HSG A
	1,352	98	Roofs, HSG A
	19,752	68	Weighted Average
	12,200		61.77% Pervious Area
	7,552		38.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2	50	0.0230	0.16		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.40"
1.9	85	0.0110	0.73		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
0.1	23	0.0400	4.06		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.2	60	0.0900	6.09		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
7.4	218	Total			

Summary for Reach 1R: combined overflow

Inflow Area = 0.429 ac, 22.43% Impervious, Inflow Depth > 3.19" for 100-year event
Inflow = 1.47 cfs @ 12.11 hrs, Volume= 0.114 af
Outflow = 1.47 cfs @ 12.11 hrs, Volume= 0.114 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs

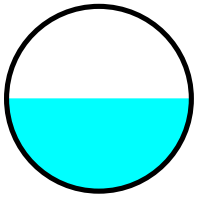
Summary for Reach 3R: 12" HDPE

Inflow Area = 0.453 ac, 38.23% Impervious, Inflow Depth > 3.88" for 100-year event
Inflow = 1.94 cfs @ 12.11 hrs, Volume= 0.147 af
Outflow = 1.94 cfs @ 12.11 hrs, Volume= 0.147 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.91 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 1.86 fps, Avg. Travel Time= 0.1 min

Peak Storage= 3 cf @ 12.11 hrs
Average Depth at Peak Storage= 0.50'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 3.86 cfs

12.0" Round Pipe
n= 0.012 Corrugated PP, smooth interior
Length= 8.0' Slope= 0.0100 '/'
Inlet Invert= 27.50', Outlet Invert= 27.42'



Summary for Pond 3P: 6-Leaching pits

Inflow Area = 0.453 ac, 38.23% Impervious, Inflow Depth > 3.88" for 100-year event
Inflow = 1.94 cfs @ 12.11 hrs, Volume= 0.147 af
Outflow = 0.39 cfs @ 12.51 hrs, Volume= 0.118 af, Atten= 80%, Lag= 24.0 min
Discarded = 0.18 cfs @ 12.51 hrs, Volume= 0.108 af
Secondary = 0.20 cfs @ 12.51 hrs, Volume= 0.010 af

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 30.03' @ 12.51 hrs Surf.Area= 197 sf Storage= 1,113 cf

Plug-Flow detention time= 170.4 min calculated for 0.118 af (81% of inflow)
Center-of-Mass det. time= 94.2 min (926.3 - 832.1)

Volume	Invert	Avail.Storage	Storage Description
#1	25.00'	545 cf	**Custom Stage Data (Conic)**Listed below (Recalc) 2,042 cf Overall - 679 cf Embedded = 1,363 cf x 40.0% Voids
#2	26.00'	570 cf	**5.50'D x 4.00'H Vertical Cone/Cylinder** x 6 Inside #1 679 cf Overall - 3.0" Wall Thickness = 570 cf
		1,115 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
25.00	405	0	0	405
30.00	405	2,025	2,025	762
30.10	4	15	2,040	1,163
30.50	4	2	2,042	1,166

Device	Routing	Invert	Outlet Devices
#1	Discarded	25.00'	**8.270 in/hr Exfiltration over Wetted area**
#2	Secondary	30.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.19 cfs @ 12.51 hrs HW=30.03' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.19 cfs)

Secondary OutFlow Max=0.16 cfs @ 12.51 hrs HW=30.03' (Free Discharge)
└**2=Orifice/Grate** (Weir Controls 0.16 cfs @ 0.60 fps)

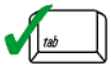
DEP STORMWATER MANAGEMENT FORMS

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.

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.

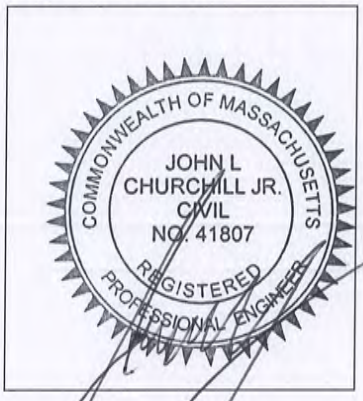
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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



2/7/22

Signature and Date

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.

STORMWATER OPERATIONS AND MAINTENANCE PLAN

Stormwater Operations and Maintenance Plan

DATE: February 7, 2022

Responsible Party:
R.J. Motto, Inc.
P.O. Box 150
Buzzards Bay, MA 02532

Project Address:
21 Old Glen Charlie Road
E. Wareham, MA 02538

Engineering By:
JC Engineering, Inc.
2854 Cranberry Highway
East Wareham, MA 02538

The project site will be owned and maintained by the owner of the property. The owner will be responsible for the required inspections and maintenance of the drainage system.

Illicit Discharges
All Illicit discharges to the stormwater management system are prohibited.

Deep Sump Catch Basin
The Deep sump catch basin shall be inspected by the owner/operator on a quarterly basis or after a major storm event. Catch basins sumps will be cleaned annually during the early spring or when the sediment rises to within half the available sump height of the catch basin, whichever comes first.

Infiltration Structures
Once the system is operational, inspections of the leaching structures should occur after every major storm event for the first few months. After the system is in operation, inspections should be every six months. Special attention should be directed towards the depth of sediment in the leaching structures. There should be no accumulation of sediment within the leaching structures. Silt and debris are to be removed using vacuum pumping techniques as required.

Pre-Construction Requirements

Prior to the start of any construction on the site the following procedures are to be implemented.

- Hay bale dikes and silt fence are to be installed down gradient of all earthwork proposed in that particular phase of work. Hay bales and silt fence are to be installed at the limit of work and/or adjacent to the wetland resource areas and/or natural areas to be protected as shown on the plans.

- All major trees designated to be saved are to be flagged in the field and fenced off as necessary to prevent damage during construction.

- A temporary settling pool is to be constructed on the up gradient side of silt fences and hay bale dikes at the limit of work such that stormwater runoff is channeled to the temporary settling pool and filtered through the hay bales prior to leaving the site.

- Safety barriers, warnings and fences to be installed along Old Glen Charlie Road as necessary to protect the general public prior to the start of the work adjacent to the roadway.

- A temporary construction entrance is to be constructed at the access point to the site. The entrance is to be stabilized in such a manner as to prevent the tracking of soil onto the public way.

- A dust monitoring plan will be established prior to the start of construction.

- Weekly training sessions will be conducted for all site contractors at the job.

- A person responsible for daily inspection of all erosion control methodologies and action plan for corrections/repairs when needed will be established.

Construction Period Pollution Prevention

- The contractor must install erosion control measures as shown on the plans and details prior to starting any other work on the site construction. Erosion control must be installed at every inlet structure and inlet swale and maintained for the duration of the project. Silt fence and/or haybales as shown on plans shall be inspected, repaired and/or maintained by the contractor weekly and within 12 hours of each storm event.

- Water and/or covers to minimize dust and erosion from newly graded areas and stock piles of earth will be implemented during construction as needed or when conditions are anticipated to be greater than 20 m.p.h. Application rate of water shall be sufficient to moisten soil so as to not create runoff and/or ponding. No surfactants shall be used.

- A regular street sweeping schedule of hard surfaces will be established prior to construction and will be continued until the completion of the full site development.

- A person will be assigned to monitor the perimeter erosion control methodologies on a daily basis.

- Owner or its representative shall perform weekly review/training sessions.

- Construction of a temporary settling area is to be utilized as a method of controlling concentrated flows from areas that are under construction.

- Temporary settling areas are to be constructed on an as needed basis and located throughout the construction phase as required by earthwork activities.

- At the beginning of earthwork operations on the site a mechanical on-site sweeper is to be maintained such that the public way can be kept clean during the construction phase.

- As elements of the drainage system are installed, silt fences and “silt sacs” are to be installed around all catch basins and under grates until the tributary area to that basin is completely stabilized.

- As general earthwork is completed the exterior perimeters of the areas that have been completed are to be stabilized using erosion control grass.

- Stabilize slopes steeper than 3:1 (horizontal to vertical) with seed, secured geotextile fabric, or rock rip-rap as required to prevent erosion during construction.

- Sediment shall be contained within the construction site and shall be removed when they reach a depth of 6 inches.

- Clean out catch basins, drain manholes and storm drain pipes after completion of construction.

- No stormwater shall be allowed to enter the structures until all catchbasins, drain manholes and stormdrain pipes have been cleaned, the binder course is installed and all disturbed areas are stabilized.

- If the binder course is in place for more than 3 months without a wearing course, the contractor shall set the rim elevation of the drainage structures level with the binder course. The rim elevations shall be reset just prior to placing the wearing course.

- The contractor is responsible for all stormwater best management practices being in place to contain stormwater in the event that drainage structures are not at pavement grade during a storm event, and all cleanup in the event that such measures fail during said storm event.

- Temporary surfaces should be stabilized with as soon as active grading is suspended. Temporary measures include seeding with grass, jute netting, or straw mulch. Permanent stabilization should be established early in the fall to allow good cover before cold weather comes.

- A construction entrance in accordance with construction details shall be installed at the site entrance to prevent sediments from being tracked offsite.

- It is the responsibility of the contractor to maintain and supplement the specified sedimentation controls as necessary to prevent sedimentation of off-site areas and/or any regulated resource areas. Failure by the contractor to control erosion, pollution and/or siltation shall be cause for the owner to employ outside assistance or to use his own forces to provide the necessary corrective measures, the cost of such assistance plus project engineering costs will be the contractor's responsibility. If the owner shall fail their responsibility of this Plan, the Town has the right to enter upon property after 15 days notice to take corrective actions and bill the Owner for their Services.

- Haybales and Silt Fence shall be installed at the following locations: Toe of slope of embankment construction, Toe of temporary earthwork stockpiles. All locations as indicated on the Plans.

- A log of regular inspections and maintenance is to be maintained by the construction superintendent.

- When all areas tributary to any catch basin on the site are stabilized with permanent plantings and paving, that catch basin is to be cleaned of all

sediment and debris that has accumulated during construction and the "silt sacs" removed.

- During construction of the project, the Owner and/or its representative, is to be the responsible party for enforcing the installation and maintenance of all erosion control devices. A permanent file is to be established for recording daily inspections, problems and maintenance of the erosion control devices. A 24 hour emergency hotline is to be established with the number posted on a sign at the construction entrance to the project and on the construction trailer indicating who can be contacted in case of an emergency on the site.

Long-Term Operation and Maintenance Program

- At the end of construction on the project, Owner shall be provided with a certified as built plan of all utilities constructed on the site.

- All Catch basins shall be inspected by the owner/operator on a quarterly basis or after a major storm event. Catch basins sumps will be cleaned annually during the early spring or when the sediment rises to within half the available sump height of the catch basin, whichever comes first.

- Once the system is operational, inspections of the Infiltration Structures should occur after every major storm event for the first few months. After the system is in operation, inspections should be every six months. Special attention should be directed towards the depth of sediment in the Leaching Pits. Sediment removal from the Leaching Pits accomplished as needed by means of a labor crew. Sediment shall be removed off-site and disposed of in a legal manner. Inspections should also include checking for potential problems that include, but are not limited to, any forms of erosion, tree growth in the leaching area, and sediment accumulation, etc. Trash and debris accumulated within any portion of the Infiltration Structures should be removed at this time. Silt and debris is to be removed using vacuum pumping techniques as required.

- The Owner, is to be responsible for the maintenance of the project after construction has been completed. The owner is to provide the Planning Department, Conservation Commission and Building Department with a contact name and telephone number for purposes of communication between the owner and the Town Boards and Commissions. At each time that the contact person changes, the above Boards and Commission are to be notified of the new contact information.

- The Owner shall hire a Stormwater Professional to inspect the system quarterly as required.

- This Operations and Maintenance plan is to be incorporated into all necessary documents with the stormwater operations and maintenance plan to ensure that a long-term maintenance program is adhered to by the developer and all future property owners.

- Waste shall be properly stored in sealed containers if stored outside. The preferred method is to store waste either indoors or in a structure with a locking cover to prevent entrance from animals. The containers shall be covered to prevent rainfall from leaching through the household waste.

- Vehicle washing shall be performed with non-detergent cleaners. The preferred method is to clean a vehicle is at a vehicle washing facility.

- Yard maintenance equipment, including lawn mowers and chainsaws shall be stored in a covered area. Periodic maintenance shall be performed on all equipment to ensure that no gas or oil leak into the ground.

- Yard waste shall be disposed in an approved off-site disposal facility or stored on-site in a composting pile.

- If applicable, septic systems shall be properly maintained and inspected in accordance with the State Environmental Code, Title 5. A failing septic systems shall be repaired immediately to prevent effluent from discharging into the storm drains. Never discharge gasoline, oils or chemicals into septic systems.

- Gasoline and oils shall be stored in sealed containers and in a covered, secure, and level area to prevent accidental spills. All gasoline, oil, and chemical spills shall be reported to the Wareham Fire Department and Regional DEP office.

- Lawn fertilizers and pesticides shall be in sealed containers within a covered area and remain dry. Slow release lawn fertilizers shall be used to limit the amount of fertilizer entering the groundwater. Limit the application of fertilizers to lawn area only. Sweep up any spills on impervious material to prevent runoff into the storm drains.

- Pet waste shall be properly disposed of to prevent bacteria from washing into storm drains. Small amounts of waste can be buried or sealed in a plastic bag and thrown into the trash. The preferred method is to flush the waste down the toilet.

- Snow de-icing chemicals shall be stored in a sealed container and a covered area.

- Snow shall be removed from all parking surfaces and fire truck clearance areas to provide adequate access for all safety vehicles. Snow shall be removed from all catch basin grates to avoid flooding during snow melt.

- All sand and loam piles stored on-site shall be properly stabilized or covered to prevent sediment from entering the storm drains. All piles shall be contained in a level, upland area and surrounded by a silt fence and/or haybales.

- All structural and non-structural stormwater management facilities shall be maintained to ensure proper working condition during construction and shall be fully maintained in accordance with this plan. The owner shall be responsible for maintaining the site's storm water management system in compliance with Federal, state, and local requirements and in accordance with best management practices. In the event that the Town determines that the owner has materially failed in its obligation to maintain the drainage system in accordance with best management practices and the Stormwater Operation and Maintenance Plan, the Town shall have the right, upon written notice to the Owner, and Owner's failure to remedy the maintenance issue within fifteen (15) days' notice thereof, to enter upon the site to perform the required maintenance. All costs incurred by the Town in connection with its performance of such required maintenance on the site shall be reimbursed by the Owner to the Town within thirty (30) days of the Owner's receipt of the Town's invoice for such costs.

REFERENCES

HydroCAD. Stormwater Analysis Software, Heastead Methods, Inc. 1998.

Massachusetts Department of Environmental Protection & Massachusetts Office of Coastal Zone Management. March 1997. *Stormwater Management Handboo*k. Volume 1 & 2.

U.S. Soil Conservation Service 1969. *Soil Survey of Plymouth County, Massachusetts.*

U.S. Soil Conservation Service. June 1986. *Urban Hydrology for Small Watersheds (Technical Release 55)*

DRAINAGE AREA PLANS

NAD 83

MAP 129
LOT 1108
N/F
COMM OF MA

MAP 129
LOT 1101-B
N/F CHERYLE
SHUBERT

#23

EX.
SHED

EDGE OF PAVEMENT

EDGE OF PAVEMENT

EDGE OF PAVEMENT

DP 1

EX. GRAVEL DRIVEWAY

EX. GRAVEL DRIVEWAY

1

#21A
EXISTING
UNIT

#21B
EXISTING
UNIT

EX.
DECK

EX.
DECK

EXISTING
SEPTIC TANKS

EXISTING SOIL
ABSORPTION
SYSTEM

EX. SHED

2

SB (FND)

MHB
(FND)

WF 1

WF 2

WF 3

WF 4

WF 5

WF 6

DP 2

WF 7

WF 8

WF 9

WF 10

MAP 129
LOT 1101-C1
81,354 S.F.
(75,596 S.F.
UPLANDS)

FLOW PATH

FLOW PATH

MAP 129
LOT 1101-C2
N/F MATTHEW &
SARAH BRIDGES

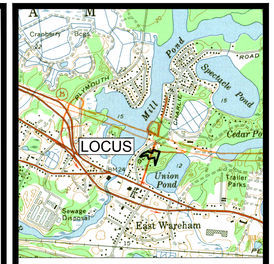
#19

MAP 129
LOT 1101-A
N/F DANIEL
LIZARRALDE

GRAPHIC SCALE

20 0 10 20 40 80

(IN FEET)
1 inch = 20 ft.



LOCUS MAP
SCALE 1" = 2000'

PROPOSED SITE PLAN
AT
21 OLD GLEN CHARLIE ROAD
IN
EAST WAREHAM
MASSACHUSETTS
(PLYMOUTH COUNTY)

EXISTING DRAINAGE AREAS

REVISIONS:

No.	DATE	DESC.
1	2/2/22	NO CHANGE THIS SHEET

PREPARED FOR:

R.J. MOTTO, INC.
P.O. BOX 150
BUZZARDS BAY, MA 02532

ENGINEERING BY:

JC ENGINEERING, INC.
2854 CRANBERRY HIGHWAY
EAST WAREHAM, MA 02538
508-273-0377

DATE: DECEMBER 22, 2021
FIELD: BM/JF
CALC./DESIGN: BMB
DRAWN: BMB
CHECK: JLC
JOB NO: 4872

SHEET 1 OF 1

NAD 83

DP 1

EDGE OF PAVEMENT

EDGE OF PAVEMENT

EDGE OF PAVEMENT

1

FLOW PATH

3

FLOW PATH

2

FLOW PATH

DP 2

VEGETATED WETLAND DELINEATED BY SABATIA, INC. ON 12/13/19

#21A EXISTING UNIT

#21B EXISTING UNIT

EX. DECK

EX. DECK

EX. SHED

#23

#19

MAP 129
LOT 1101-B
N/F CHERYLE SHUBERT

MAP 129
LOT 1108
N/F
COMM OF MA

MAP 129
LOT 1101-C2
N/F MATTHEW & SARAH BRIDGES

MAP 129
LOT 1101-A
N/F DANIEL LIZARRALDE

SB (FND)

MHB (FND)

WF 1

WF 2

WF 3

WF 4

WF 5

WF 6

WF 7

WF 8

WF 9

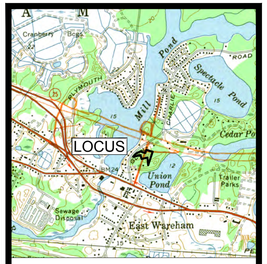
WF 10

33.0'

GRAPHIC SCALE

20 0 10 20 40 80

(IN FEET)
1 inch = 20 ft.



LOCUS MAP
SCALE 1" = 2000'

PROPOSED SITE PLAN

AT

21 OLD GLEN CHARLIE ROAD

IN

EAST WAREHAM
MASSACHUSETTS
(PLYMOUTH COUNTY)

PROPOSED DRAINAGE AREAS

REVISIONS:

No.	DATE	DESC.
1	2/2/22	ZONING COMMENTS

PREPARED FOR:

R.J. MOTTO, INC.
P.O. BOX 150
BUZZARDS BAY, MA 02532

ENGINEERING BY:

JC ENGINEERING, INC.
2854 CRANBERRY HIGHWAY
EAST WAREHAM, MA 02538
508-273-0377

DATE: DECEMBER 22, 2021

FIELD: BM/JF

CALC./DESIGN: BMB

DRAWN: BMB

CHECK: JLC

JOB NO: 4872

SHEET 1 OF 1