Stormwater Management Report
Ascend Cannabis Dispensary

115 Coggeshall Street
New Bedford, Massachusetts

PREPARED FOR:

Ascend Mass, LLC
500 Totten Pond Road
Cambridge, MA

January 8, 2021

1/11/2021

FUSS & O'NEILL

108 Myrtle Street
Quincy, MA 02171

Project No. 20191061.T10

FUSS & O'NEILL

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1 Executive Summary

Ascend Mass, LLC proposes to construct a Cannabis Retail Establishment at 115 Coggeshall Street in New Bedford, Massachusetts. The property is currently developed and occupied by a building and its related site improvements. The site is bounded by commercial properties to the north, east and west, and Coggeshall Street to the south. The project location is depicted on the Site Location Map attached as *Figure 1* in this report.

The project includes the redevelopment of the existing building along with the parking lot, driveway, sidewalks, stormwater infrastructure, utilities, and landscaping. The overall drainage pattern of the site will be unchanged by the project.

The proposed stormwater management system design is consistent with the guidelines of Massachusetts Stormwater Handbook and the Wetlands Protection Act Regulations (310 CMR 10.00.). Stormwater best management practices (BMPs) have been implemented to promote groundwater recharge and to treat the water quality volume. The existing and proposed site conditions and proposed stormwater management system are described in detail in *Section 2* of this report.

The design drawings include controls to protect receiving stormwater systems and properties adjacent to the development from erosion and sedimentation impacts caused by construction site runoff. The plan incorporates both non-structural and structural controls, such as inspections, waste management, good housekeeping and maintenance, perimeter sediment barriers, dust suppression, and a construction entrance. The existing and proposed drainage systems will be protected with catch basin inlet protection devices and compost filter socks. Additional information related to erosion and sediment controls is included in *Section* 5. In order to ensure the long-term success of the stormwater management system, post-construction operation and maintenance practices will be required in accordance with the Long-Term Operation and Maintenance Plan that has been developed for the site.

2 Project Description

2.1 Existing Conditions

The project is located north of Coggeshall Street on a parcel identified by the City of New Bedford Tax Assessor as Property 086 0010, which is approximately 0.22 acres. Mixed Used Business properties are located to the north, west, and east of the property. The parcel is developed and contains a building, walkways, and a parking area located north of the building. There are no stormwater BMPs located on the property.

There are no wetlands on or within 100' of the site. The site is not within a NHESP Priority Habitat of Rare Species, Estimated Habitat of Rare Wildlife, or Area of Critical Environmental Concern (ACEC).

Federal Emergency Management Agency (FEMA) mapping shows that the site lies primarily in Zone X, an area with reduced flood risk due to levee, and partially within Zone AE, an area with a flood elevation of 6 feet. FEMA Flood Insurance Rate Map (FIRM) (Panel Number 25005C0391G, Effective Date: July 16, 2014 and Panel Number 25005C0393G, Effective Date: July 16, 2014) is included as *Figure 2*.

The site is characterized by Natural Resources Conservation Service (NRCS) as Urban Land (602). Urban Land is defined by excavated and filled land and has no assigned hydrologic soil group (HSG). A geotechnical investigation was performed by McArdle Gannon Associates, Inc. to evaluate subsurface conditions of the site. Two soil borings were performed on September 28, 2020 as part of the investigation to determine subsurface soil types, depth of groundwater, and depth to refusal. Included in the Geotechnical Engineering Report were three particle size distribution reports for the site soils. Utilizing the USDA Textural Triangle and geotechnical data collected, the site soils can be classified as sand, loamy sand, and sandy loam. For the hydrological analysis, a conservative classification of loamy sand with a HSG of "A" was used. Groundwater was found between 5-5.5 feet below existing grade, at an elevation of approximately 1.5-2 feet. The NRCS soils report and Geotechnical Engineering Report are included in *Appendix A*.

2.2 Proposed Conditions

The project includes the redevelopment of the existing building along with the associated parking lot, sidewalks, stormwater infrastructure, utilities, and landscaping. As a result of the redevelopment, a net decrease of approximately 730 square feet of impervious area is proposed for the site. The Massachusetts Stormwater Handbook (Handbook) defines this project as redevelopment because it is located at a previously developed site and has a net reduction in impervious area.

The Stormwater Management system is comprised of a subsurface infiltration system and a storm sewer system which includes catch basins with deep sumps. The subsurface infiltration system is located within the parking lot to the north of the building. The system provides water quality treatment and groundwater recharge for the parking lot, roof, and northern driveway. Runoff from this area flows to one of two deep-sump catch basins and directed into the subsurface system isolator rows. An outlet control structure immediately downstream of the system will manage the discharge from the system. The bottom of the infiltration system is at an elevation of 3.5 feet, or approximately 1.5-2 feet above

groundwater. Test pits will be scheduled to confirm seasonal high groundwater. The subsurface infiltration system is currently proposed with the maximum separation to groundwater achievable based on site constraints. If tests pits indicate that the minimum 2 foot separation to groundwater cannot be achieved, the system will be revised accordingly.

The site consists of soils with a rapid infiltration rate (greater than 2.4 inches per hour). As a result, 44% of Total Suspended Solids (TSS) must be removed prior to infiltration. Pre-treatment is achieved through 25% removal in the deep-sump catch basins, consistent with the Handbook, and 25% through the subsurface infiltration system isolator rows. The isolator rows were designed to have an equivalent capacity of a sediment forebay, which is designed to hold 0.1-inch/impervious acre to achieve 25% pre-treatment.

3 Bordering Land Subject to Flooding

A small portion of the site is located within Zone AE, an area with a base flood elevation of six feet (See *Figure 2).*

Work within the floodplain will be limited to the reconstruction of existing sidewalk, driveway, and utilities. A reduction of impervious area within the floodplain is proposed. Existing grades within the floodplain will be closely maintained.

3.1 BLSF Performance Standards

The proposed redevelopment of the site follows the criteria in 310 CMR 10.58 (4)(a), General Performance Standards for Bordering Land Subject to Flooding. The site conforms to each of the following:

1. **Compensatory storage shall be provided.**

   Existing grades within the floodplain will be closely maintained. As a result, there will be no proposed fill and compensatory storage is not provided.

2. **Work shall not restrict flows so as to cause an increase in flood stage or velocity**

   Existing flow patterns will remain and not be affected by this redevelopment of the site. Existing grades within the floodplain will be closely maintained resulting in no increase in flood stage or velocity.

3. **Work in those portions of the bordering land subject to flooding found to be significant to the protection of wildlife habitat shall not impair its capacity to provide important wildlife habitat functions.**

   Proposed work for the site is located within previously developed areas. It is not anticipated the project will have an effect on wildlife habitat within the limits of the project or within areas surrounding the project.

4 Hydrologic and Hydraulic Analysis

The hydrologic analyses for existing and proposed conditions were completed using a computer software package, HydroCAD version 10.00-21, to determine peak runoff flow rates and total runoff volumes for the watershed models. The model is based on the NRCS Technical Release 20 and Technical Release 55 (TR-55), and is subject to cumulative rainfall/volume dependent routing calculations. Hydrographs are prepared for each element of the watershed and routed through the dynamic-storage-indication method to produce various time-based results.

Two design points were developed for the project. Design Point 1 (denoted as Link 10L in the hydrologic analyses) is the stormwater management system in Coggeshall Street. Design Point 2 (denoted as Link 20L) is the plaza parking lot to the north of the site.

The pre-development hydrologic analysis is included as *Appendix B*, and the post-development hydrologic analysis is in *Appendix C*.

4.1 Existing Watershed Summary

Stormwater runoff from the site is conveyed via sheet flow and shallow concentrated flow toward the two design points. Coggesshall Street to the south and the commercial properties to the north, east, and west have been established as the limits of analysis. Two subcatchments have been established for the project's pre-development conditions, as described below.

- **Subcatchment 10S** consists of the majority of the property, which includes the existing building and associated parking, driveways, sidewalks and surrounding vegetated area. Stormwater runoff from this subcatchment flows to the south to the gutter in Coggeshall Street before discharging to a catch basin at the intersection of Coggeshall Street and Veterans Memorial Highway. This catch basin is connected to the box culvert in Coggeshall Street (Design Point 10L).

- **Subcatchment 20S** consists of a small area at the northern portion of the site that includes a grassed area and concrete dumpster pad. Stormwater runoff from this subcatchment flows to the north towards a catch basin in the plaza parking lot (Design Point 20L).

The Pre-Development Watershed Map is included as *Figure 3*.

4.2 Proposed Watershed Summary

As a result of the proposed development, overall drainage patterns mimic existing conditions. The boundary of the post-development analysis is the same as the pre-development conditions. As a result of the proposed grading, subcatchment 20S has been removed and accommodated in Subcatchment 10S-A. The post-development subcatchments are described below.

- **Subcatchment 10S-A** consists of the building, parking, retail entrance driveway, sidwalks, and surrounding vegetated area. Stormwater runoff from this subcatchment flows into one of two catch basins in the parking lot and directed to the subsurface infiltration system 10P. The subsurface infiltration system discharges outlet controlled stormwater to the box culvert in Coggeshall Street (Design Point 10L).

- **Subcatchment 10S-B** consists of a sidewalk, delivery entrance driveway and turn around area, and surrounding vegetated area. Stormwater runoff from the driveway, turn around area, and portion of the sidewalk and vegetated area flows to the south to the gutter in Coggeshall Street before discharging to a catch basin at the intersection of Coggeshall Street and Veterans Memorial Highway. This catch basin is connected to the box culvert in Coggeshall Street (Design Point 10L). The remaining sidewalk and vegetated area flows to a yard drain which discharges to the box culvert in Coggeshall Street (Design Point 10L).

The Post-Development Subcatchment Map is included as *Figure 4*.

4.3 Hydrologic Analysis Results

The proposed BMPs and net reduction in impervious area effectively reduce the site's peak runoff rates compared to existing conditions during the 2-, 10-, 25-, and 100-year, 24 hour Type III storm events analyzed. The pre- and post-development peak flow rates for the two design points are included in the below tables.

2 Year Design Storm				
Design Point	Existing Flow (CFS)	Proposed Flow (CFS)	Net Change (CFS)	Net Change (%)
10L - Coggeshall	0.72	0.15	-0.57	-79%
20L - Off-Site Parking	0.07	0.00	-0.07	-100%
Total	0.79	0.15	-0.64	-81%

10 Year Design Storm				
Design Point	Existing Flow (CFS)	Proposed Flow (CFS)	Net Change (CFS)	Net Change (%)
10L - Coggeshall	1.23	1.05	-0.18	-15%
20L - Off-Site Parking	0.11	0.00	-0.11	-100%
Total	1.34	1.05	-0.29	-22%

25 Year Design Storm				
Design Point	Existing Flow (CFS)	Proposed Flow (CFS)	Net Change (CFS)	Net Change (%)
10L - Coggeshall	1.61	1.52	-0.09	-6%
20L - Off-Site Parking	0.14	0.00	-0.14	-100%
Total	1.75	1.52	-0.23	-13%

100 Year Design Storm				
Design Point	Existing Flow (CFS)	Proposed Flow (CFS)	Net Change (CFS)	Net Change (%)
10L - Coggeshall	2.40	2.34	-0.06	-3%
20L - Off-Site Parking	0.20	0.00	-0.20	-100%
Total	2.60	2.34	-0.26	-10%

4.4 Storm Sewer Design

The proposed storm sewer system has been designed to convey the 25-year design storm. 24-hour rainfall intensities were obtained from the National Oceanic and Atmospheric Administration point precipitation frequency estimates (NOAA Atlas 14, Volume 10, Version 3). Calculations for the proposed storm sewer network along, with the rainfall intensities obtained from the NOAA Atlas 14, are included in *Appendix D*.

5 Soil Erosion and Sedimentation Control

Soil erosion and sedimentation control details and narratives for construction periods are provided on the site plans. Soil erosion and sedimentation control details and procedures are consistent with the "Massachusetts Erosion and Sediment Control Guideline for Urban and Suburban Areas."

Construction period erosion and sedimentation controls will include a construction entrance, compost filter socks, catch basin inlet protection, and water for dust control. Additional erosion and sediment controls will be utilized as required. Perimeter sediment controls will be placed down-gradient of disturbed areas. Water will be applied to exposed soils to provide dust control as needed.

Waste materials generated from construction activities will include excavated soil, pavement, building debris, and utilities. All excavation debris and other waste will be transported to an approved disposal facility. If required, materials may be temporarily stockpiled within designated staging areas. Details and procedures are provided in the construction site plans.

Construction materials, including site and building materials, will be present on-site during various stages of construction. All materials will be temporarily stored within designated staging or lay-down areas and will be transported to the site as needed.

6 Construction Sequence

A detailed construction sequence is included on the site plans. This construction sequence is subject to change based on construction methods, weather, or due to other unforeseen circumstances.

7 Massachusetts Stormwater Handbook Standards

The following is a description of how the proposed project conforms with the stormwater management standards (Standards) outlined in the Massachusetts Stormwater Handbook. The site is considered redevelopment because the project is located at a previously developed site and has a net reduction in impervious area. The Standards are met to the greatest extent practicable. The Stormwater Management Checklist is included in *Appendix E*.

Standard 1: No Untreated Discharge or Erosion to Wetlands
There are no wetlands on or adjacent to the project site.

Standard 2: Peak Rate Attenuation
Post-development discharge rates from the 2-, 10-, 25-, and 100-year storm events will be reduced as a result of the proposed project compared to the pre-development condition. This will be achieved by the storage provided by the subsurface infiltration system and by the net decrease in impervious coverage as compared to existing conditions. Peak flow results are provided in *Section 4.3* of this report.

Standard 3: Stormwater Recharge
The subsurface infiltration system will allow infiltration and groundwater recharge. The subsurface infiltration system been designed to provide storage in excess of the recharge volume required by this standard. Stormwater recharge calculations are included in *Appendix F*.

Standard 4: Water Quality
The subsurface infiltration system will provide water quality treatment through filtration, and infiltration. The subsurface infiltration system provides storage in excess of the water quality volume required by this standard for the site. Water quality is improved in areas not treated by the subsurface infiltration system through a reduction in impervious area as compared to existing conditions. Water quality calculations are included in the BMP Sizing Calculations in *Appendix F*. Total Suspended Solid (TSS) removal calculations are included in *Appendix G*.

Standard 5: Land Uses with Higher Potential Pollutant Loads
The project does not contain any area of higher pollutant loads as defined by the Massachusetts Stormwater Handbook.

Standard 6: Critical Areas
The site is not located within Zone II or Interim Wellhead Protection Areas, or other Critical Areas, which include Shellfish Growing Areas, Bathing Beaches, Outstanding Resource Waters, Special Resource Waters, and Cold-Water Fisheries.

Standard 7: Redevelopment
The proposed project is considered a redevelopment project per the Massachusetts Stormwater Handbook. The redevelopment improves existing conditions through a reduction in impervious area as well as treatment and groundwater recharge in the subsurface infiltration system.

Standard 8: Construction Pollution Prevention and Erosion and Sediment Controls
General erosion and sedimentation controls will be implemented and maintained in accordance with local, state, and federal requirements until construction is complete and disturbed areas have been stabilized. An erosion and sediment control plan has been included in the plans.

Standard 9: Long-Term Operation and Maintenance Plan
A Long Term Operation and Maintenance Plan has been prepared and is included in *Appendix H*.

Standard 10: Illicit Discharges to Drainage System
This project does not contain illicit discharges to Stormwater Management Systems as defined in the Massachusetts Stormwater Handbook.

8 Summary

This Stormwater Management Report describes proposed work and stormwater management associated with the development of the Cannabis Retail Establishment at 115 Coggeshall Street, New Bedford, Massachusetts. The stormwater management system, which includes a subsurface infiltration system and a storm sewer system, will provide water quality treatment, groundwater recharge, and peak flow attenuation. Peak run-off rates from the site will decrease when compared to pre-development conditions during the 2-, 10-, 25-, and 100-year storm events.

The proposed design addresses the applicable standards set forth in the MassDEP Stormwater Management Guidelines as described in Section 7 of this report. Erosion control measures have been incorporated into the design. Based on the conditions summarized above, the proposed site improvements will have no adverse effect on abutters or the receiving drainage systems.

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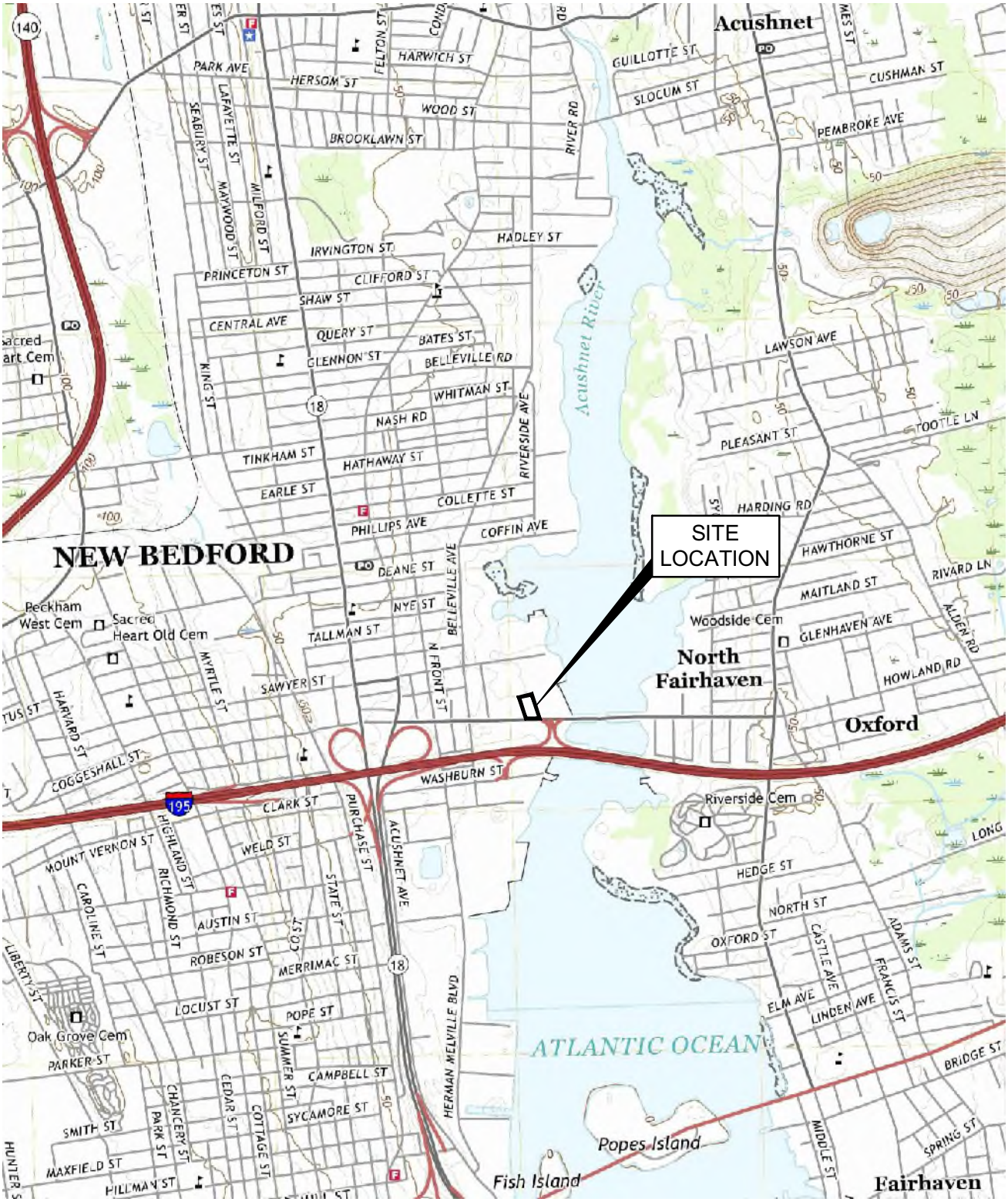
Figures



MAP REFERENCE:
THIS MAP WAS PREPARED FROM THE FOLLOWING USGS 7.5 MINUTE SERIES TOPOGRAPHICAL MAP:
NEW BEDFORD NORTH QUADRANGLE, MASSACHUSETTS, 2018

SCALE:	
HORZ.:	1" = 2000'
VERT.:	
DATUM:	
HORZ.:	
VERT.:	

0 1000 2000
GRAPHIC SCALE

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ASCEND MASS, LLC

SITE LOCATION MAP

115 COGGESHALL STREET

NEW BEDFORD MASSACHUSETTS

PROJ. No.: 20191061.T10
DATE: 01/08/2020

FIGURE 1

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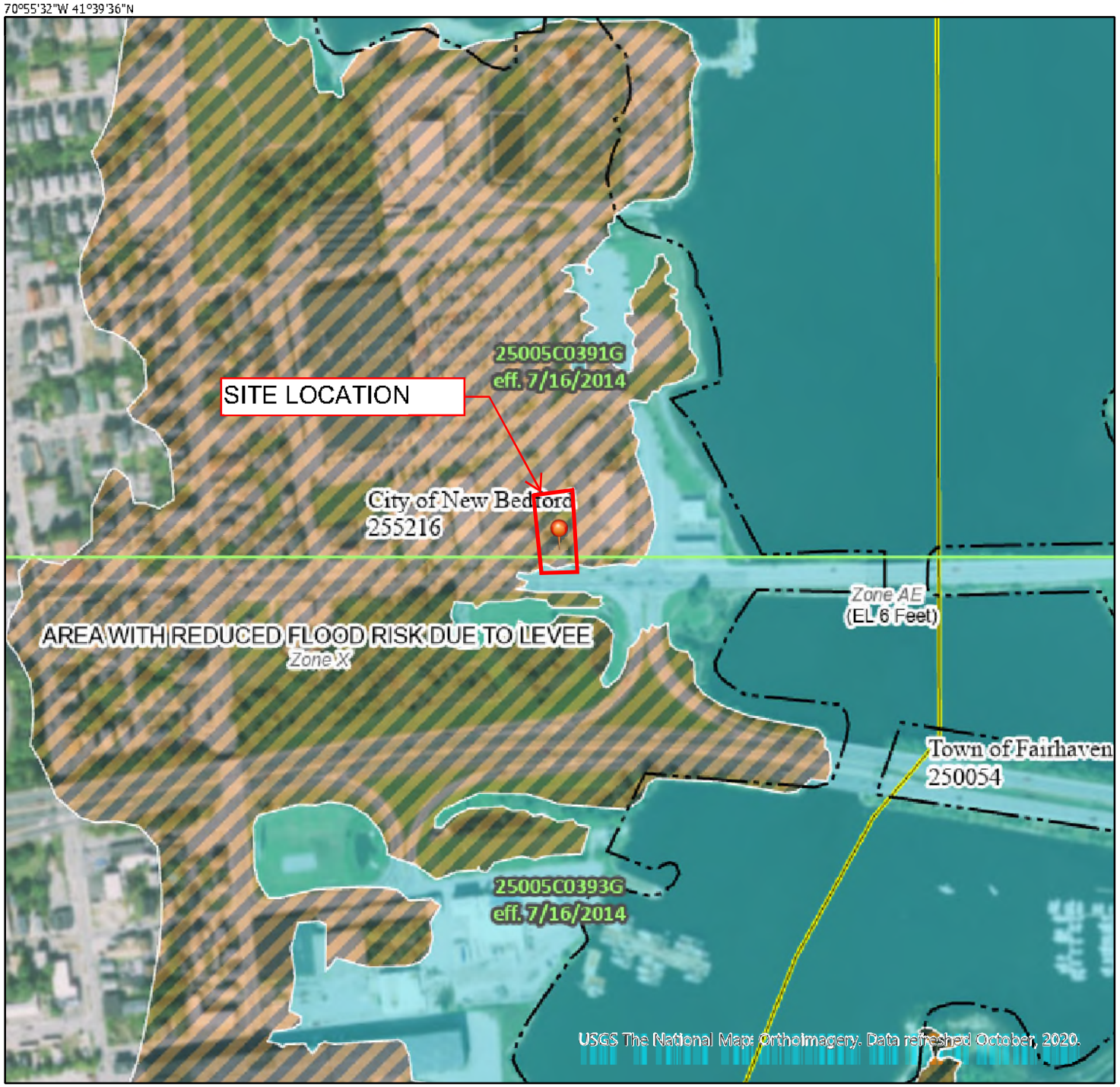
MS VIEW: LAYER STATE: Plotter: DWG TO PDF.PC3 CTB File: FO.STB

National Flood Hazard Layer FIRMette

FEMA



0 250 500 1,000 1,500 2,000 Feet

1:6,000

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

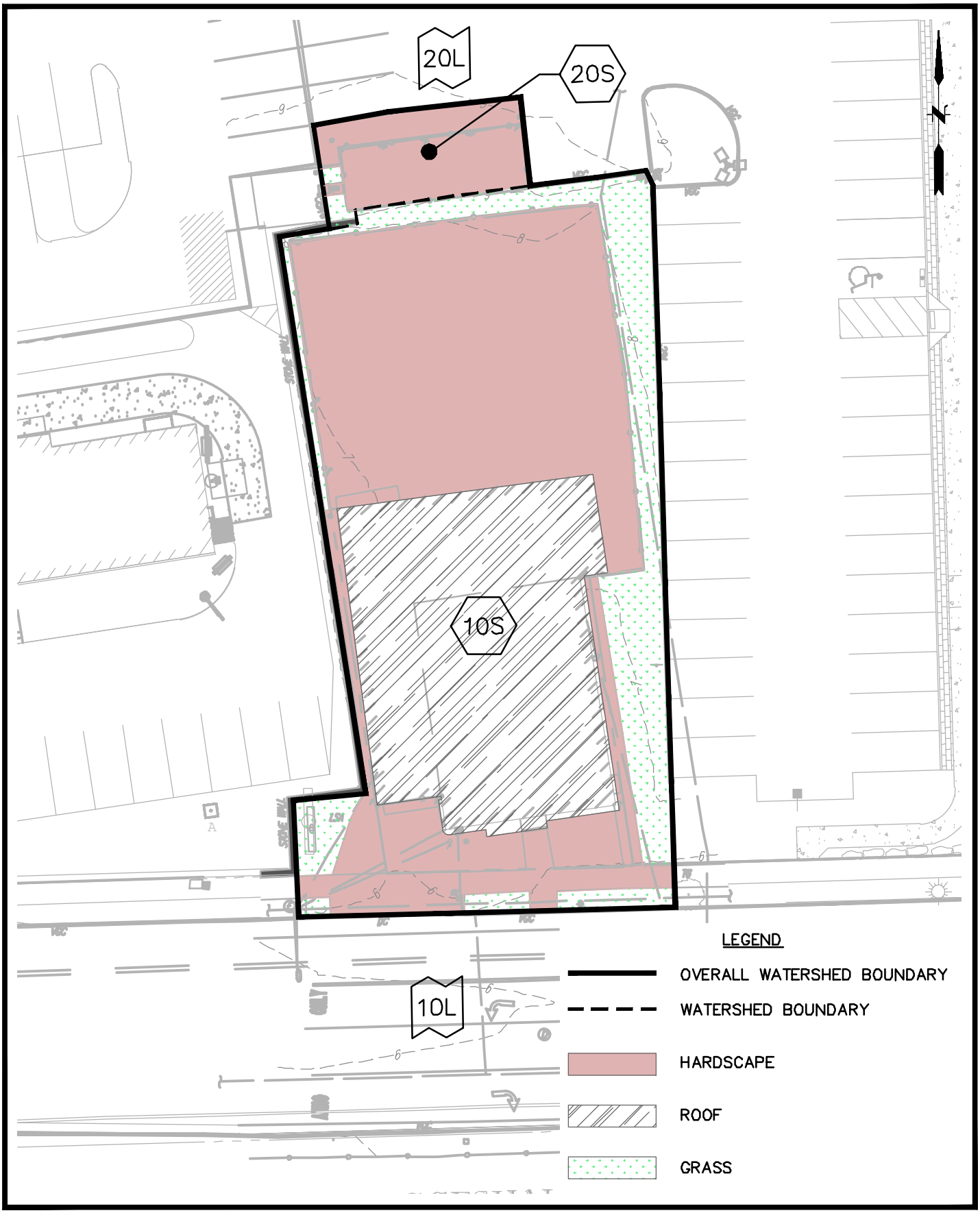
N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 11/20/2020 at 11:00 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.



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HORZ.:
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0 15 30
GRAPHIC SCALE

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ASCEND MASS, LLC

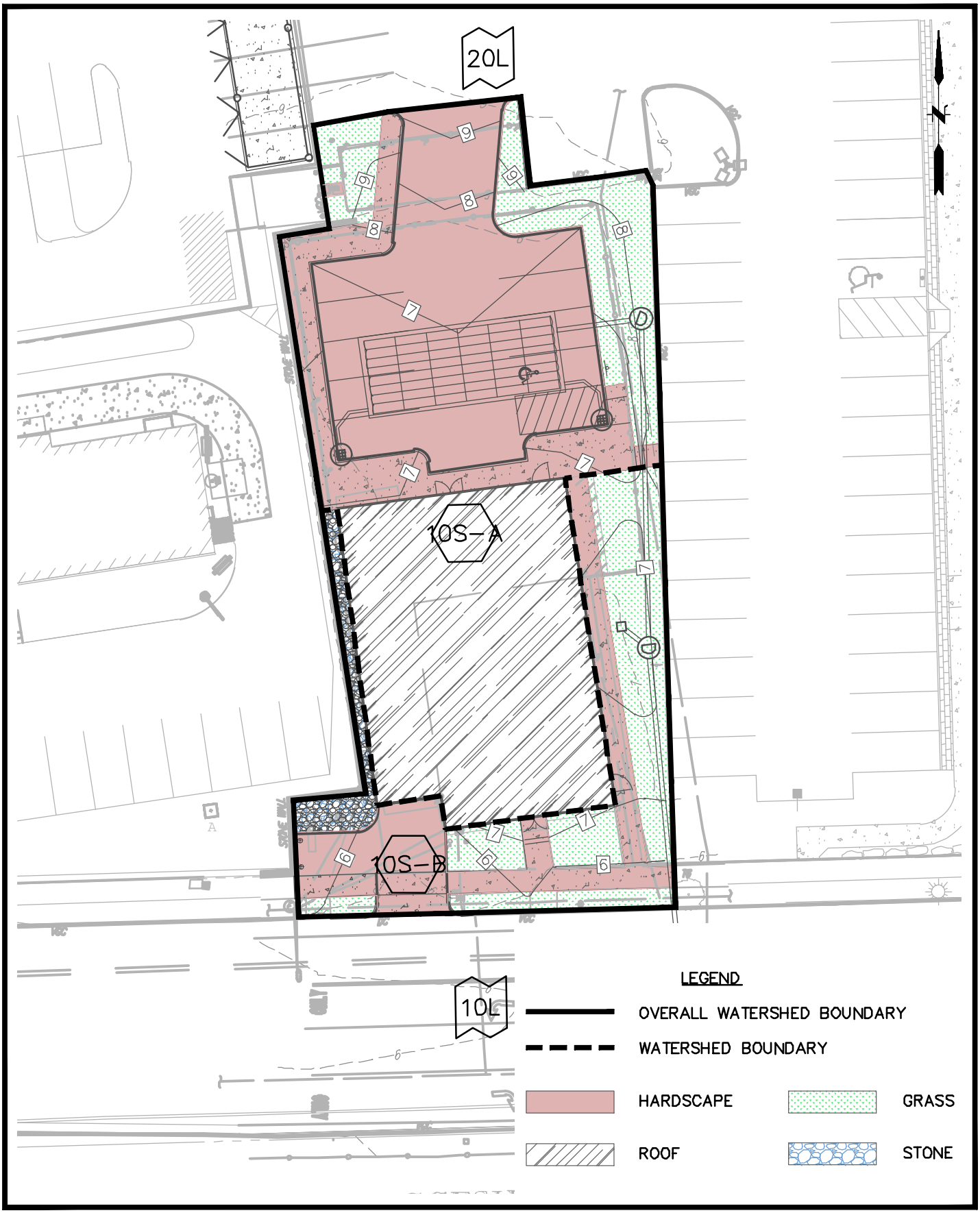
PRE-DEVELOPMENT WATERSHED MAP

115 COGGESHALL STREET

NEW BEDFORD MASSACHUSETTS

PROJ. No.: 20191061.T10
DATE: 01/08/2021

FIGURE 3



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LAYER STATE:
MS VIEW:

SCALE:
HORZ.: 1" = 30'
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DATUM:
HORZ.:
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0 15 30
GRAPHIC SCALE

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ASCEND MASS, LLC

POST-DEVELOPMENT WATERSHED MAP

115 COGGESHALL STREET

NEW BEDFORD MASSACHUSETTS

PROJ. No.: 20191061.T10
DATE: 01/08/2021

FIGURE 4

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Appendix A

NRCS Soil Report

Custom Soil Resource Report
Soil Map

Map Scale: 1:509 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 5 10 20 30

Feet
0 20 40 80 120

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 1:20,000.

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 14, Jun 9, 2020

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—Jul 3, 2017

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
602	Urban land	1.3	100.0%
Totals for Area of Interest		**1.3**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Bristol County, Massachusetts, Southern Part

602—Urban land

Map Unit Setting

National map unit symbol: v5ry
Frost-free period: 120 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Setting

Parent material: Excavated and filled land

Minor Components

Udorthents

Percent of map unit: 15 percent
Hydric soil rating: Unranked

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McArdle Gannon Associates, Inc.
Engineers & Consultants

GEOTECHNICAL ENGINEERING REPORT

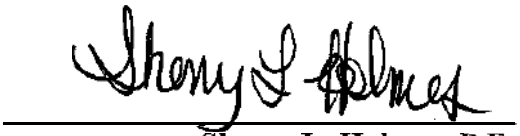
PROPOSED ADDITION
115 COGGESHALL STREET
NEW BEDFORD, MASSACHUSETTS

Prepared for:

Ascend Wellness Holdings LLC
500 Totten Pond Road, Floor 6
North Waltham, MA

Prepared by:

McArdle Gannon Associates, Inc.
300 Oak Street, Suite 460
Pembroke, Massachusetts



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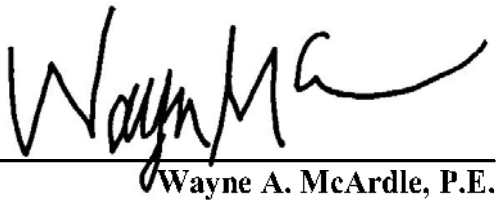


Wayne A. McArdle, P.E.
Massachusetts Professional Engineer License No: 41835

October 13, 2020
MGA File No:W0825

McArdle Gannon Associates, Inc.
Engineers & Consultants

October 13, 2020
MGA File No. W0825

KC Downer
Director of Construction
Ascend Wellness Holdings LLC
500 Totten Pond Road, Floor 6
North Waltham, MA 02451

RE: Geotechnical Engineering Report – Proposed Addition – 115 Coggeshall Street, New Bedford, MA

KC:

McArdle Gannon Associates, Inc. is pleased to present the results of our geotechnical engineering studies for the referenced project. The objective of our studies has been to assess the subsurface conditions near the proposed building addition area and provide recommendations for building addition foundation and slab support, seismic design criteria, and related earthwork construction considerations.

Our geotechnical engineering studies have been performed in accordance with our proposal to you dated September 14, 2020 and our findings, conclusions and recommendations are subject to the Statement of Limitations included as Appendix A.

SITE AND PROJECT DESCRIPTION

Our understanding of the project is based on our recent site visits, our discussions with Nathan Langlais (BKA Architects), and review of the following documents:

- A plan entitled "Adult Use Cannabis Retail Establishment," Sheet CON-2, by Fuss & O'Neill (F&O), dated November 19, 2019, and
- A plan entitled "Surficial Materials Map of the New Bedford North Quadrangle, Massachusetts," by the United States Geological Survey (USGS), dated 2018.

The site is located at 115 Coggeshall Street in New Bedford, Massachusetts. A Site Locus is attached as Figure 1. The site is bordered by Coggeshall Street to the north and is generally surrounded by commercial properties. The Acushnet River is located to the east of the site.

The site is currently developed with a 2-story brick building within the southern portion of the site with an attached 1-story garage-type addition to the north and west, as well as pavement areas in the northern portion of the site. The site appears to be relatively flat and is currently surrounded by chain link fencing.

We understand that the existing 1-story building addition will be demolished and a new addition will be built within the same footprint. There is no below grade space planned. A new concrete slab will likely be constructed within the existing building to remain. We have assumed that the first floor elevation will match the existing elevations and site grades will remain relatively unchanged.

SUBSURFACE EXPLORATIONS

A subsurface exploration program consisting of two (2) soil test borings was completed as part of our studies to gather information on the subsurface conditions at the site. The purpose of the explorations was to assess subsurface soil and groundwater conditions near the proposed building addition area with particular emphasis on assessing the density characteristics of the natural soils and the thickness of surficial existing fill soils.

New England Boring Contractors of East Taunton, Massachusetts performed two borings (MGA-1 and MGA-2) at the site on September 28, 2020 using a truck mounted drill rig. The borings were advanced using 4 inch diameter flush jointed casing to a depth of about 36± feet below existing ground surface terminating in natural granular soils.

Standard penetration testing (SPT) and split spoon samples were generally obtained continuously in the upper 16± feet and at 5-foot intervals thereafter during advancement of the borings. The testing was performed by driving a standard 2-inch outside diameter split spoon sampler up to 24 inches using a standard 140-pound automatic hammer falling 30 inches. The number of hammer blows required to drive the sampler in 6-inch increments (or to refusal) are recorded on the boring logs attached in Appendix B.

The soil samples retrieved in the split spoon sampler during each SPT were visually described in the field by MGA using Burmister soil descriptions. It should be recognized that the inside diameter of the split spoon sampler is 1.4± inches. Therefore, soil samples obtained via Standard Penetration Testing do not account for soil fractions in excess of about 1.4± inches in diameter, which may be present in any given strata.

MGA personnel observed the explorations, visually described the conditions encountered, prepared the logs, and located the explorations in the field by taping from the existing site features. Ground surface elevations were not available. The exploration locations are approximately shown on Figure 2.

LABORATORY SOIL TESTING

Three laboratory gradation tests were performed on representative samples of the existing fill and natural granular soils collected during the exploration phase from borings MGA-1 and MGA-2. We utilized the test results to assist us in classifying the soils, to assess the reuse potential of the on-site soils as structural fill on the project, and to assess the engineering characteristics of the on-site soils. The test results are attached in Appendix C.

SUBSURFACE CONDITIONS

The general subsurface conditions encountered at the boring locations consist of surficial asphalt over about 4.9± to 5.4± feet of existing fill soils underlain by natural granular soils (sand and silt, sand, and silty sand and gravel) to the depths explored.

Asphalt: A surficial 1.5± inch thick layer of asphalt was encountered at each boring location.

Fill: Existing fill was encountered below the asphalt at each boring location. The fill was about 4.9± to 5.4± feet thick and generally consists of very loose to medium dense, brown, gray, gray-brown, black, fine to medium/fine to coarse sand with about 5 to 20 percent fine gravel, about 5 to 25 percent silt, and up to about 5 percent brick fragments.

Refer to Appendix C for gradation curves of the 1-3/8 inch minus fraction of the existing fill soils collected from borings MGA-1 and MGA-2.

Natural Granular Soils: Below the existing fill, a natural deposit of granular soils (sand and silt over sand over silty sand and gravel) was encountered at a depth of about 5± to 5.5± feet below existing site grades at the boring locations.

An approximately 5.5± to 6± feet thick layer of natural sand and silt was encountered directly below the fill. The sand and silt generally consists of medium dense to dense, gray-brown to beige, fine/fine to medium sand with about 35 to 45 percent silt.

Natural sand was encountered below the sand and silt and generally consists of loose to medium dense, gray to beige, fine/fine to medium/fine to coarse sand with about 5 to 20 percent silt and 0 to 25 percent fine gravel.

Silty sand and gravel was encountered at about 34± below existing grade at boring MGA-1. The silty sand and gravel generally consists of dense, fine to coarse sand with about 35 to 40 percent fine gravel and about 15 to 20 percent silt.

The natural granular soils were not fully penetrated at the test boring locations. Refer to Appendix C for a gradation curve of the 1-3/8 inch minus fraction of the natural granular soils (sand and silt) collected from boring MGA-2.

Groundwater: Groundwater levels for our study were measured in the test borings at the times and under the conditions noted on the logs. Groundwater was encountered at about 5± to 5.5± feet below existing grade during drilling at the boring locations.

It should be expected that groundwater levels will fluctuate due to variations in temperature, rainfall and other factors. Therefore, groundwater levels at any given time may be different than those reported herein.

CONCLUSIONS AND RECOMMENDATIONS

The existing fill soils are not considered suitable for support of the proposed building addition structural loads (foundation or slab) due to their composition, erratic density, and potential compressibility. Because of their relatively shallow depths and thicknesses, removal and replacement of these unsuitable soils with compacted structural soil fill appears economically and technically feasible for the proposed building addition area. It is anticipated this will likely require excavations to about 5± to 5.5± feet in depth from the existing site grades based upon the recent borings. The existing fill may be locally thicker around existing utilities and structures. Existing structures, utilities, and pavement should also be removed from within the proposed building addition area.

Our conclusions and recommendations for use in the design and earthwork construction of the proposed building addition are presented below and are subject to the Limitations attached in Appendix A. Our recommendations for these and other items are made in the following subsections:

- Earthwork
- Foundations and Allowable Bearing Capacities
- Slab Support
- Seismic Design Criteria
- Lateral Earth Pressures on Foundation Walls
- Lateral Load Resistance
- Reuse of On-site Soils
- Construction Dewatering
- Additional Explorations

Earthwork

Based on the conditions observed in the test borings, the depth to firm natural ground near the building addition is roughly 5± to 5.5± feet below existing grade. This relatively shallow depth, in our opinion, makes removal of the existing fill soils and their replacement with compacted structural fill both technically and economical feasible.

Existing fill soils within the proposed building addition area should be completely removed to firm natural ground a minimum distance of 4 feet beyond the building addition footprint or within the area bounded by a one horizontal to one vertical (1H:1V) line sloping downward and

outward from proposed bottom of exterior footing to firm natural ground, whichever is greater. Note that due to the proximity of the proposed building addition to the western property line, there may not be sufficient space to remove the existing fill soils to 4 feet laterally in this area. In addition, any existing asphalt, slabs, foundations and utilities should be removed within these limits.

Adjacent to the existing building, if existing fill soils are encountered within the stress zone of the existing building foundations, these soils may remain in-place. The existing building foundation stress zone is defined by the area bounded by a one horizontal to one vertical (1H:1V) line sloping downward and outward 1 foot laterally beyond existing bottom of exterior footing to firm natural ground. We recommend that further evaluation of the bearing conditions in these areas be performed during construction, if necessary.

All excavations should be performed with a smooth edge bucket to limit disturbance to the natural sand and silt soils and to clean the bottom of loose soil.

Where required, Structural Fill should be placed in controlled compacted lifts up to the proposed foundation and slab subgrade elevations. Structural Fill from on-site or off-site sources should be placed in 12-inch maximum thick lifts and each lift should be compacted to at least 95 percent of the material's maximum dry density as determined by ASTM D-1557 and to a firm and stable condition as assessed by the geotechnical engineer. Fill from off-site sources used within the proposed building addition area should meet the minimum gradation requirements for Structural Fill recommended in the attached Table 1.

Alternatively, new foundations could be lowered to bear directly on the natural soils. In this case, the lateral limits of excavation could be reduced to the area directly below the new footings and slab.

We anticipate that portions of the on-site excavated existing fill soils will be suitable for reuse as Structural Fill provided these soils are maintained at suitable moisture contents for proper compaction and that debris and oversize particles, defined as those greater than 2/3 the loose lift thickness, are removed prior to reuse. Refer to the "Reuse of On-site Soils" section below for more information.

The work described above should be observed by a qualified geotechnical engineer from this office to verify that firm natural ground has been achieved and that fill is placed and compacted to the required densities within the intent of this report.

Foundations and Allowable Bearing Capacities

Spread footings are recommended for support of the proposed building addition loads provided the preceding recommendations are followed under appropriate geotechnical engineering field observation. Suitable foundation bearing materials include the natural undisturbed granular deposits and suitably placed and compacted Structural Fill.

Due to the proximity of the groundwater table and the silty nature of the natural sand and silt, we recommend that foundation subgrades be over-excavated with a smooth edge bucket and a 6-inch thick minimum layer of compacted ¾ inch crushed stone placed upon the subgrade to protect it from water. Three-quarter inch crushed stone should meet the recommended gradation requirements shown in the attached Table 1.

Provided the recommendations presented herein are followed under appropriate geotechnical engineering observation by this office, a preliminary maximum allowable bearing capacity of one and one-half tons per square foot (1.5 TSF) is recommended for use in design of new foundations bearing on natural granular soils or compacted Structural Fill. This bearing stress is considered preliminary and will not be considered finalized until verified in the field during construction by MGA.

The new foundations should be designed and constructed at a level such that they do not impose additional loads on adjacent foundations and foundation walls for the existing building. If new foundations are constructed at a level such that they impose additional loads on the existing foundations or foundation walls, the project structural engineer should assess the condition to determine if the foundations and foundation walls can withstand additional loads imposed by the new foundations.

Similarly, new foundations should be designed such that their construction does not undermine existing foundations. Existing foundations that would potentially be undermined would need to be underpinned during construction. MGA is available to provide recommendations, review, or consultation for underpinning, if requested.

If winter construction is anticipated, attention should be paid to protecting foundation subgrade soils from freezing. This protection should not only be implemented before footings are poured but after as well. During cold weather, do not excavate to full indicated depth unless footings can be poured immediately after the excavation is finished. Protect footings and slabs from frost penetration into the soils upon which they rest. Insulating blankets should be spread upon the subgrade soils around poured footings until the forms are stripped and backfilling is set to proceed. Backfilling should commence as soon as allowable after forms are removed. Temporarily mounding fill over poured footings to protect from frost penetration during freezing temperatures could also be implemented.

For isolated column foundations (if any) that are smaller than 3 feet in least lateral dimension (width or diameter), the recommended bearing pressure should be reduced to one-third of the recommended value multiplied by the least lateral footing dimension in feet in accordance with the Ninth Edition of The Massachusetts State Building Code (MSBC). Regardless of the recommended allowable bearing capacity, continuous footings should be at least 18 inches wide in the least lateral dimension.

Exterior footings should be located at least 4 feet below finish grade for frost protection. Footings should also be founded or otherwise located so no utility is located with the 1H:1V theoretical footing stress zone. Footings should either be dropped below the invert of the pipes or be located well away from them.

Footings should be backfilled as soon as practical after the concrete has cured in an effort to protect the subgrades upon which they bear. Care should be taken not to nest cobbles/boulders up against the footings, walls and utility structures during backfilling. Oversize cobbles and boulders should be removed prior to backfilling.

Slab Support

Slab-on-grade construction is recommended for the proposed building addition provided existing fill soils are removed and replaced with compacted Structural Fill as discussed above.

Slabs should bear directly on a 10-inch thick base course Sand and Gravel layer compacted to at least 95 percent of the material's maximum dry density (ASTM D-1557). The base course material should consist of hard, durable sand and gravel meeting the gradation requirements shown in the attached Table 1.

Alternatively, the slab could be constructed on a 6-inch thick layer of compacted ¾ inch crushed stone meeting the recommended gradation requirements shown in Table 1.

Seismic Design Criteria

Site Seismic Coefficient

Based on the results of our explorations, the site is considered a Site Class D soil site in accordance with Section 1613 of the 9th edition of the MSBC. In accordance with table 1604.11 in the MSBC, maximum considered earthquake response accelerations factors of S_S=0.170 and S_1=0.058 should be utilized for the city of New Bedford.

The maximum considered earthquake spectral response accelerations adjusted for Site Class effects are S_{MS}=0.272 and S_{M1}=0.139 in accordance with Section 1613.3.3. Design spectral response accelerations of S_{DS}=0.181 and S_{D1}=0.093 (in accordance with Section 1613.3.4) should be used in determining the Seismic Design Category.

Liquefaction Potential

Loose sand soils were encountered below the water table at the boring locations. Loose granular soils below the water table can liquefy under cyclic loading caused by an earthquake. We identified one (1) sample determined to be potentially susceptible to liquefaction based on Figure 1804.6c in the MSBC.

We conducted a liquefaction assessment on the one (1) sample determined to be potentially susceptible to liquefaction (MGA-2, S-11, 29-31 feet). The assessment was performed in accordance with "Standard Penetration Test-Based Probabilistic and Deterministic Assessment of Seismic Soil Liquefaction Potential" by Cetin, Seed, Kiureghian, Tokimatsu, Harder, Kayen and Moss as published in Vol. 130, No. 12 of the *ASCE Journal of Geotechnical and Geoenvironmental Engineering / December 2004.*

We considered an earthquake with a peak ground acceleration of 0.136g in accordance with Section 1803.5.12.2.2.2 of the MSBC. Our analysis indicates that the likelihood of the design earthquake triggering liquefaction of the loose sand deposits at the site is about 5 to 20 percent.

We estimate that liquefaction of the 5± foot thick loose zone encountered at boring MGA-2 during the design earthquake could cause level ground at the site to settle about 0.1± inch. Actual settlements (total and differential) could be greater at locations where loose soils are thicker than encountered at the boring locations and during a higher peak ground acceleration event.

Considering the limited size and thickness of the loose zones observed in the borings, we feel that the liquefaction potential of the soils at the site is marginal. The project structural engineer should determine if additional structural design requirements are warranted based upon the anticipated settlement due to the design earthquake.

Lateral Earth Pressures on Foundation Walls

Foundation walls serving as retaining walls should be designed in accordance with the lateral pressures listed below for the permanent condition. These recommendations assume that water pressure is not allowed to develop behind the walls. The height of the wall (H) is defined as the distance in feet between the bottom of upper finished floor level on the retained earth side of the wall and the top of the lower finished floor level (or finished site grade) on the down-slope side of the wall.

For seismic loading conditions, walls should be designed to resist static plus seismic earth pressures. Surcharge loading does not need to be considered for seismic design unless the surcharge will be applied over an extended time.

Static Earth: Calculate pressures using an equivalent fluid unit weight equal to 65 pounds per square foot (psf) per foot for restrained walls (braced at the top and bottom). For unrestrained walls (walls that are free to deflect laterally at least 0.0015H at the top of the wall), use an equivalent fluid unit weight equal to 45 psf per foot depth.

Seismic Earth: Calculate in accordance with the MSBC Section 1610.2 using a total soil unit weight (γ_t) of 130 pounds per cubic foot (pcf).

Surcharge: Uniform pressure applied from the elevation of the surcharge to the bottom of the foundation element with a magnitude of 0.5q where q is the vertical surcharge load, uniformly distributed over the height of the wall for restrained and unrestrained walls, respectively.

Retaining walls should be designed for a factor of safety of 1.5 against sliding and overturning under static loading conditions and 1.2 under seismic loading conditions. Passive soil pressure should not be included as a resisting force.

Lateral Load Resistance

A coefficient of friction equal to 0.35 may be used to calculate ultimate sliding resistance between the soil-bearing cast-in-place concrete footings and the naturally deposited granular soils or compacted Structural Fill. A factor of safety of at least 1.5 should be applied to calculate the allowable sliding resistance.

Where compacted crushed stone is used below foundations, a coefficient of friction equal to 0.6 may be used. The stone should be a minimum of 6 inches thick and be compacted to an unyielding state.

The allowable net (passive minus active) lateral resistance provided by the backfill surrounding the foundation elements can be estimated using an equivalent fluid unit weight of 250 pounds per cubic foot (pcf). This value assumes that granular backfill is systematically placed and compacted in lifts within 5 feet laterally against structure elements. The top of the passive zone should be 6 inches below the top of the adjacent soil or backfill surface. If the horizontal distance between nearby footings, walls, or grade beams is less than twice the height of the subject structural element, the passive pressure should be discounted proportionately to the distance (full pressure at twice the height away) to accommodate interaction of the elements.

If additional sliding resistance is needed, such as for footings that are not buried at a sufficient depth to develop passive soil resistance, footings can be constructed with "keys."

Reuse of On-site Soils

From a geotechnical standpoint and assuming there are no environmental implications, portions of the existing fill soils may be re-useable as compacted Structural Fill provided these soils are maintained at suitable moisture contents for proper compaction and that debris and oversize particles, defined as those greater than 2/3 the loose lift thickness, are removed prior to reuse. We suggest segregating higher quality fill soils from lesser quality materials during excavation operations and focus on reusing the lesser quality materials below landscape and pavement areas of the site (outside the building addition area).

Some of the on-site fill soils may be difficult to reuse if they become excessively wet because of their relatively high silt content. Therefore, earthwork operations should be conducted in such a manner aimed at protecting the silty soils to be reused from excess moisture. When winter or wet weather is experienced, a portion of the on-site silty soils may not be reusable in a timely fashion and off-site structural fill may be required to reach subgrade elevations.

Trace amount of brick was encountered in some of the recovered samples of the fill, indicating that some of the fill soils may contain debris. Any wood, metal, trash, or organic matter should be culled out of the fill prior to reuse and properly disposed of off-site.

If encountered, existing concrete, bricks, slabs, and boulders should be removed from the existing fill prior to reuse and either processed by crushing or screening for reuse on-site or removed from the site. Depending on the amount of Structural Fill required at the site and on the

contractor's available equipment (crusher, hoe ram, etc.), it may be possible to process these materials with the combination of hoe ramming and crushing at the site. In addition, crushing the concrete and bricks generated during demolition of the existing building/slabs and reclaiming existing pavement to create materials suitable for reuse as structural fill on the project could be considered. These procedures could allow the earthwork contractor to reuse the material on-site or effectively produce material that can be hauled off-site. This may not be economical if the contractor would have to rent equipment or not desirable if there's not enough space on site for the crushing operation or if additional structural fill soils are not required.

The natural sand and silt soils are not considered suitable for reuse as Structural Fill within the proposed building addition due to its high silt content.

Construction Dewatering

We anticipate excavations to remove existing fill soils and possibly deeper utility excavations during construction will extend near or below stabilized groundwater levels at the site (5± to 5.5± feet below grade at the boring locations during drilling). Dewatering should be performed as necessary to protect subgrades and allow all final excavation, subgrade preparation, foundation construction and backfilling to be conducted in-the-dry. We anticipate that dewatering can be accomplished by sumping from shallow pits, trenches and drainage ditches.

Discharge of pumped water is subject to local, state and federal regulations. The contractor should conduct dewatering and discharge water in accordance with all applicable regulations. If effluent is discharged directly to municipal systems, it would be subject to regulatory requirements including discharge permitting. Typically, sedimentation and pH control will be required prior to off-site discharge of construction dewatering effluent in addition to possible treatment for other constituents if indicated by groundwater quality test data.

The contractor should implement temporary surface water runoff control measures during construction. Temporary measures should include, but are not necessarily limited to, the use of small earth berms or construction of a drainage ditch adjacent to the top of proposed excavations to divert and/or reduce the amount of surface water flowing over exposed slopes and into excavations during construction.

Additional Explorations

Note that the test borings were performed near the proposed building addition outside of the existing building. No explorations were performed within the existing building area where a new slab on grade is planned due to access issues. Therefore, we recommend that additional explorations (test borings or test pits) be performed within the existing building area once accessible to assess subsurface conditions and to develop recommendations for the new slab on grade.

CONSTRUCTION DOCUMENTS AND QUALITY ASSURANCE

McArdle Gannon Associates should be provided the opportunity to review geotechnical aspects of the final plans and specifications prepared by others in order to confirm that our recommendations were interpreted and implemented as intended.

The recommendations contained in this report are based on known and reasonably predictable behavior of properly engineered and constructed foundations and other facilities. We recommend that an engineer and/or technician, qualified by training and experience, perform full-time field observations of the geotechnical aspects of construction to:

- Observe removal of existing unsuitable soil materials from footing and slab areas and confirm the character of the material encountered at the bearing levels,
- Confirm that materials used as fill and backfill are in accordance with the specification requirements,
- Make judgments on the suitability of excavated materials for reuse as fill, particularly the reuse of on-site soils as compacted Structural Fill,
- Observe preparation of footing bearing surfaces and subgrades beneath slabs,
- Observe and test placement and compaction of Structural Fill (required by the Massachusetts State Building Code) and other compacted fills, and
- Monitor the processing and consistency of on-site materials re-used as fill.

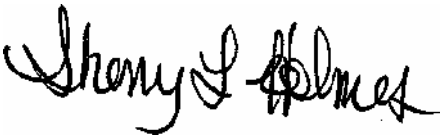
The performance of the structure will depend on the manner in which the geotechnical construction activities are performed. In part due to the nature of site soils and the earthwork that will be performed, it is recommended that McArdle Gannon Associates be retained to perform field observations of the geotechnical aspects of construction. This will enable us to observe compliance with the design concepts and specifications, help resolve construction problems, facilitate design changes in the event that subsurface conditions differ from those anticipated prior to the start of construction, and facilitate re-use of on-site soils.

The comments and recommendations provided herein pertaining to re-use of on-site soils as engineered fill beneath foundations and slabs are contingent upon McArdle Gannon Associates monitoring the placement of these materials.

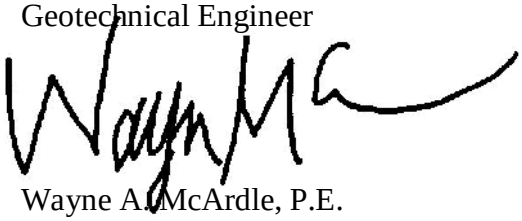
We appreciate the opportunity to assist you on this project and look forward to providing construction observation services as the project moves forward. Please feel free to contact us should you have any questions regarding this report or require additional information.

Very truly yours,

MCARDLE GANNON ASSOCIATES, INC.



Sherry L. Holmes, P.E
Geotechnical Engineer



Wayne A. McArdle, P.E.
Principal

cc: Nathan Langlais, BKA Architects

SLH/WAM/slh

Attachments: Figure 1 – Site Locus
Figure 2 – Exploration Location Plan
Table 1 – Recommended Use and Gradation Criteria for Fill Materials
Appendix A – Statement of Limitations
Appendix B – Soil Test Boring Logs
Appendix C – Geotechnical Laboratory Test Results

FIGURES

McArdle Gannon Associates, Inc.
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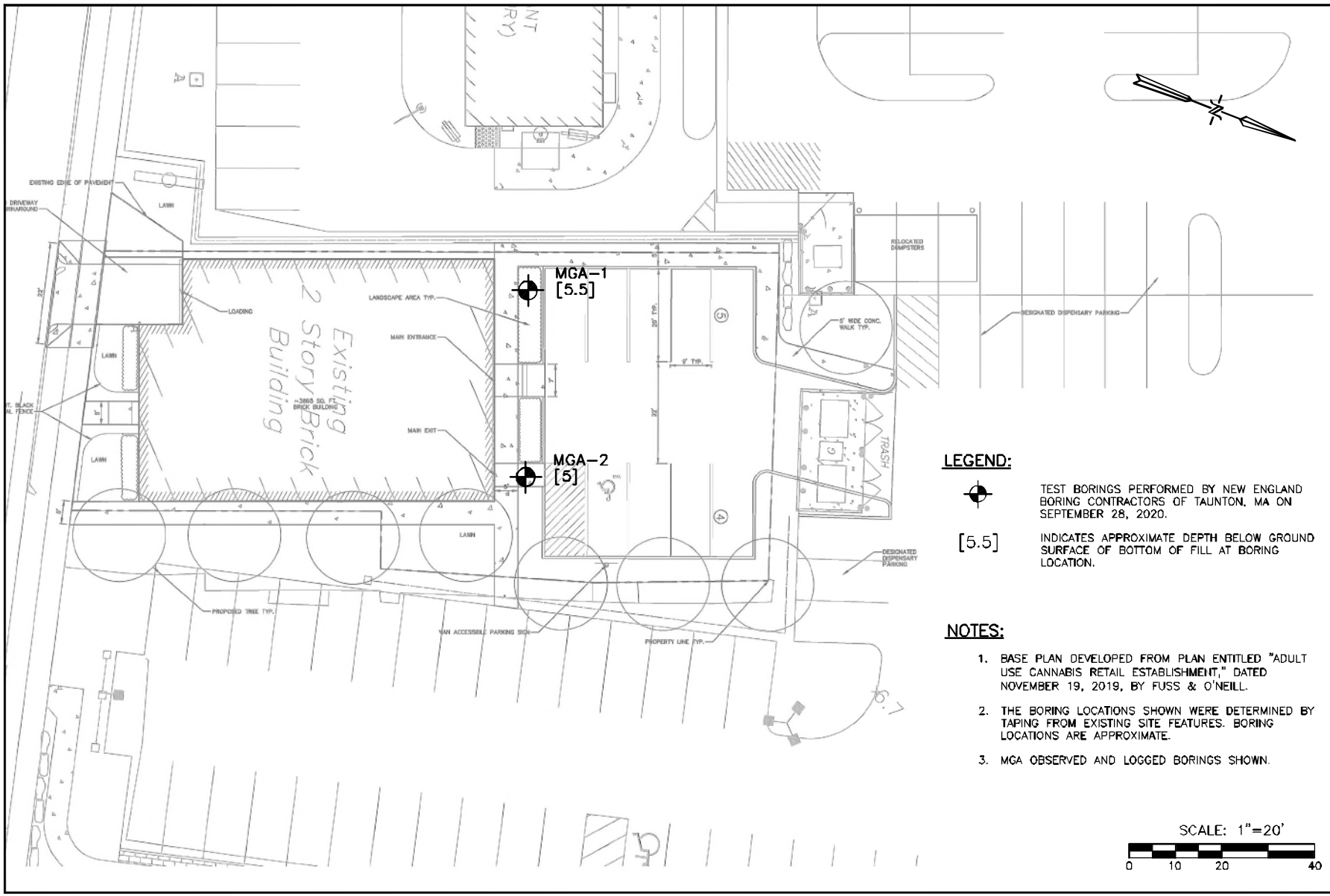
LOCUS PLAN
PROPOSED ADDITION
115 COGGESHALL STREET
NEW BEDFORD, MASSACHUSETTS

PROJECT: W0825 | DATE: 10/2020 | SCALE: AS NOTED

SKETCH NO.:
FIG. No. 1

DRAWN: RED
CHECKED: SL



LEGEND:

⌖	TEST BORINGS PERFORMED BY NEW ENGLAND BORING CONTRACTORS OF TAUNTON, MA ON SEPTEMBER 28, 2020.
[5.5]	INDICATES APPROXIMATE DEPTH BELOW GROUND SURFACE OF BOTTOM OF FILL AT BORING LOCATION.

NOTES:

1. BASE PLAN DEVELOPED FROM PLAN ENTITLED "ADULT USE CANNABIS RETAIL ESTABLISHMENT," DATED NOVEMBER 19, 2019, BY FUSS & O'NEILL.
2. THE BORING LOCATIONS SHOWN WERE DETERMINED BY TAPING FROM EXISTING SITE FEATURES. BORING LOCATIONS ARE APPROXIMATE.
3. MGA OBSERVED AND LOGGED BORINGS SHOWN.

SCALE: 1"=20'

0 10 20 40

SKETCH NO.: FIG. No. 2

EXPLORATION LOCATION PLAN

PROPOSED ADDITION

115 COGGESHALL STREET, NEW BEDFORD, MASSACHUSETTS

PROJECT: W0825 | DATE: 10/2020 | SCALE: AS NOTED

DRAWN: RED | CHECKED: SLH

McArdle Gannon Associates, Inc.
Engineers & Consultants
300 Oak Street, Suite 460
Pembroke, MA 02359
781.826.0040 phone
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TABLE

TABLE 1

RECOMMENDED USE AND GRADATION CRITERIA FOR FILL MATERIALS

USE OF MATERIALS

Off-site Structural Fill:	Backfill inside building addition areas below base course and free draining backfill behind foundation walls
Sand and Gravel:	Base course below slabs and free draining backfill behind foundation walls
Crushed Stone:	As base course below slabs or working mat in wet areas

GRADATION REQUIREMENTS

OFF-SITE STRUCTURAL FILL – shall be free from ice and snow, roots, sod, rubbish and other deleterious or organic matter. Structural Fill shall conform to the following gradation requirements:

Sieve Size	Percent Passing by Weight
*	100
No. 10	30 – 95
No. 40	10 – 70
No. 200	0 – 10**

*Two thirds (2/3) of the loose lift thickness.
**0 – 8 for free-draining fill behind foundation/retaining walls.

SAND AND GRAVEL – shall consist of durable sand and gravel and shall be free from ice and snow, roots, sod, rubbish and other deleterious or organic matter. Sand and Gravel shall conform to the following gradation requirements:

Sieve Size	Percent Passing by Weight
4 inches	100
½ inch	50 – 85
No. 4	40 – 75
No. 10	30 – 60
No. 40	10 – 35
No. 100	5 – 20
No. 200	2 – 8

CRUSHED STONE – shall consist of durable crushed rock or durable crushed gravel stone and shall be free from ice and snow, roots, sod, rubbish and other deleterious or organic matter. Crushed Stone shall conform to the following gradation requirements:

Sieve Size	Percent Passing by Weight
1 inch	100
¾ inch	90-100
½ inch	10-50
3/8 inch	0 – 20
No. 4	0 – 5

APPENDIX A: STATEMENT OF LIMITATIONS

STATEMENT OF LIMITATIONS

Explorations

The analysis and recommendations submitted in this report are based in part upon the data obtained from subsurface explorations. The nature and extent of variations between these explorations may not become evident until construction. If variations then appear evident, it will be necessary to re-evaluate the recommendations of this report.

The stratification lines on the logs represent the approximate boundary between soil types and the transition may be gradual.

Water level readings have been made in the explorations at the time and under the conditions stated on the logs. This data has been reviewed and interpretations made in the text of this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature, and other factors that are different from the time the measurements were made.

Review

In the event that any change in the nature, design or location of the proposed structure are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of this report modified or verified in writing.

It is recommended that this firm be provided the opportunity for a general review of final design and specifications in order that earthwork recommendations may be properly interpreted and implemented in the design and specifications.

Construction

It is recommended that this firm be retained to provide soil engineering services during the construction phase of the work. This is to observe compliance with design concepts, specifications, and recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated prior to start of construction.

Use of Report

This report has been prepared for the exclusive use of Ascend Wellness Holdings LLC for specific application to the Proposed Addition at 115 Coggeshall Street in New Bedford, Massachusetts, in accordance with generally accepted geotechnical engineering practices. No other warranty, expressed or implied, is made.

APPENDIX B: SOIL TEST BORING LOGS

McArdle Gannon Associates, Inc. Engineers & Consultants	TEST BORING LOG	BORING MGA-1

PROJECT: Proposed Addition - 115 Coggeshall Street, New Bedford, MA
CLIENT: Ascend Wellness Holdings LLC
CONTRACTOR: New England Boring Contractors

MGA NO. : W0825
SHEET NO. : 1 of 2
LOCATION N : See Plan
E :
ELEVATION :
DATE START : 09/28/20
END : 09/28/20
DRILLER : Chris Knight
ENGINEER : Robert Drown

GROUNDWATER		DEPTH (ft) OF:			EQUIPMENT	CASING	SAMPLER	CORE
Date	Time	Water	Casing	Hole	Type	HW	Split Spoon	----
9/28/20	8:30am	5.5	4	6	Size I.D.	4"	1-3/8"	----
					Hammer Wt.	140#	140#	- - - -
					Hammer Fall	30"	30"	- - - -

Depth in Feet	Strata Change	Case BPF (Drill) (min/ft)	Sampler Blows Per 6" (RQD%)	Sample Number/ Type	Sample Depth Range (ft)	Sample Recov-ery (in)	Elev-ation/ Depth (ft)	FIELD CLASSIFICATION AND REMARKS
0			4	S-1	0.0	17	-0.1	-ASPHALT-
			10		2.0		0.1	Medium dense, brown/tan/black, fine to coarse SAND, little Silt, trace fine Gravel.
		10	8					
			10					
		24	4	S-2	2.0	13		Medium dense, gray-brown, fine to medium SAND, little (-) fine Gravel, trace (+) Silt.
			6		4.0			-FILL-
		24	6					
4			5					
		30	5	S-3	4.0	7		Medium dense, gray-brown, fine to coarse SAND, little (-) fine Gravel, trace Silt.
			6		5.5			
		60	6				-5.5	
				S-3A	5.5	6	5.5	Light brown, wet, fine SAND and SILT.
			14					
		35	9	S-4	6.0	13		Dense, gray-brown, fine SAND and SILT.
			17		6.0			
		39	22		8.0			-SAND & SILT-
8			22					
		47						
		4	6	S-5	9.0	18		Medium dense, gray-brown, fine SAND and SILT.
			7		11.0			
		14	11					
			11				-11.0	
		10	6	S-6	11.0	16	11.0	Medium dense, gray, fine SAND, trace (+) Silt.
12			11		13.0			
		16	10					
			11					
		14						
		36	5	S-7	14.0	14		Medium dense, gray, fine SAND, trace Silt.
			5		16.0			
		40	6					
16			8					
		40						-SAND-
		65						
		43						
		14	4	S-8	19.0	9		Loose, gray, fine to coarse SAND, trace (-) fine Gravel, trace Silt.
20			4		21.0			
		16	4					
			3					
		15						
		30						

BLOWS/FT.	DENSITY
0 - 4	Very Loose
4 - 10	Loose
10 - 30	Medium Dense
30 - 50	Dense
50 +	Very Dense

BLOWS/FT.	CONSISTENCY
0 - 2	Very Soft
2 - 4	Soft
4 - 8	Medium Stiff
8 - 15	Stiff
15 - 30	Very Stiff
30+	Hard

SAMPLE IDENTIFICATION
- S - Split Spoon
- T - Thin Wall Tube
- U - Undisturbed Piston
- C - Diamond Core
- B - Bulk/Grab Sample

SUMMARY
Station:
Rock:
Samples:

BORING MGA-1

McArdle Gannon Associates, Inc. Engineers & Consultants	TEST BORING LOG	BORING MGA-1
PROJECT: Proposed Addition - 115 Coggeshall Street, New Bedford, MA **CLIENT:** Ascend Wellness Holdings LLC		**MGA NO. : W0825** **SHEET NO. : 2 of 2**

Depth in Feet	Strata Change	Case BPF (Drill) (min/ft)	Sampler Blows Per 6" (RQD%)	Sample Number/ Type	Sample Depth Range (ft)	Sample Recov-ery (in)	Elev-ation/ Depth (ft)	FIELD CLASSIFICATION AND REMARKS
		41						
24		36	9 7 6 5	S-9	24.0 26.0	5		Medium dense, gray, fine to medium SAND, little fine Gravel, trace Silt.
		35						
		52						-SAND-
		65						
28		60						
		25	6 4 6 8	S-10	29.0 31.0	9		Loose to medium dense, beige, fine to medium SAND, little fine Gravel, trace Silt.
		61						
		91						
32		110						
		64					-34.0	
			6 17 14 16	S-11	34.0 36.0	8	34.0	Dense, gray, fine to coarse SAND and fine GRAVEL, little (+) Silt.
							-36.0	-SILTY SAND & GRAVEL-
36							36.0	BOTTOM OF BORING AT 36 FEET.
40								
44								
48								

BLOWS/FT.	DENSITY
0 - 4	Very Loose
4 - 10	Loose
10 - 30	Medium Dense
30 - 50	Dense
50 +	Very Dense

BLOWS/FT.	CONSISTENCY
0 - 2	Very Soft
2 - 4	Soft
4 - 8	Medium Stiff
8 - 15	Stiff
15 - 30	Very Stiff
30+	Hard

SAMPLE IDENTIFICATION

- S - Split Spoon
- T - Thin Wall Tube
- U - Undisturbed Piston
- C - Diamond Core
- B - Bulk/Grab Sample

SUMMARY

Station:
Rock:
Samples:

BORING MGA-1

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McArdle Gannon Associates, Inc.
Engineers & Consultants

TEST BORING LOG

BORING MGA-2

PROJECT: Proposed Addition - 115 Coggeshall Street, New Bedford, MA
CLIENT: Ascend Wellness Holdings LLC
CONTRACTOR: New England Boring Contractors

MGA NO. : W0825
SHEET NO. : 1 of 2
LOCATION N : See Plan
E :
ELEVATION :
DATE START : 09/28/20
END : 09/28/20
DRILLER : Chris Knight
ENGINEER : Robert Drown

GROUNDWATER		DEPTH (ft) OF:			EQUIPMENT	CASING	SAMPLER	CORE
Date	Time	Water	Casing	Hole	Type	HW	Split Spoon	----
9/28/20	12:00pm	5	4	6	Size I.D.	4"	1-3/8"	----
					Hammer Wt.	140#	140#	- - - -
					Hammer Fall	30"	30"	- - - -

Depth in Feet	Strata Change	Case BPF (Drill) (min/ft)	Sampler Blows Per 6" (RQD%)	Sample Number/ Type	Sample Depth Range (ft)	Sample Recovery (in)	Elevation/ Depth (ft)	FIELD CLASSIFICATION AND REMARKS
0			4	S-1	0.0	18	-0.1	-ASPHALT-
			5		2.0		0.1	Loose, brown, fine to medium SAND, some Silt, little (-) fine Gravel, trace (-) Brick.
		10	3					
			3					
		17	1	S-2	2.0	18		Very loose, gray-brown, fine to medium SAND, little (-) fine Gravel, trace Silt, trace (-) Brick.
			2		4.0			-FILL-
		15	1					
4			1					Gray/brown/black, fine to coarse SAND, trace (+) fine Gravel, trace (-) Silt.
		18	3	S-3	4.0	10		
			4		5.0		-5.0	
		30	9	S-3A	5.0	12	5.0	Beige, wet, fine SAND and SILT.
			10	S-4	6.0	14		Medium dense, gray-brown, fine SAND and SILT.
		37	8		6.0			
			11		8.0			-SAND & SILT-
		48	14					
8			15					
		58						
		30	10	S-5	9.0	12		Medium dense, gray-brown, fine to medium SAND, some Silt.
			7		11.0			
		25	6					
			7				-11.0	
		23	8	S-6	11.0	12	11.0	Medium dense, gray-brown, fine to medium SAND, trace Silt, trace fine Gravel.
12			8		13.0			
		25	7					
			5					
		36						
		10	6	S-7	14.0	10		Medium dense, beige, fine to coarse SAND, some fine Gravel, trace Silt.
			5		16.0			
		14	6					
16			5					
		28	3	S-8	16.0	16		Loose, beige, fine to coarse SAND, little fine Gravel, trace Silt.
			3		18.0			
		25	5					-SAND-
			6					
		58						
		48	8	S-9	19.0	12		Medium dense, gray, fine to medium SAND, little fine Gravel, little Silt.
			7		21.0			
20		34	10					
			8					
		39						
		54						

BLOWS/FT.	DENSITY
0 - 4	Very Loose
4 - 10	Loose
10 - 30	Medium Dense
30 - 50	Dense
50 +	Very Dense

BLOWS/FT.	CONSISTENCY
0 - 2	Very Soft
2 - 4	Soft
4 - 8	Medium Stiff
8 - 15	Stiff
15 - 30	Very Stiff
30+	Hard

SAMPLE IDENTIFICATION
- S - Split Spoon
- T - Thin Wall Tube
- U - Undisturbed Piston
- C - Diamond Core
- B - Bulk/Grab Sample

SUMMARY
Station:
Rock:
Samples:

BORING MGA-2

McArdle Gannon Associates, Inc. Engineers & Consultants	TEST BORING LOG	BORING MGA-2
PROJECT: Proposed Addition - 115 Coggeshall Street, New Bedford, MA **CLIENT:** Ascend Wellness Holdings LLC		**MGA NO. : W0825** **SHEET NO. : 2 of 2**

Depth in Feet	Strata Change	Case BPF (Drill) (min/ft)	Sampler Blows Per 6" (RQD%)	Sample Number/ Type	Sample Depth Range (ft)	Sample Recov-ery (in)	Elev-ation/ Depth (ft)	FIELD CLASSIFICATION AND REMARKS
		59						
24		25	2 4 4 8	S-10	24.0 26.0	8		Loose, gray, fine to coarse SAND, some (-) fine Gravel, trace Silt.
		41						
		58						
		67						
28		59						
		25	6 2 5 7	S-11	29.0 31.0	10		Loose, gray, fine to coarse SAND, some (-) fine Gravel, trace Silt.
		49						
		67						
32		82						-SAND-
		102						
			4 5 5 12	S-12	34.0 36.0	9		Loose to medium dense, gray, fine to medium SAND, little Silt.
36							-36.0 36.0	BOTTOM OF BORING AT 36 FEET.
40								
44								
48								

BLOWS/FT.	DENSITY
0 - 4	Very Loose
4 - 10	Loose
10 - 30	Medium Dense
30 - 50	Dense
50 +	Very Dense

BLOWS/FT.	CONSISTENCY
0 - 2	Very Soft
2 - 4	Soft
4 - 8	Medium Stiff
8 - 15	Stiff
15 - 30	Very Stiff
30+	Hard

SAMPLE IDENTIFICATION

- S - Split Spoon
- T - Thin Wall Tube
- U - Undisturbed Piston
- C - Diamond Core
- B - Bulk/Grab Sample

SUMMARY

Station:
Rock:
Samples:

BORING MGA-2

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KEY TO SYMBOLS

Symbol	Description
Strata symbols	
	Asphalt
	Fill
	Sand & Silt
	Sand
	Silty sand and gravel
Soil Samplers	
	Split Spoon

Notes:

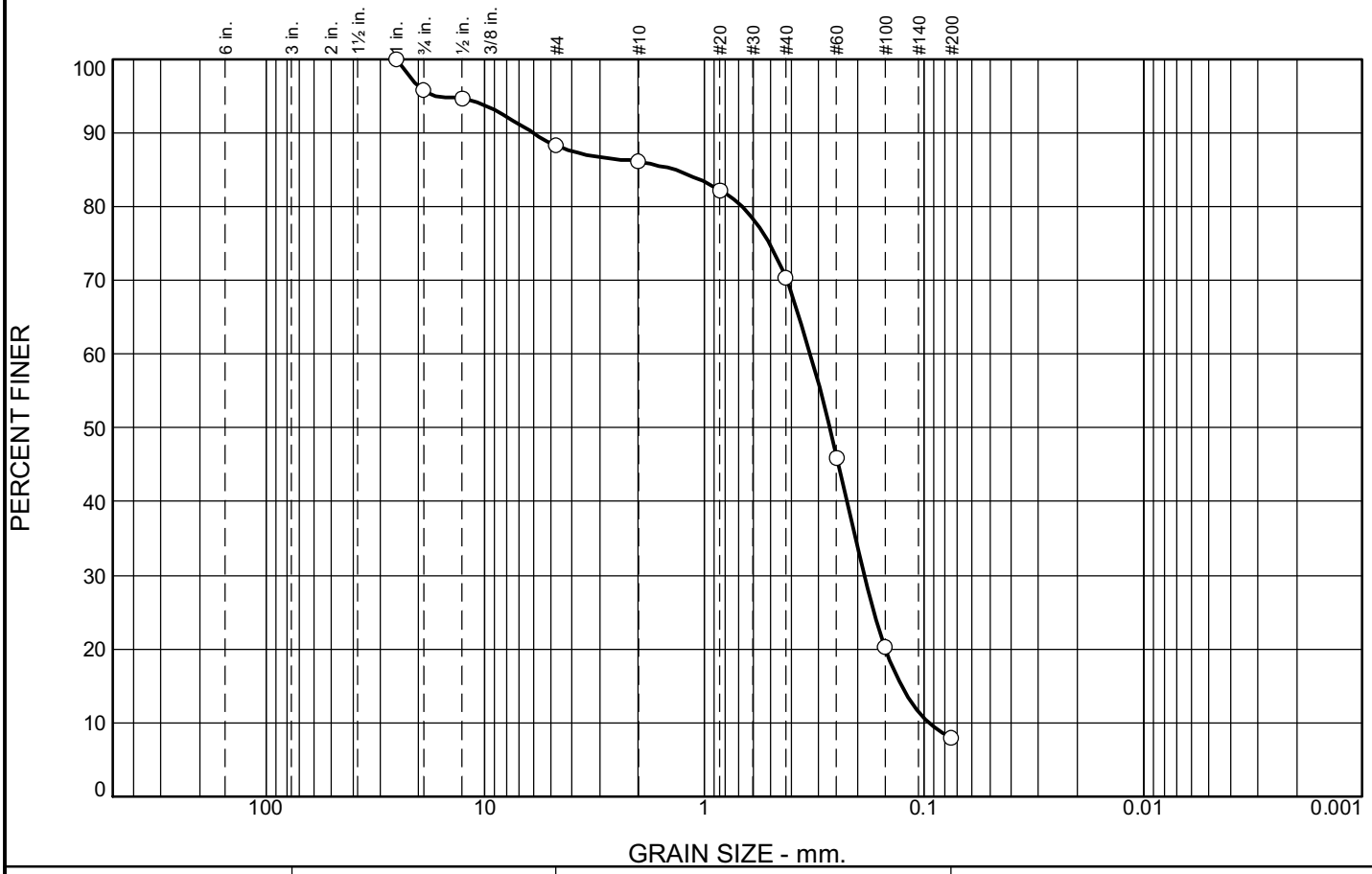
1. Test borings performed by New England Boring Contractors on September 28, 2020 using a truck mounted drill rig equipped with a 140-pound automatic hammer.

2. Ground surface elevations were not available.

3. MGA observed and logged the borings.

APPENDIX C: GEOTECHNICAL LABORATORY TEST RESULTS

PARTICLE SIZE DISTRIBUTION REPORT



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	4.2	7.5	2.2	15.8	62.4	7.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
3/4	95.8		
1/2	94.7		
#4	88.3		
#10	86.1		
#20	82.2		
#40	70.3		
#60	46.0		
#100	20.3		
#200	7.9		

* (no specification provided)

Material Description

Gray-brown, fine to medium SAND, little (-) fine Gravel, trace (+) Silt.

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 6.0709 D_{85}= 1.3739 D_{60}= 0.3290
D_{50}= 0.2694 D_{30}= 0.1862 D_{15}= 0.1264
D_{10}= 0.0944 C_u= 3.49 C_c= 1.12

Classification

USCS= AASHTO=

Remarks

Existing Fill
Water Content: 4.1%

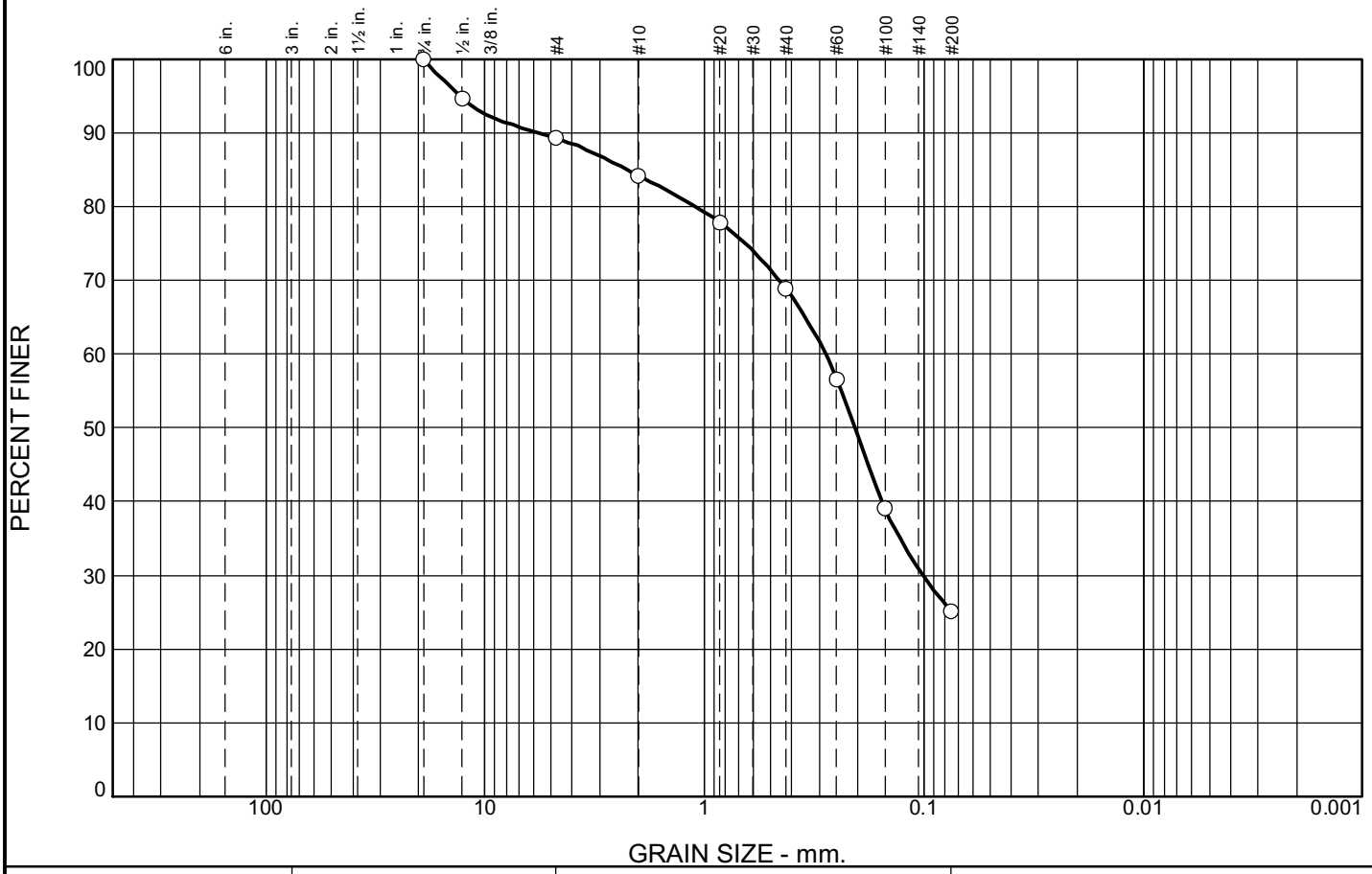
Source of Sample: MGA-1 **Depth:** 2-4'
Sample Number: S-2

Date: 09/30/2020

McArdle Gannon Associates, Inc.
Engineers & Consultants

Client: Ascend Wellness Holdings LLC
Project: Proposed Addition
115 Coggeshall Street, New Bedford, MA
Project No: W0825 **Figure**

PARTICLE SIZE DISTRIBUTION REPORT



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	10.7	5.1	15.3	43.7	25.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
1/2	94.7		
#4	89.3		
#10	84.2		
#20	77.8		
#40	68.9		
#60	56.6		
#100	39.1		
#200	25.2		

* (no specification provided)

Material Description

Brown, fine to medium SAND, some Silt, little (-) fine Gravel. [Contains trace (-) Brick]

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 5.6279 D_{85}= 2.2539 D_{60}= 0.2809
D_{50}= 0.2060 D_{30}= 0.1013 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Existing Fill
Water Content: 7.2%

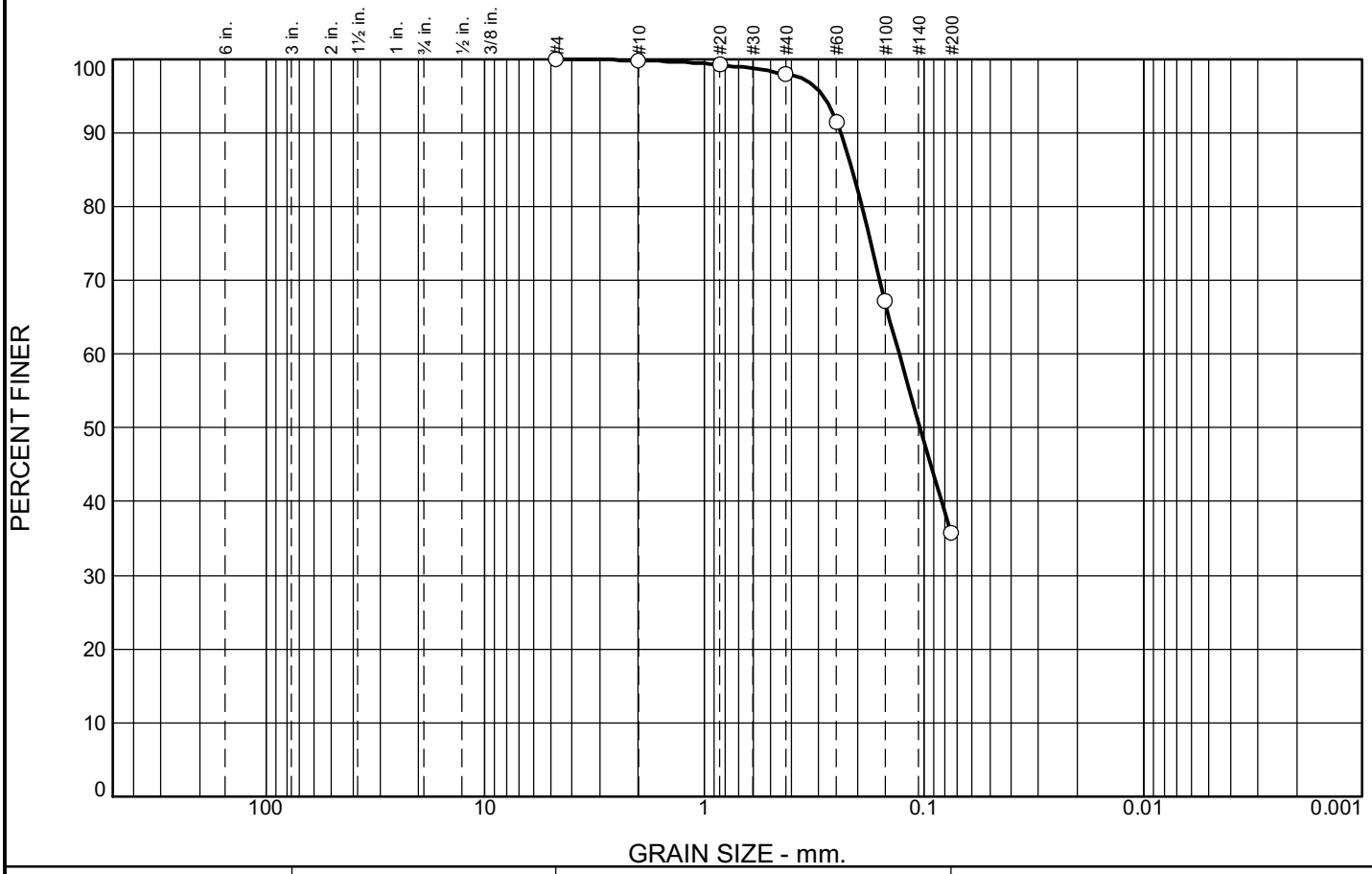
Source of Sample: MGA-2 **Depth:** 0-2'
Sample Number: S-1

Date: 09/30/2020

McArdle Gannon Associates, Inc.
Engineers & Consultants

Client: Ascend Wellness Holdings LLC
Project: Proposed Addition
115 Coggeshall Street, New Bedford, MA
Project No: W0825 **Figure**

PARTICLE SIZE DISTRIBUTION REPORT



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.2	1.8	62.2	35.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.8		
#20	99.2		
#40	98.0		
#60	91.4		
#100	67.3		
#200	35.8		

* (no specification provided)

Material Description

Beige, fine SAND and SILT.

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.2396 D_{85}= 0.2121 D_{60}= 0.1297
D_{50}= 0.1044 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Natural Sand & Silt
Water Content: 21.1%

Source of Sample: MGA-2 **Depth:** 5-6'
Sample Number: S-3A

Date: 09/30/2020

McArdle Gannon Associates, Inc.
Engineers & Consultants

Client: Ascend Wellness Holdings LLC
Project: Proposed Addition
115 Coggeshall Street, New Bedford, MA
Project No: W0825 **Figure**

Fuss & O'Neill
MGA-1
Gravel: 11.7%
Sand: 80.4%
Silt: 7.9%
Clay: 0%

Recalculated as percentage of Sand, Silt, & Clay, omitting Gravel:

Sand: 91.1%
Silt: 8.9%
Clay: 0%

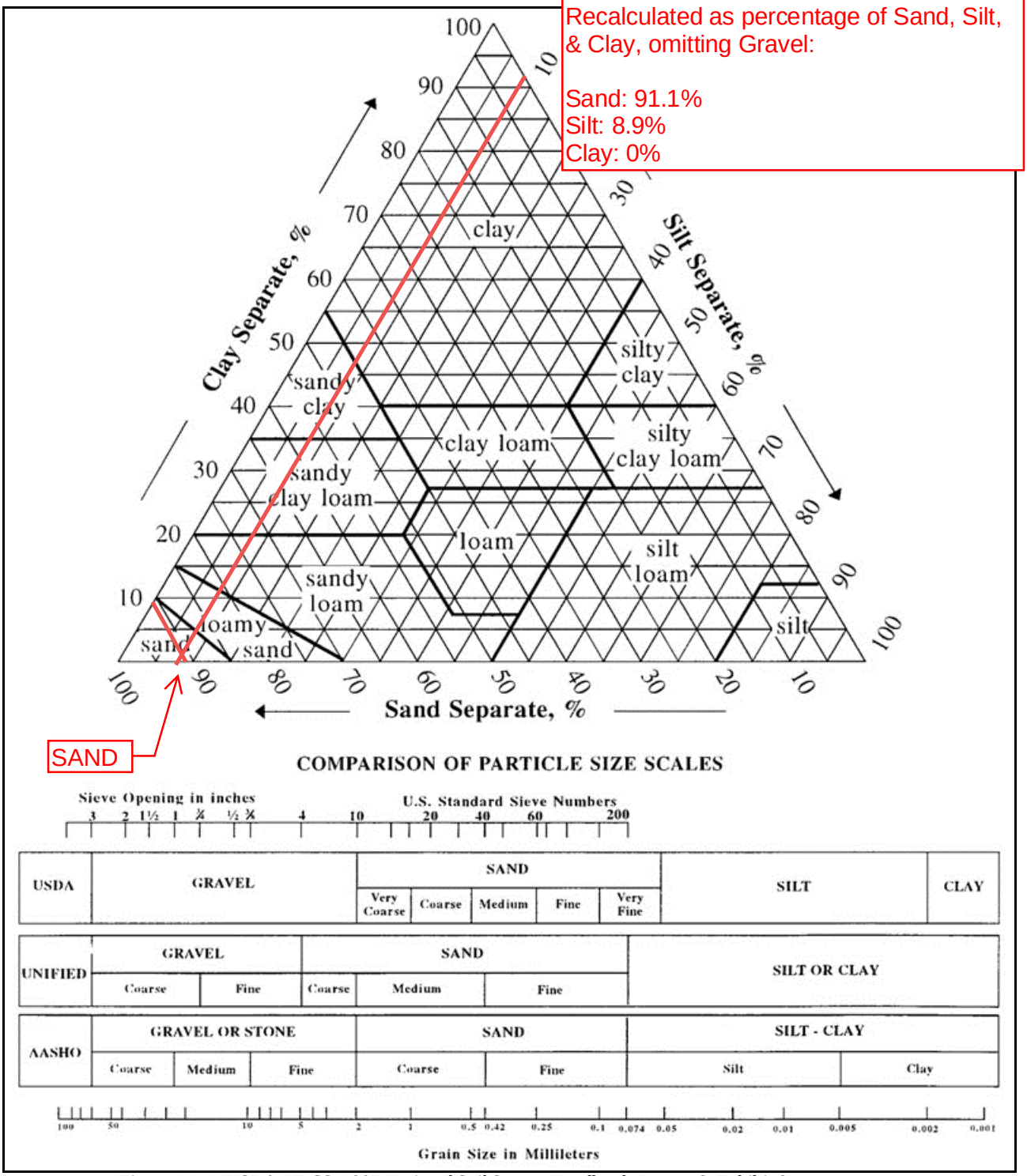


Figure 2.3.2: USDA, NRCS, 2007 National Soil Survey Handbook, Part 618, Exhibit 8, http://soils.usda.gov/technical/handbook/contents/part618ex.html#ex8

Fuss & O'Neill
MGA-2
Gravel: 10.7%
Sand: 64.1%
Silt: 25.2%
Clay: 0%

Recalculated as percentage of Sand, Silt, & Clay, omitting Gravel:

Sand: 71.8%
Silt: 28.2%
Clay: 0%

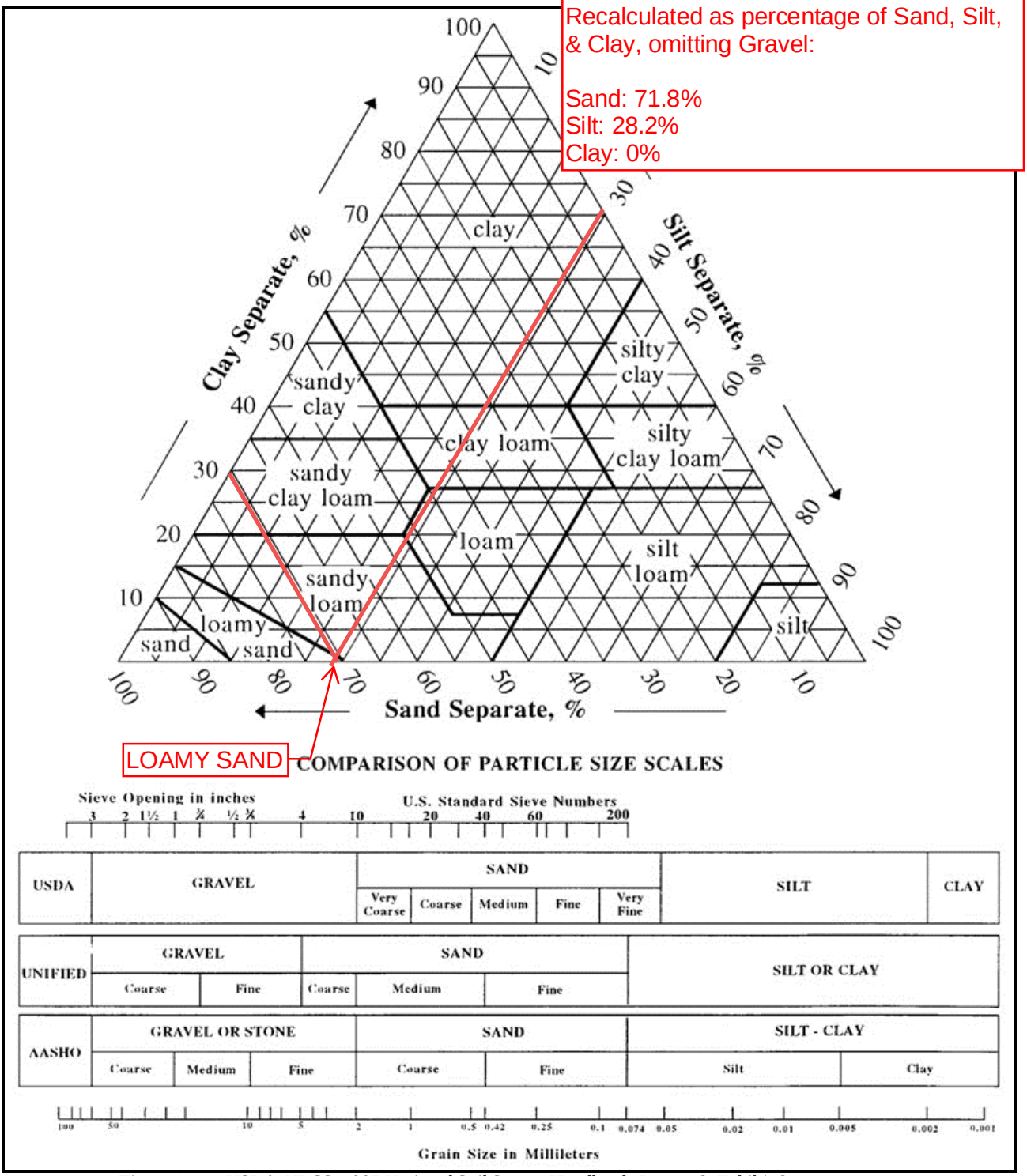


Figure 2.3.2: USDA, NRCS, 2007 National Soil Survey Handbook, Part 618, Exhibit 8, http://soils.usda.gov/technical/handbook/contents/part618ex.html#ex8

Fuss & O'Neill
MGA-2
Gravel: 0%
Sand: 64.2%
Silt: 35.8%
Clay: 0%

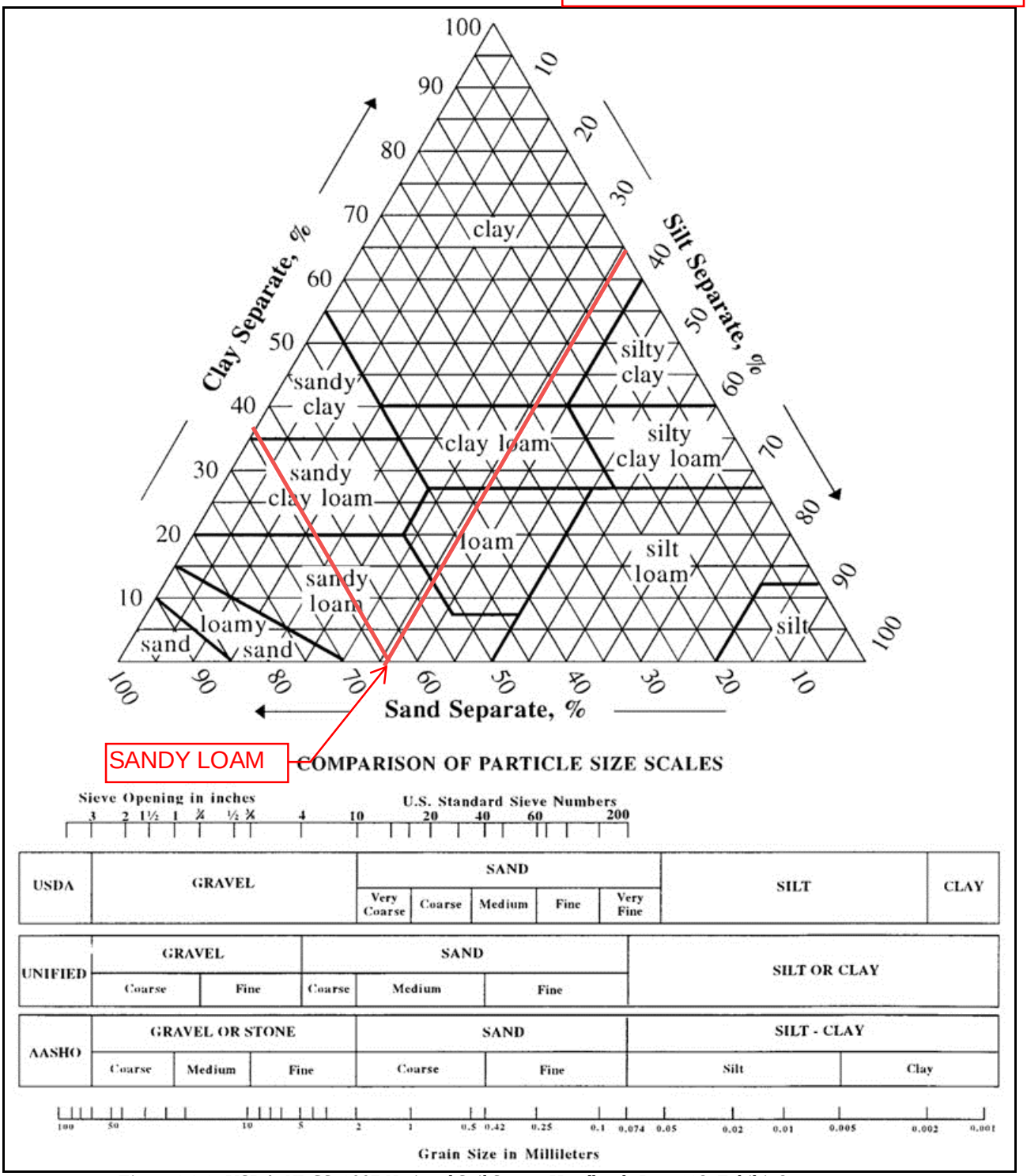
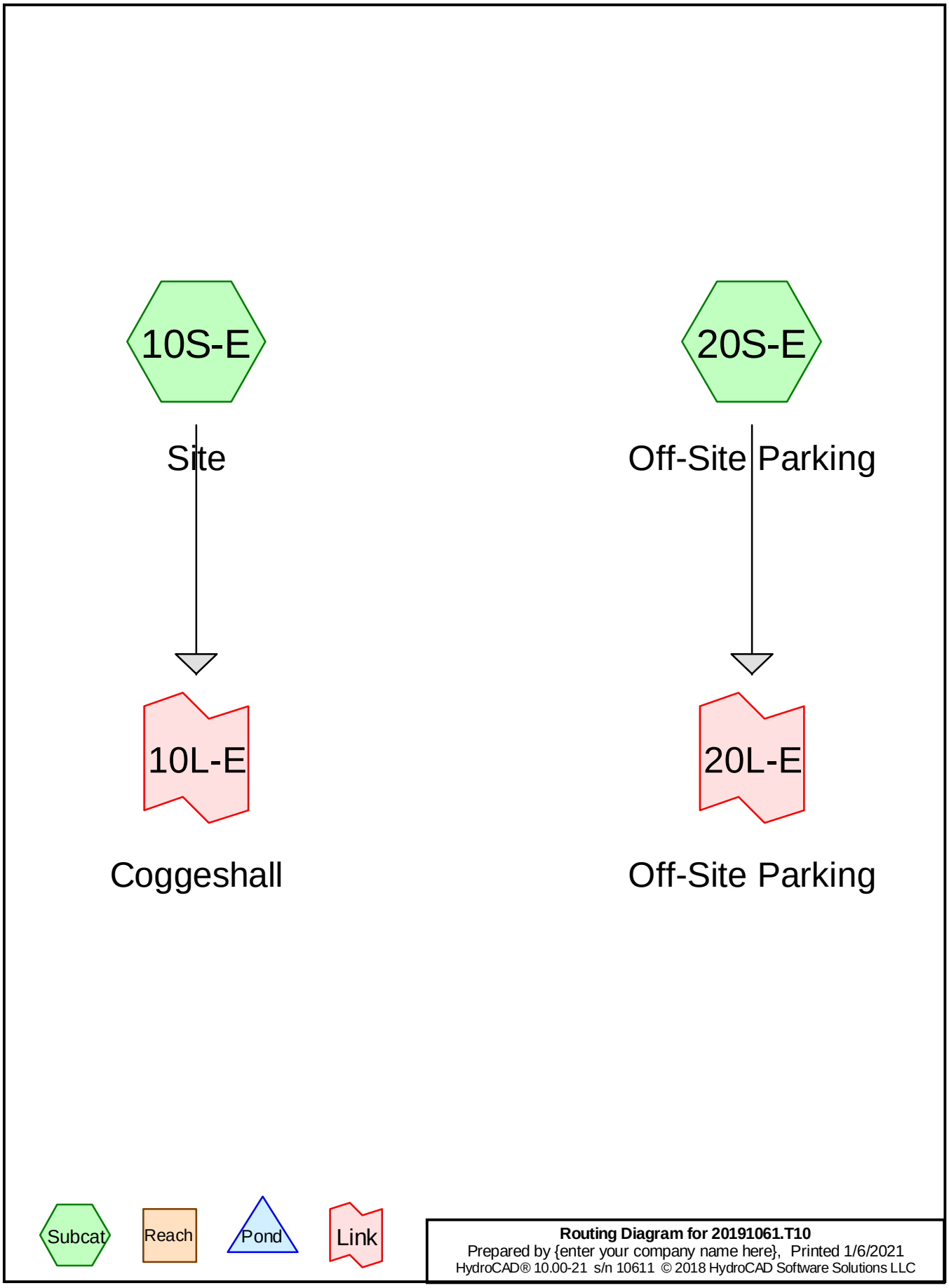


Figure 2.3.2: USDA, NRCS, 2007 National Soil Survey Handbook, Part 618, Exhibit 8, http://soils.usda.gov/technical/handbook/contents/part618ex.html#ex8

FUSS & O'NEILL

Appendix B

Pre-Development Watershed Analysis


10S-E
Site
20S-E
Off-Site Parking
10L-E
Coggeshall
20L-E
Off-Site Parking
Subcat
Reach
Pond
Link
Routing Diagram for 20191061.T10
Prepared by {enter your company name here}, Printed 1/6/2021
HydroCAD® 10.00-21 s/n 10611 © 2018 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
2,470	39	>75% Grass cover, Good, HSG A (10S-E, 20S-E)
7,288	98	Paved parking, HSG A (10S-E, 20S-E)
4,172	98	Roofs, HSG A (10S-E)
13,930	**88**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
13,930	HSG A	10S-E, 20S-E
0	HSG B	
0	HSG C	
0	HSG D	
0	Other	
13,930		**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Subcatch Numbers
2,470	0	0	0	0	2,470	>75% Grass cover, Good	
7,288	0	0	0	0	7,288	Paved parking	
4,172	0	0	0	0	4,172	Roofs	
13,930	**0**	**0**	**0**	**0**	**13,930**	**TOTAL AREA**	

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10S-E: Site Runoff Area=12,932 sf 81.36% Impervious Runoff Depth=2.00"
Tc=5.0 min CN=87 Runoff=0.72 cfs 2,159 cf

Subcatchment 20S-E: Off-Site Parking Runoff Area=998 sf 94.09% Impervious Runoff Depth=2.74"
Tc=5.0 min CN=95 Runoff=0.07 cfs 228 cf

Link 10L-E: Coggeshall Inflow=0.72 cfs 2,159 cf
Primary=0.72 cfs 2,159 cf

Link 20L-E: Off-Site Parking Inflow=0.07 cfs 228 cf
Primary=0.07 cfs 228 cf

Total Runoff Area = 13,930 sf Runoff Volume = 2,387 cf Average Runoff Depth = 2.06"
17.73% Pervious = 2,470 sf 82.27% Impervious = 11,460 sf

Summary for Subcatchment 10S-E: Site

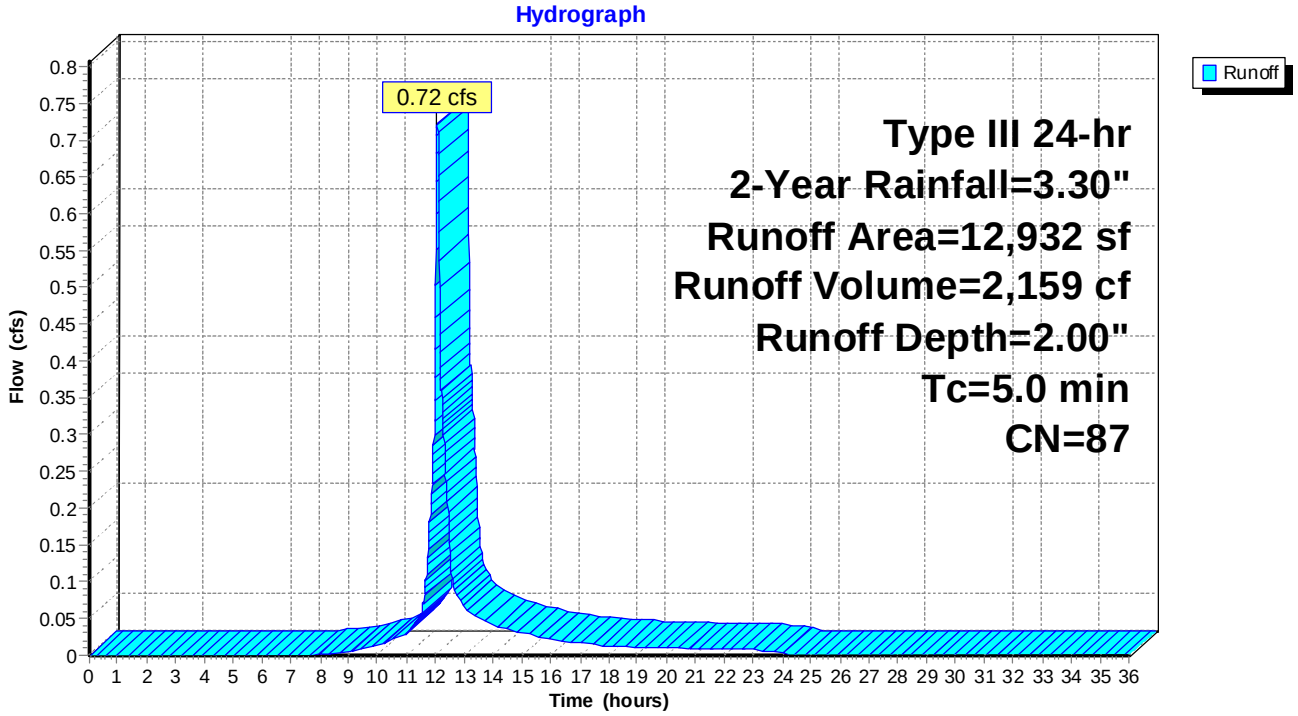
Runoff = 0.72 cfs @ 12.07 hrs, Volume= 2,159 cf, Depth= 2.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.30"

Area (sf)	CN	Description
2,411	39	>75% Grass cover, Good, HSG A
6,349	98	Paved parking, HSG A
4,172	98	Roofs, HSG A
12,932	87	Weighted Average
2,411		18.64% Pervious Area
10,521		81.36% Impervious Area

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

Subcatchment 10S-E: Site



Summary for Subcatchment 20S-E: Off-Site Parking

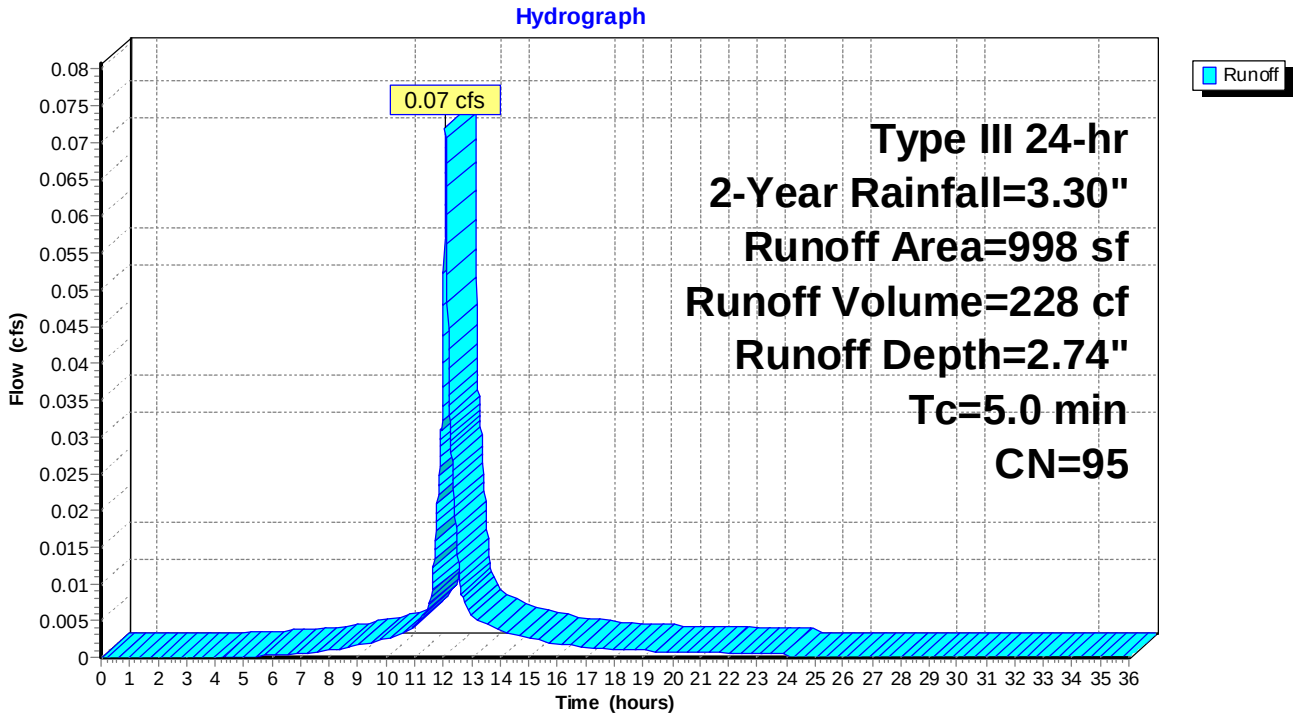
Runoff = 0.07 cfs @ 12.07 hrs, Volume= 228 cf, Depth= 2.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.30"

Area (sf)	CN	Description
59	39	>75% Grass cover, Good, HSG A
939	98	Paved parking, HSG A
998	95	Weighted Average
59		5.91% Pervious Area
939		94.09% Impervious Area

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

Subcatchment 20S-E: Off-Site Parking

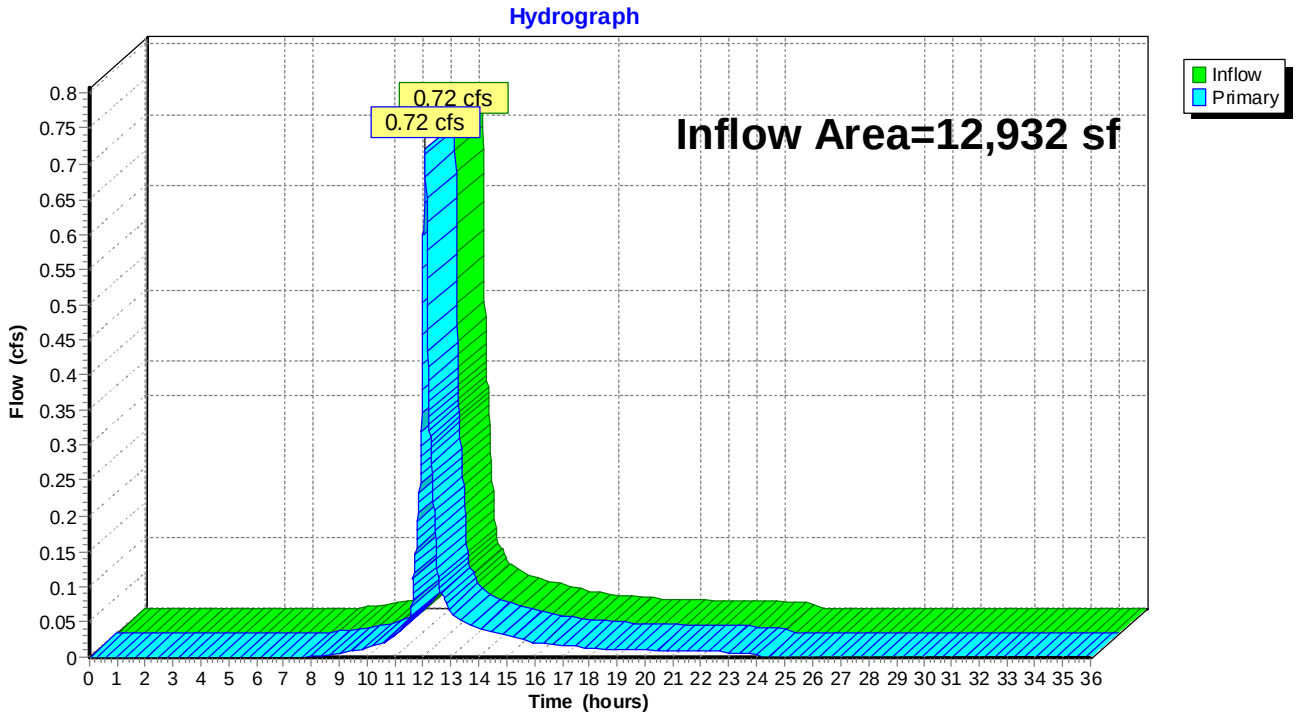


Summary for Link 10L-E: Coggeshall

Inflow Area = 12,932 sf, 81.36% Impervious, Inflow Depth = 2.00" for 2-Year event
Inflow = 0.72 cfs @ 12.07 hrs, Volume= 2,159 cf
Primary = 0.72 cfs @ 12.07 hrs, Volume= 2,159 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 10L-E: Coggeshall

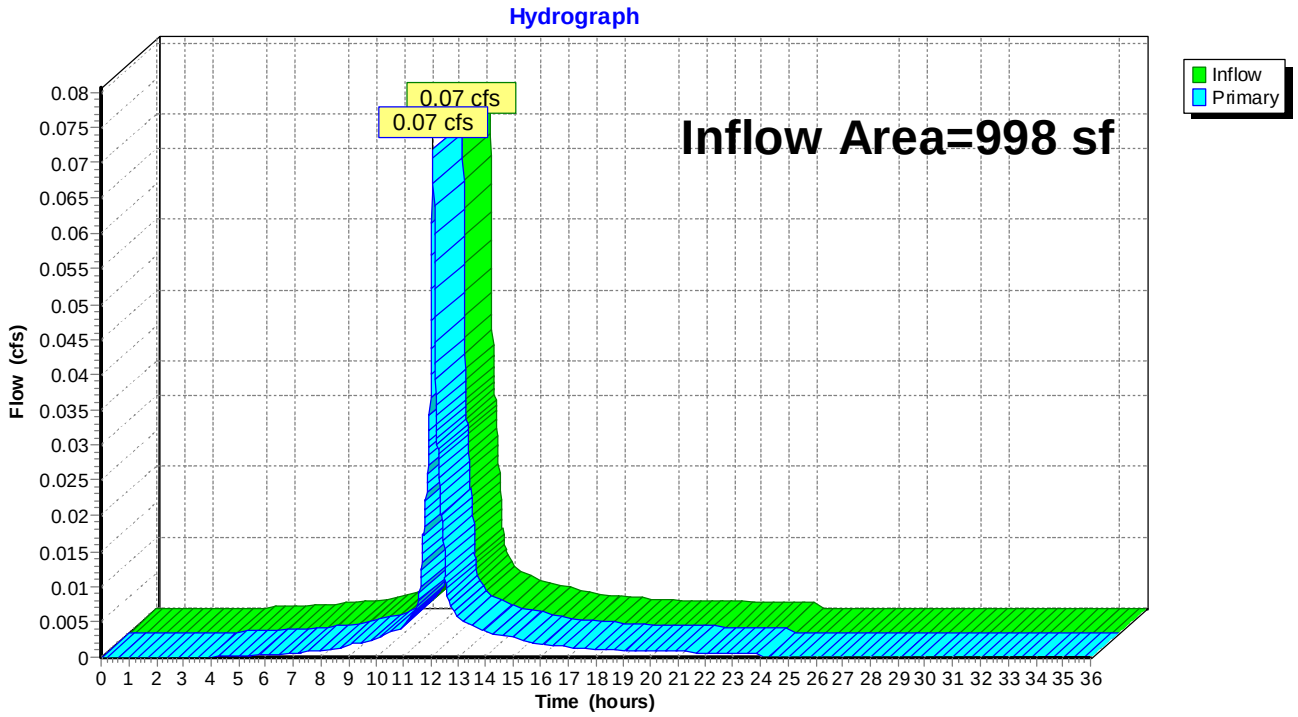


Summary for Link 20L-E: Off-Site Parking

Inflow Area = 998 sf, 94.09% Impervious, Inflow Depth = 2.74" for 2-Year event
Inflow = 0.07 cfs @ 12.07 hrs, Volume= 228 cf
Primary = 0.07 cfs @ 12.07 hrs, Volume= 228 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 20L-E: Off-Site Parking



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10S-E: Site Runoff Area=12,932 sf 81.36% Impervious Runoff Depth=3.45"
Tc=5.0 min CN=87 Runoff=1.23 cfs 3,723 cf

Subcatchment 20S-E: Off-Site Parking Runoff Area=998 sf 94.09% Impervious Runoff Depth=4.30"
Tc=5.0 min CN=95 Runoff=0.11 cfs 358 cf

Link 10L-E: Coggeshall Inflow=1.23 cfs 3,723 cf
Primary=1.23 cfs 3,723 cf

Link 20L-E: Off-Site Parking Inflow=0.11 cfs 358 cf
Primary=0.11 cfs 358 cf

Total Runoff Area = 13,930 sf Runoff Volume = 4,080 cf Average Runoff Depth = 3.52"
17.73% Pervious = 2,470 sf 82.27% Impervious = 11,460 sf

Summary for Subcatchment 10S-E: Site

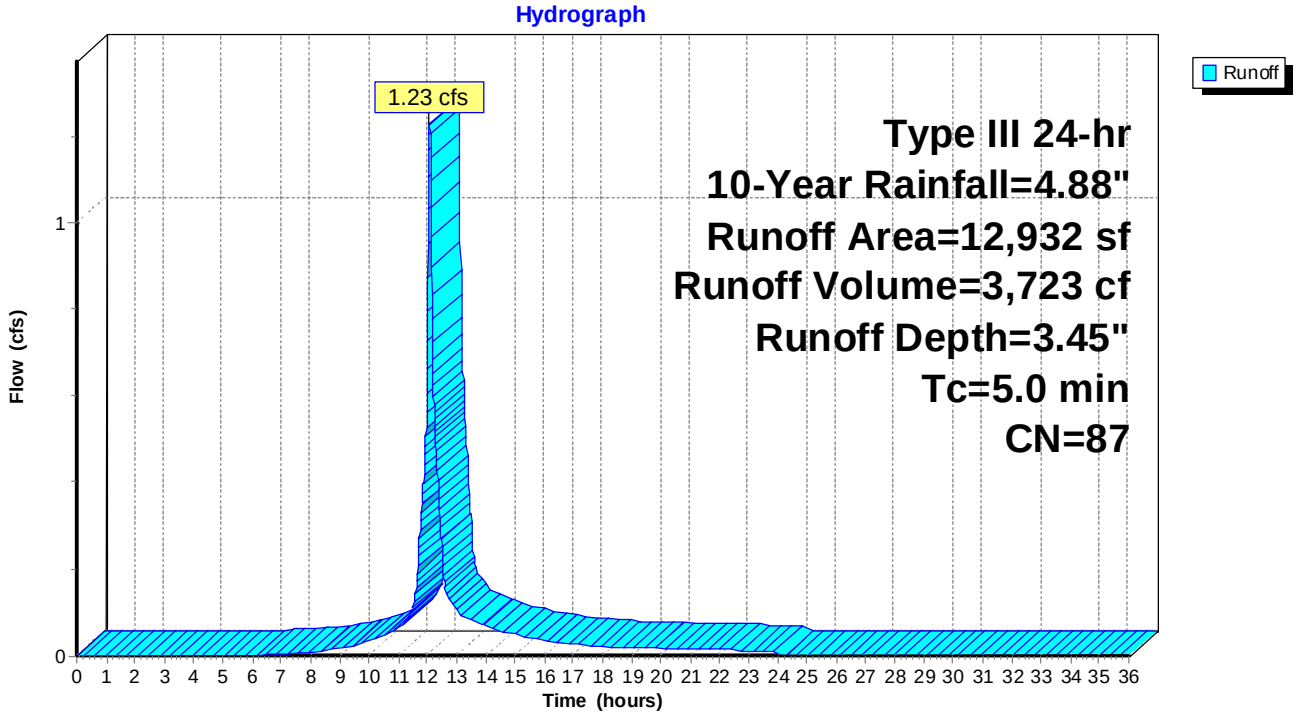
Runoff = 1.23 cfs @ 12.07 hrs, Volume= 3,723 cf, Depth= 3.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.88"

Area (sf)	CN	Description
2,411	39	>75% Grass cover, Good, HSG A
6,349	98	Paved parking, HSG A
4,172	98	Roofs, HSG A
12,932	87	Weighted Average
2,411		18.64% Pervious Area
10,521		81.36% Impervious Area

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

Subcatchment 10S-E: Site



Summary for Subcatchment 20S-E: Off-Site Parking

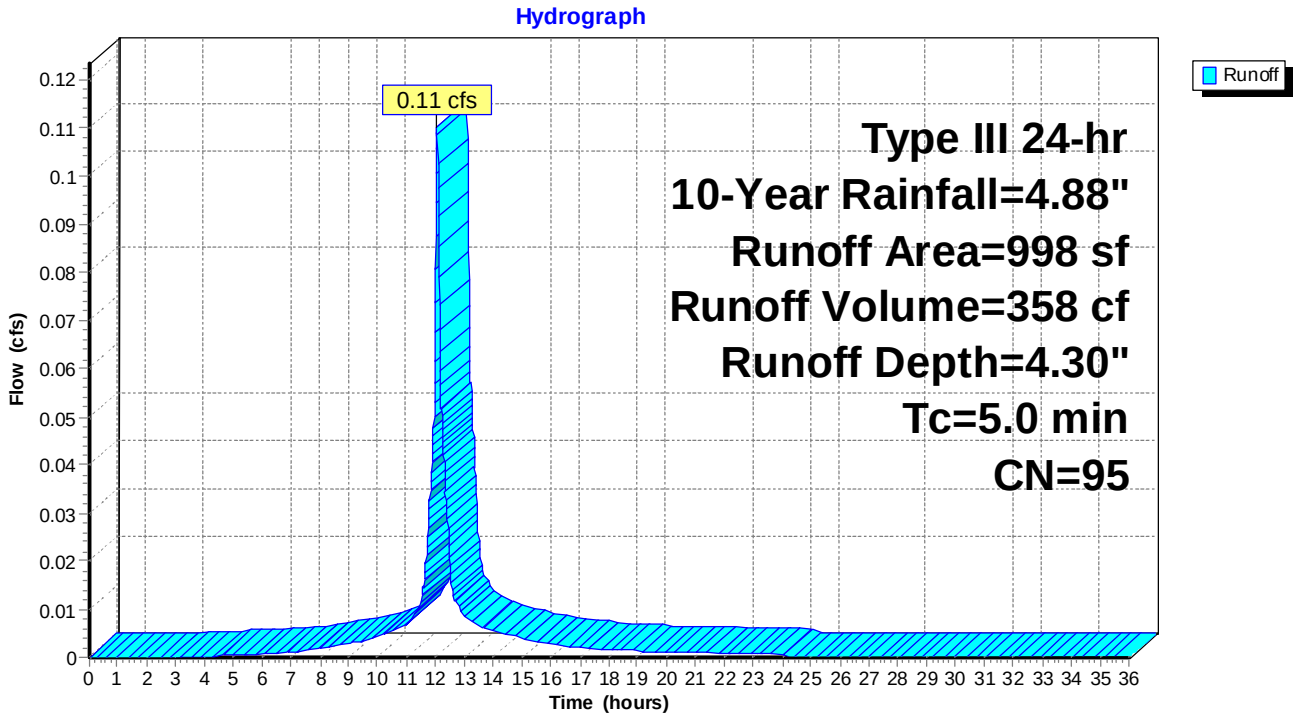
Runoff = 0.11 cfs @ 12.07 hrs, Volume= 358 cf, Depth= 4.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.88"

Area (sf)	CN	Description
59	39	>75% Grass cover, Good, HSG A
939	98	Paved parking, HSG A
998	95	Weighted Average
59		5.91% Pervious Area
939		94.09% Impervious Area

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

Subcatchment 20S-E: Off-Site Parking

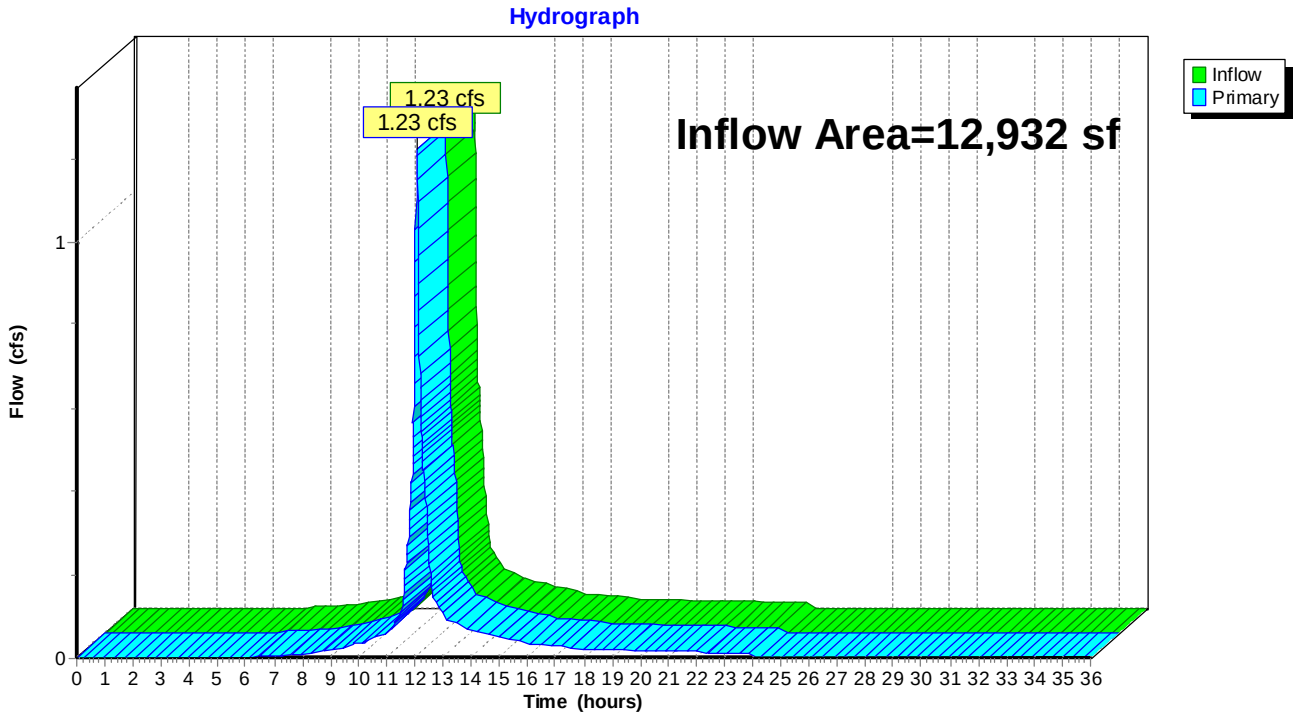


Summary for Link 10L-E: Coggeshall

Inflow Area = 12,932 sf, 81.36% Impervious, Inflow Depth = 3.45" for 10-Year event
Inflow = 1.23 cfs @ 12.07 hrs, Volume= 3,723 cf
Primary = 1.23 cfs @ 12.07 hrs, Volume= 3,723 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 10L-E: Coggeshall

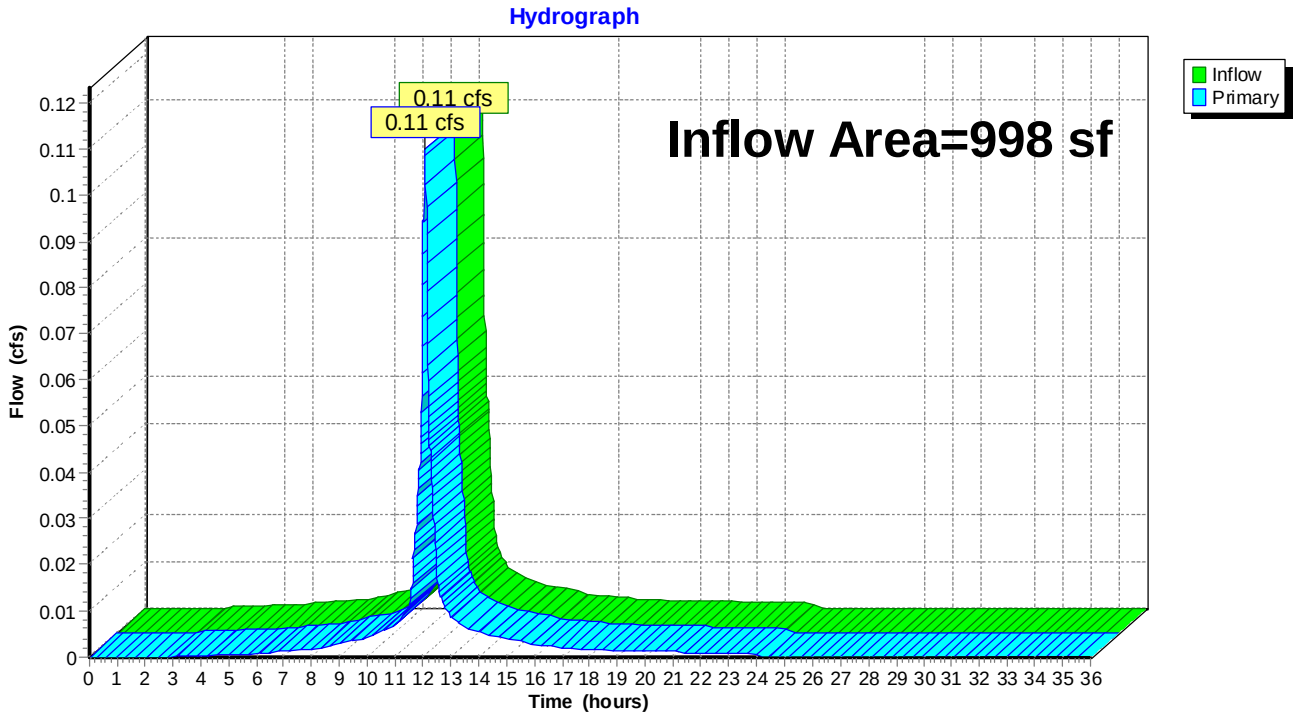


Summary for Link 20L-E: Off-Site Parking

Inflow Area = 998 sf, 94.09% Impervious, Inflow Depth = 4.30" for 10-Year event
Inflow = 0.11 cfs @ 12.07 hrs, Volume= 358 cf
Primary = 0.11 cfs @ 12.07 hrs, Volume= 358 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 20L-E: Off-Site Parking



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10S-E: Site Runoff Area=12,932 sf 81.36% Impervious Runoff Depth=4.61"
Tc=5.0 min CN=87 Runoff=1.61 cfs 4,971 cf

Subcatchment 20S-E: Off-Site Parking Runoff Area=998 sf 94.09% Impervious Runoff Depth=5.51"
Tc=5.0 min CN=95 Runoff=0.14 cfs 458 cf

Link 10L-E: Coggeshall Inflow=1.61 cfs 4,971 cf
Primary=1.61 cfs 4,971 cf

Link 20L-E: Off-Site Parking Inflow=0.14 cfs 458 cf
Primary=0.14 cfs 458 cf

Total Runoff Area = 13,930 sf Runoff Volume = 5,430 cf Average Runoff Depth = 4.68"
17.73% Pervious = 2,470 sf 82.27% Impervious = 11,460 sf

Summary for Subcatchment 10S-E: Site

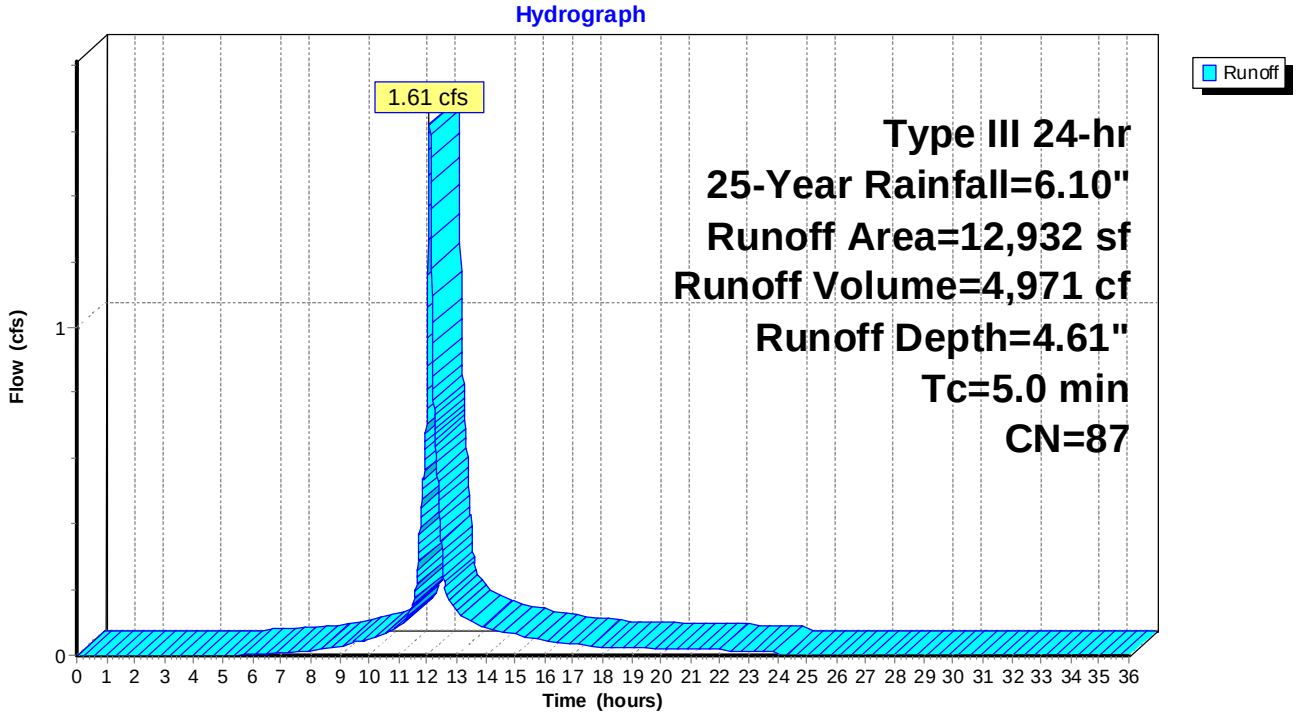
Runoff = 1.61 cfs @ 12.07 hrs, Volume= 4,971 cf, Depth= 4.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.10"

Area (sf)	CN	Description
2,411	39	>75% Grass cover, Good, HSG A
6,349	98	Paved parking, HSG A
4,172	98	Roofs, HSG A
12,932	87	Weighted Average
2,411		18.64% Pervious Area
10,521		81.36% Impervious Area

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

Subcatchment 10S-E: Site



Summary for Subcatchment 20S-E: Off-Site Parking

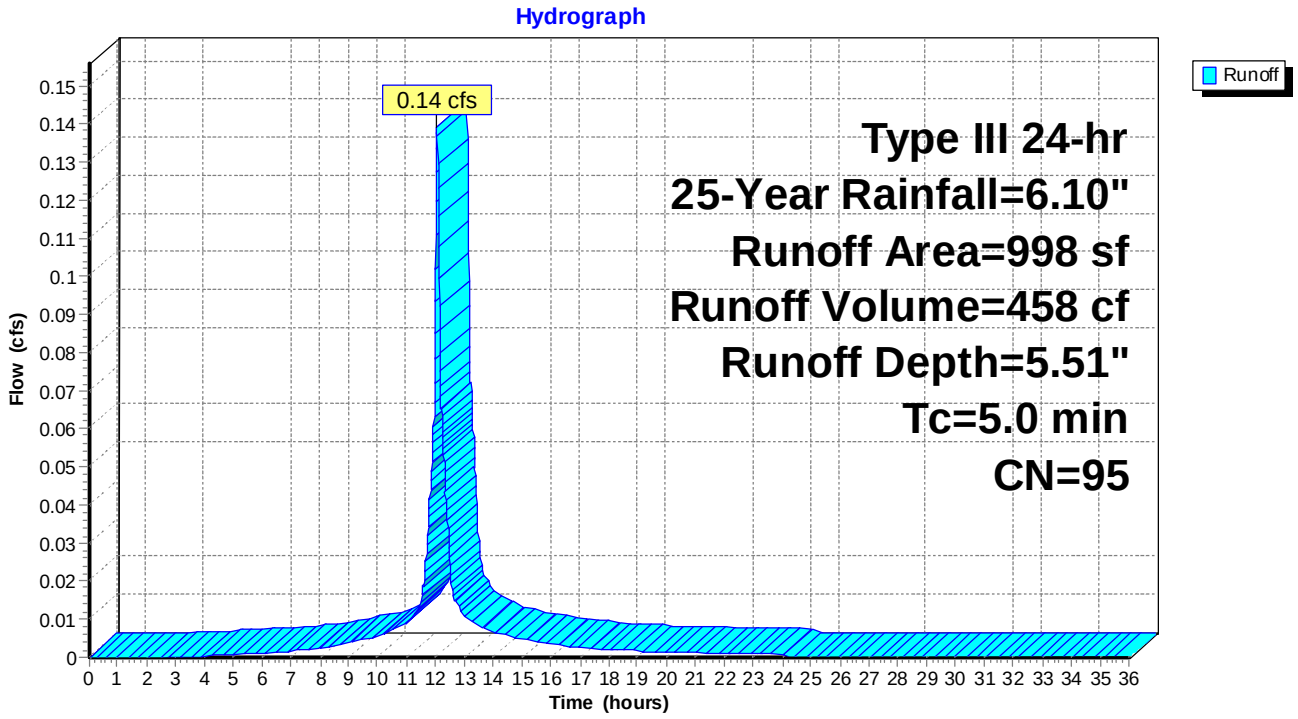
Runoff = 0.14 cfs @ 12.07 hrs, Volume= 458 cf, Depth= 5.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.10"

Area (sf)	CN	Description
59	39	>75% Grass cover, Good, HSG A
939	98	Paved parking, HSG A
998	95	Weighted Average
59		5.91% Pervious Area
939		94.09% Impervious Area

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

Subcatchment 20S-E: Off-Site Parking

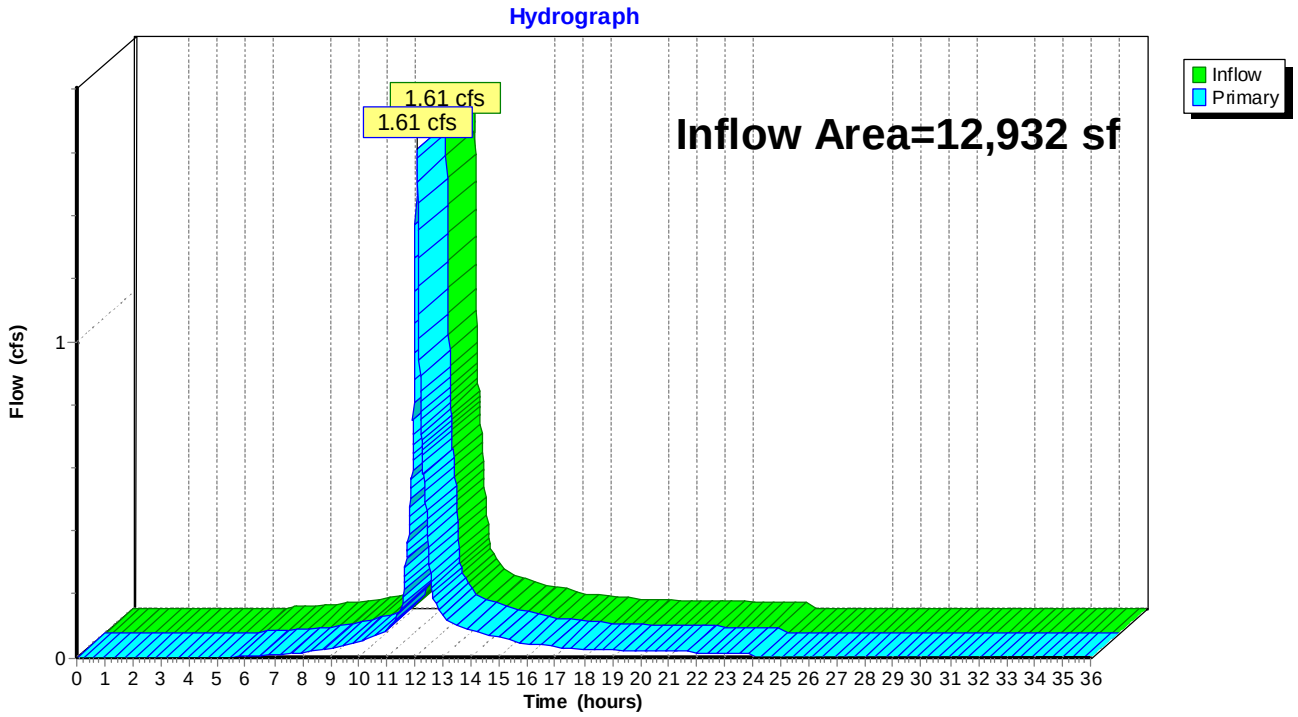


Summary for Link 10L-E: Coggeshall

Inflow Area = 12,932 sf, 81.36% Impervious, Inflow Depth = 4.61" for 25-Year event
Inflow = 1.61 cfs @ 12.07 hrs, Volume= 4,971 cf
Primary = 1.61 cfs @ 12.07 hrs, Volume= 4,971 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 10L-E: Coggeshall

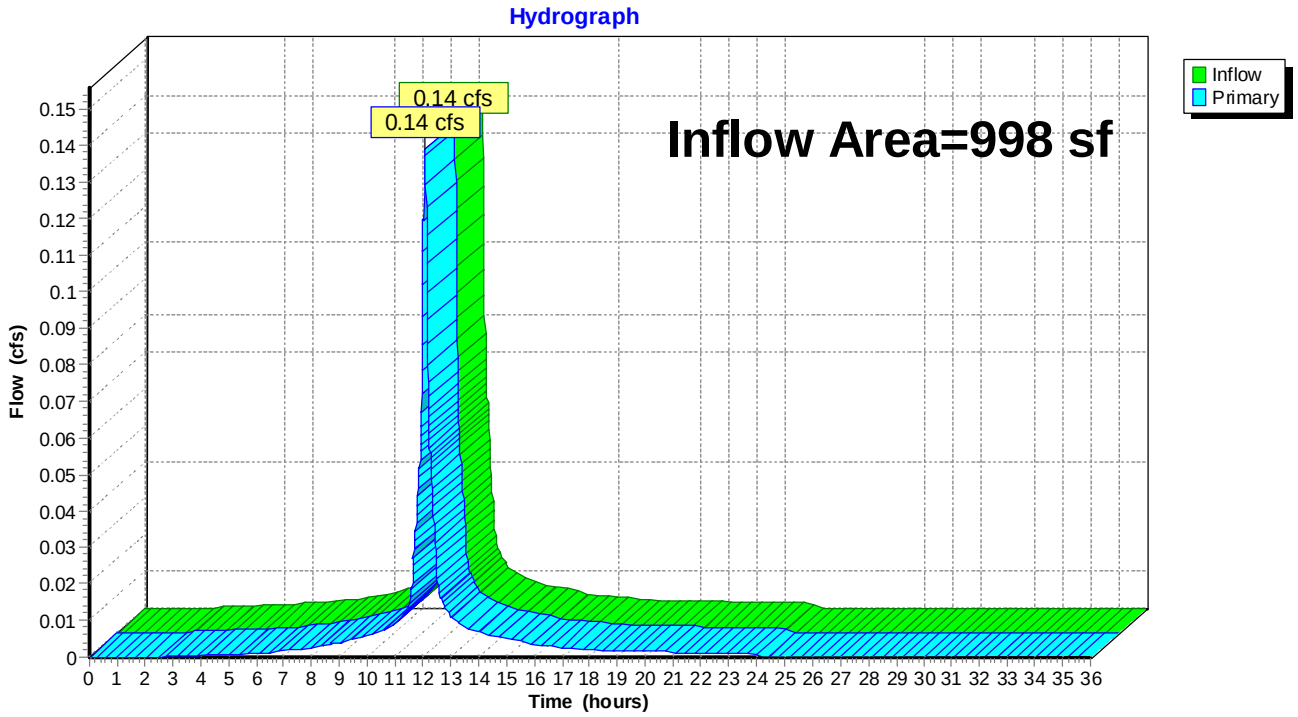


Summary for Link 20L-E: Off-Site Parking

Inflow Area = 998 sf, 94.09% Impervious, Inflow Depth = 5.51" for 25-Year event
Inflow = 0.14 cfs @ 12.07 hrs, Volume= 458 cf
Primary = 0.14 cfs @ 12.07 hrs, Volume= 458 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 20L-E: Off-Site Parking



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10S-E: Site Runoff Area=12,932 sf 81.36% Impervious Runoff Depth=7.00"
Tc=5.0 min CN=87 Runoff=2.40 cfs 7,539 cf

Subcatchment 20S-E: Off-Site Parking Runoff Area=998 sf 94.09% Impervious Runoff Depth=7.96"
Tc=5.0 min CN=95 Runoff=0.20 cfs 662 cf

Link 10L-E: Coggeshall Inflow=2.40 cfs 7,539 cf
Primary=2.40 cfs 7,539 cf

Link 20L-E: Off-Site Parking Inflow=0.20 cfs 662 cf
Primary=0.20 cfs 662 cf

Total Runoff Area = 13,930 sf Runoff Volume = 8,201 cf Average Runoff Depth = 7.06"
17.73% Pervious = 2,470 sf 82.27% Impervious = 11,460 sf

Summary for Subcatchment 10S-E: Site

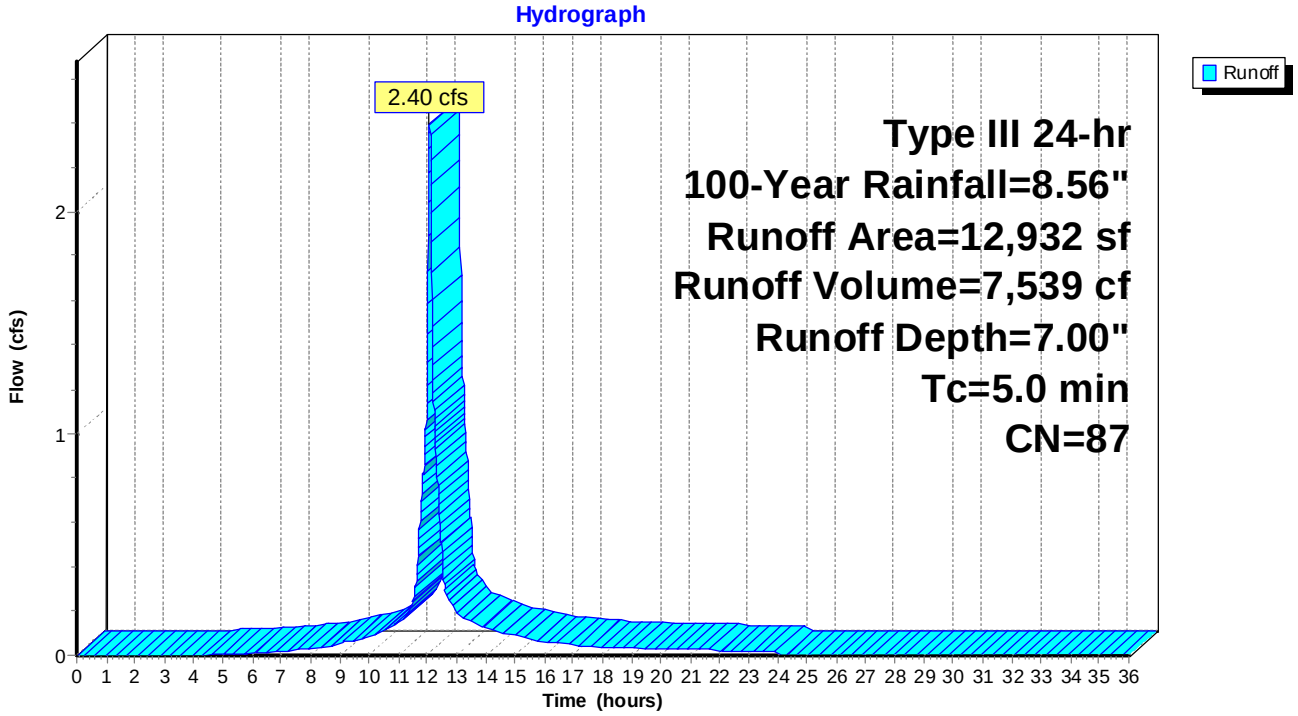
Runoff = 2.40 cfs @ 12.07 hrs, Volume= 7,539 cf, Depth= 7.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.56"

Area (sf)	CN	Description
2,411	39	>75% Grass cover, Good, HSG A
6,349	98	Paved parking, HSG A
4,172	98	Roofs, HSG A
12,932	87	Weighted Average
2,411		18.64% Pervious Area
10,521		81.36% Impervious Area

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

Subcatchment 10S-E: Site



Summary for Subcatchment 20S-E: Off-Site Parking

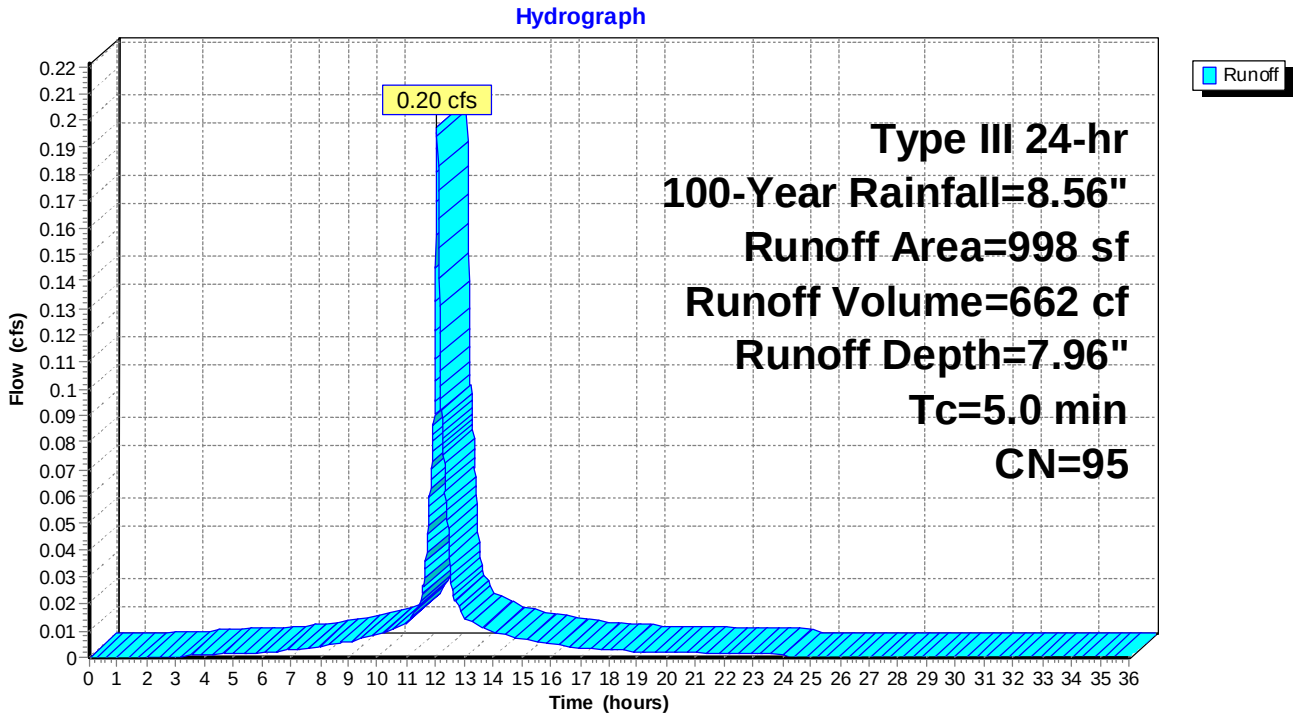
Runoff = 0.20 cfs @ 12.07 hrs, Volume= 662 cf, Depth= 7.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.56"

Area (sf)	CN	Description
59	39	>75% Grass cover, Good, HSG A
939	98	Paved parking, HSG A
998	95	Weighted Average
59		5.91% Pervious Area
939		94.09% Impervious Area

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

Subcatchment 20S-E: Off-Site Parking

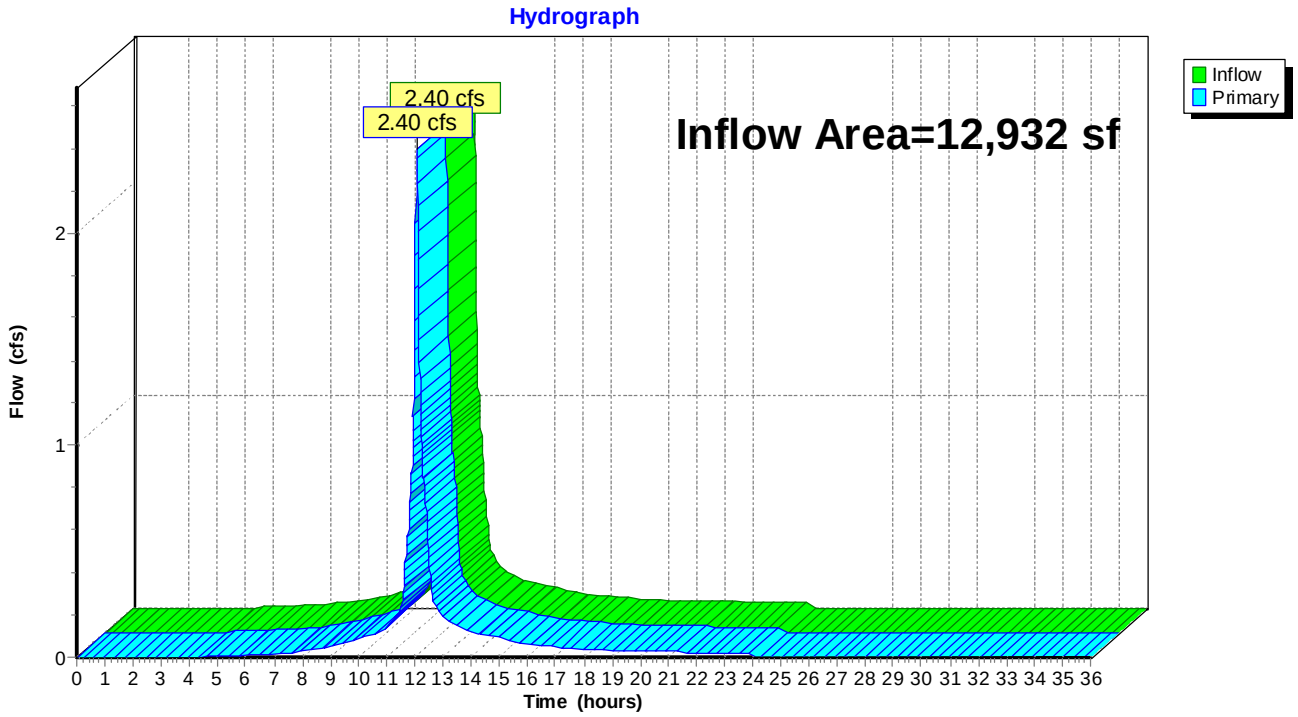


Summary for Link 10L-E: Coggeshall

Inflow Area = 12,932 sf, 81.36% Impervious, Inflow Depth = 7.00" for 100-Year event
Inflow = 2.40 cfs @ 12.07 hrs, Volume= 7,539 cf
Primary = 2.40 cfs @ 12.07 hrs, Volume= 7,539 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 10L-E: Coggeshall

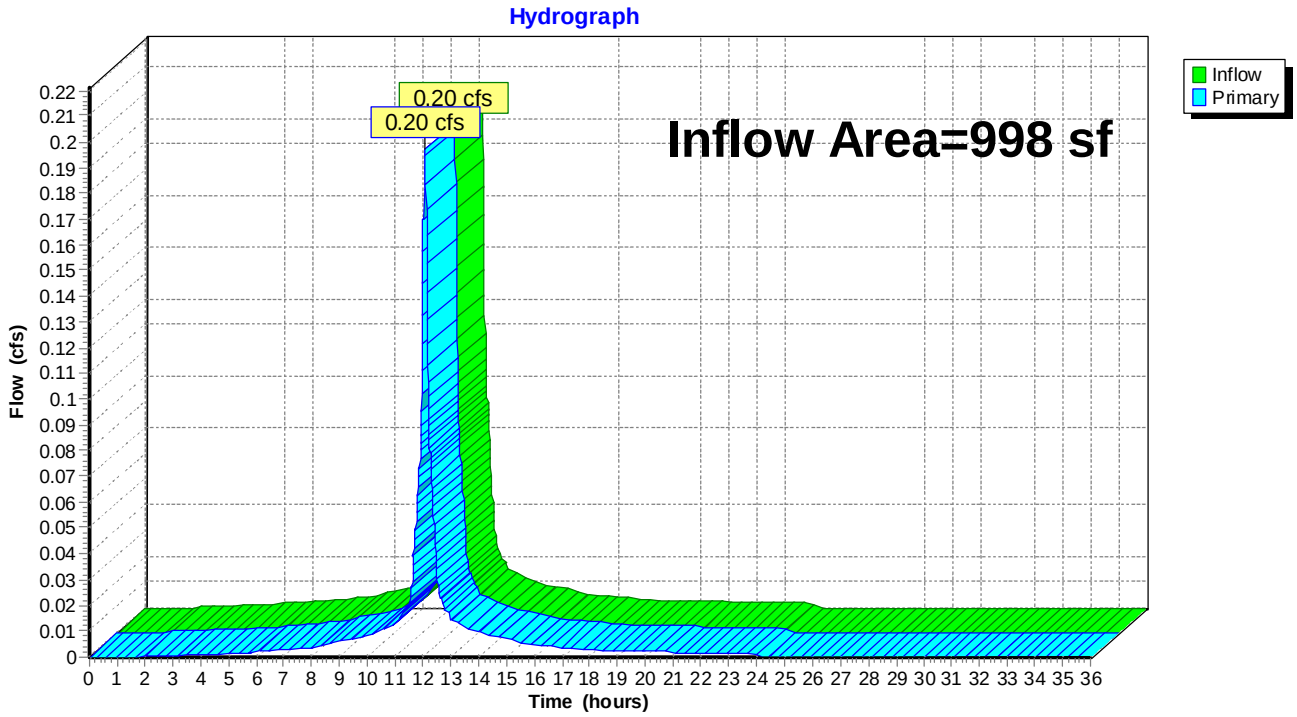


Summary for Link 20L-E: Off-Site Parking

Inflow Area = 998 sf, 94.09% Impervious, Inflow Depth = 7.96" for 100-Year event
Inflow = 0.20 cfs @ 12.07 hrs, Volume= 662 cf
Primary = 0.20 cfs @ 12.07 hrs, Volume= 662 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

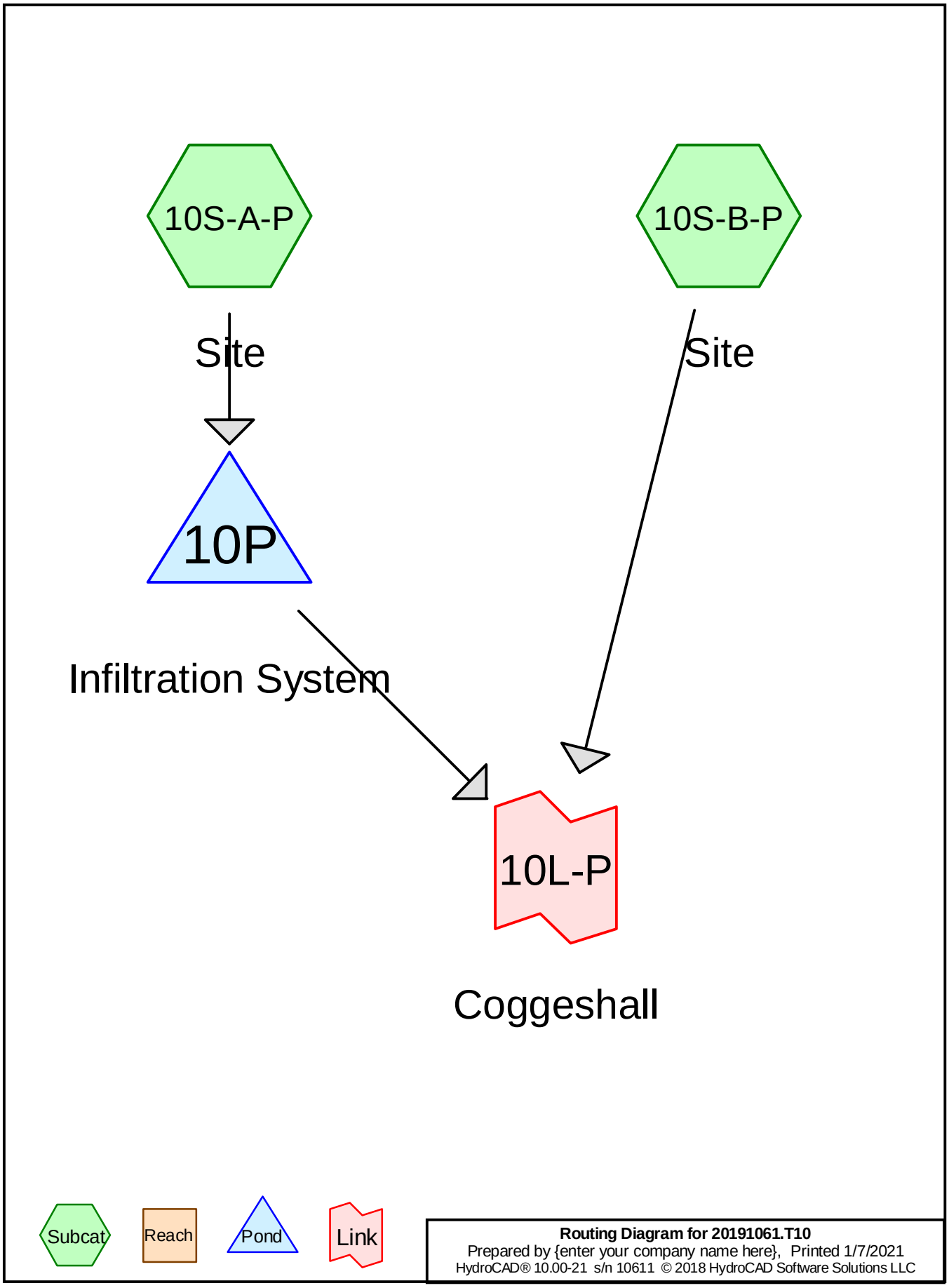
Link 20L-E: Off-Site Parking



FUSS & O'NEILL

Appendix C

Post-Development Watershed Analysis



Routing Diagram for 20191061.T10
Prepared by {enter your company name here}, Printed 1/7/2021
HydroCAD® 10.00-21 s/n 10611 © 2018 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
3,200	39	>75% Grass cover, Good, HSG A (10S-A-P, 10S-B-P)
332	76	Gravel roads, HSG A (10S-B-P)
6,492	98	Paved parking, HSG A (10S-A-P, 10S-B-P)
3,906	98	Roofs, HSG A (10S-A-P)
13,930	**84**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
13,930	HSG A	10S-A-P, 10S-B-P
0	HSG B	
0	HSG C	
0	HSG D	
0	Other	
13,930		**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Subcatch Numbers
3,200	0	0	0	0	3,200	>75% Grass cover, Good	
332	0	0	0	0	332	Gravel roads	
6,492	0	0	0	0	6,492	Paved parking	
3,906	0	0	0	0	3,906	Roofs	
13,930	**0**	**0**	**0**	**0**	**13,930**	**TOTAL AREA**	

Pipe Listing (selected nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	10P	3.90	3.00	106.0	0.0085	0.013	12.0	0.0	0.0

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10S-A-P: Site Runoff Area=10,353 sf 86.23% Impervious Runoff Depth=2.26"
Tc=5.0 min CN=90 Runoff=0.65 cfs 1,951 cf

Subcatchment 10S-B-P: Site Runoff Area=3,577 sf 41.12% Impervious Runoff Depth=0.74"
Tc=5.0 min CN=67 Runoff=0.06 cfs 221 cf

Pond 10P: Infiltration System Peak Elev=4.79' Storage=624 cf Inflow=0.65 cfs 1,951 cf
Discarded=0.08 cfs 1,862 cf Primary=0.12 cfs 89 cf Outflow=0.20 cfs 1,951 cf

Link 10L-P: Coggeshall Inflow=0.15 cfs 309 cf
Primary=0.15 cfs 309 cf

Total Runoff Area = 13,930 sf Runoff Volume = 2,172 cf Average Runoff Depth = 1.87"
25.36% Pervious = 3,532 sf 74.64% Impervious = 10,398 sf

Summary for Subcatchment 10S-A-P: Site

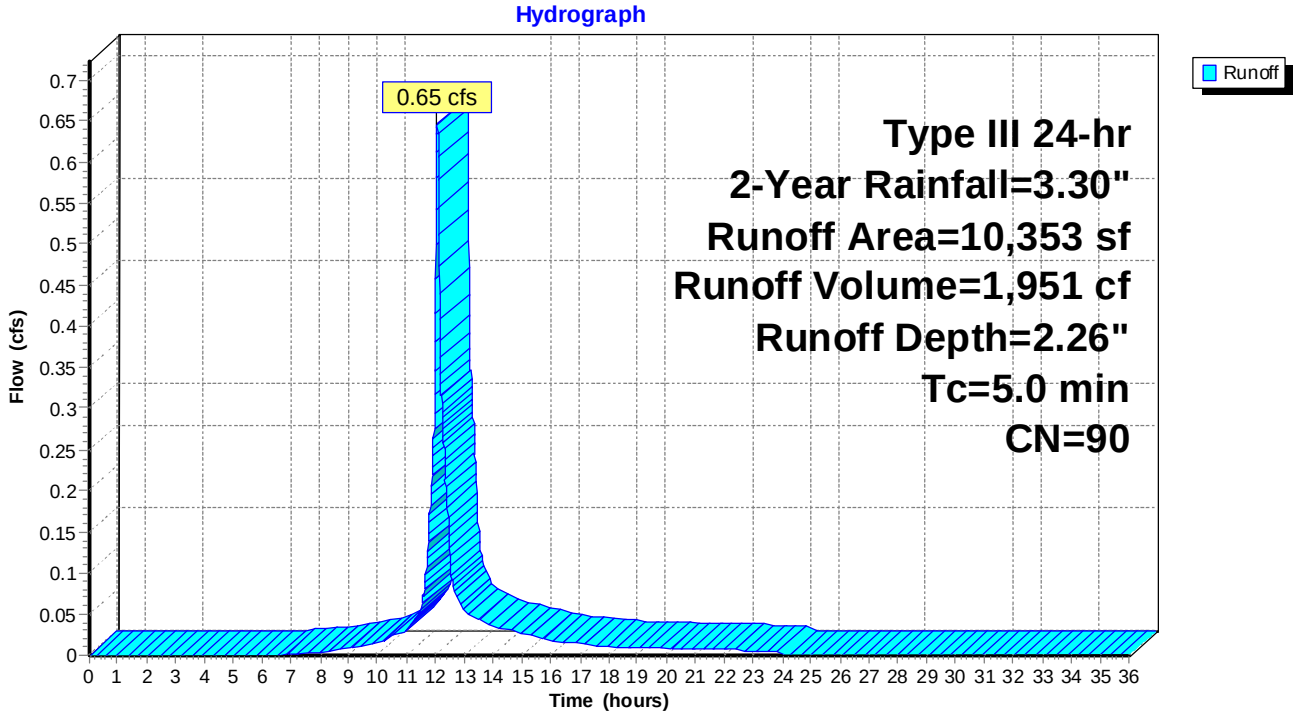
Runoff = 0.65 cfs @ 12.07 hrs, Volume= 1,951 cf, Depth= 2.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.30"

Area (sf)	CN	Description
1,426	39	>75% Grass cover, Good, HSG A
5,021	98	Paved parking, HSG A
3,906	98	Roofs, HSG A
10,353	90	Weighted Average
1,426		13.77% Pervious Area
8,927		86.23% Impervious Area

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

Subcatchment 10S-A-P: Site



Summary for Subcatchment 10S-B-P: Site

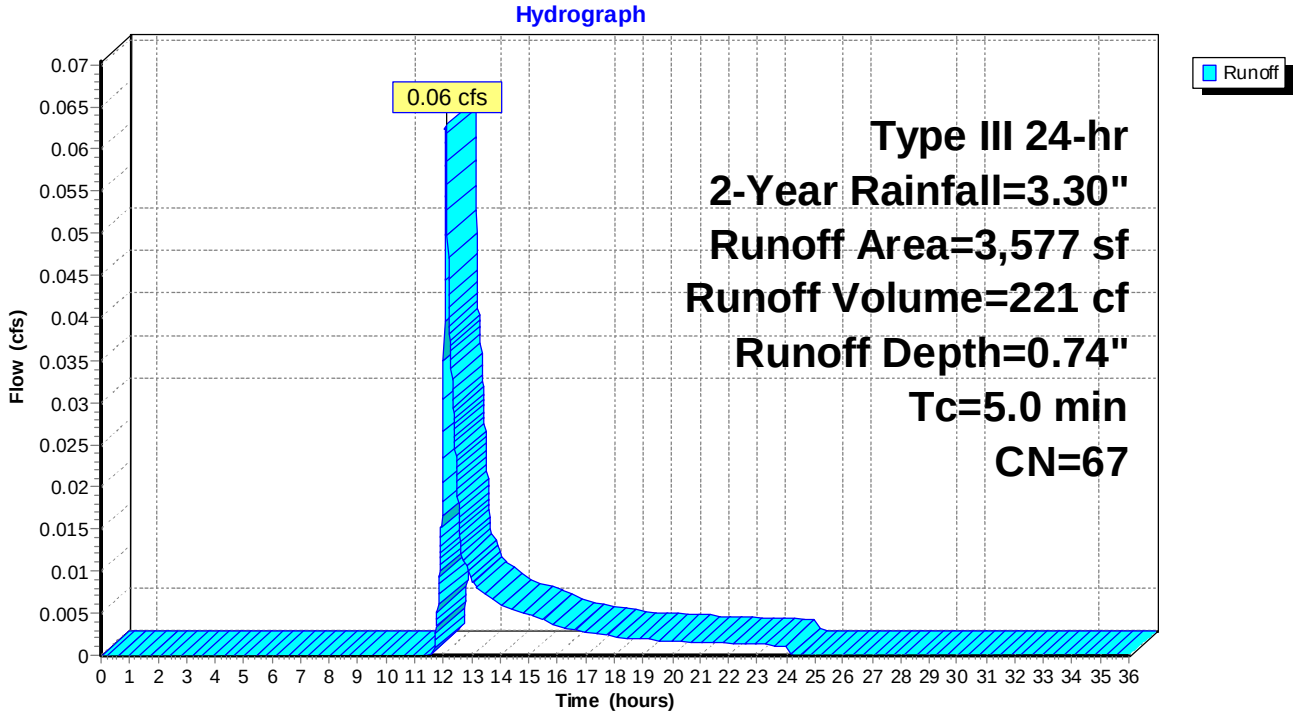
Runoff = 0.06 cfs @ 12.09 hrs, Volume= 221 cf, Depth= 0.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.30"

Area (sf)	CN	Description
1,774	39	>75% Grass cover, Good, HSG A
1,471	98	Paved parking, HSG A
332	76	Gravel roads, HSG A
3,577	67	Weighted Average
2,106		58.88% Pervious Area
1,471		41.12% Impervious Area

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

Subcatchment 10S-B-P: Site



Summary for Pond 10P: Infiltration System

Inflow Area = 10,353 sf, 86.23% Impervious, Inflow Depth = 2.26" for 2-Year event
Inflow = 0.65 cfs @ 12.07 hrs, Volume= 1,951 cf
Outflow = 0.20 cfs @ 12.38 hrs, Volume= 1,951 cf, Atten= 69%, Lag= 18.7 min
Discarded = 0.08 cfs @ 12.38 hrs, Volume= 1,862 cf
Primary = 0.12 cfs @ 12.38 hrs, Volume= 89 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 4.79' @ 12.38 hrs Surf.Area= 843 sf Storage= 624 cf

Plug-Flow detention time= 62.5 min calculated for 1,950 cf (100% of inflow)
Center-of-Mass det. time= 62.5 min (867.3 - 804.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	3.50'	544 cf	**18.67'W x 45.19'L x 2.00'H Field A** 1,687 cf Overall - 328 cf Embedded = 1,359 cf x 40.0% Voids
#2A	4.00'	328 cf	**ADS_StormTech SC-160LP +Cap** x 48 Inside #1 Effective Size= 18.0"W x 12.0"H => 0.96 sf x 7.12'L = 6.8 cf Overall Size= 25.0"W x 12.0"H x 7.56'L with 0.44' Overlap 8 Rows of 6 Chambers
		872 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	3.90'	**12.0" Round Culvert** L= 106.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 3.90' / 3.00' S= 0.0085 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	4.75'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#3	Discarded	3.50'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 1.50'

Discarded OutFlow Max=0.08 cfs @ 12.38 hrs HW=4.79' (Free Discharge)
↑—**3=Exfiltration** (Controls 0.08 cfs)

Primary OutFlow Max=0.12 cfs @ 12.38 hrs HW=4.79' (Free Discharge)
↑—**1=Culvert** (Passes 0.12 cfs of 2.32 cfs potential flow)
↑—**2=Sharp-Crested Rectangular Weir** (Weir Controls 0.12 cfs @ 0.68 fps)

Pond 10P: Infiltration System - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-160LP +Cap (ADS StormTech® SC-160LP with cap length)
Effective Size= 18.0"W x 12.0"H => 0.96 sf x 7.12'L = 6.8 cf
Overall Size= 25.0"W x 12.0"H x 7.56'L with 0.44' Overlap

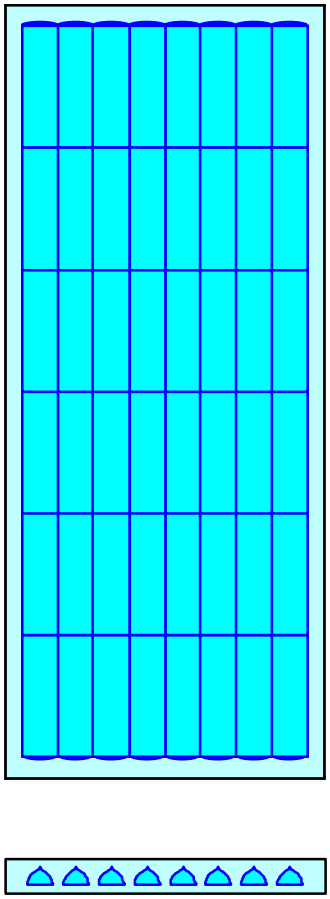
6 Chambers/Row x 7.12' Long +0.23' Cap Length x 2 = 43.19' Row Length +12.0" End Stone x 2 = 45.19' Base Length
8 Rows x 25.0" Wide + 12.0" Side Stone x 2 = 18.67' Base Width
6.0" Base + 12.0" Chamber Height + 6.0" Cover = 2.00' Field Height

48 Chambers x 6.8 cf = 328.2 cf Chamber Storage

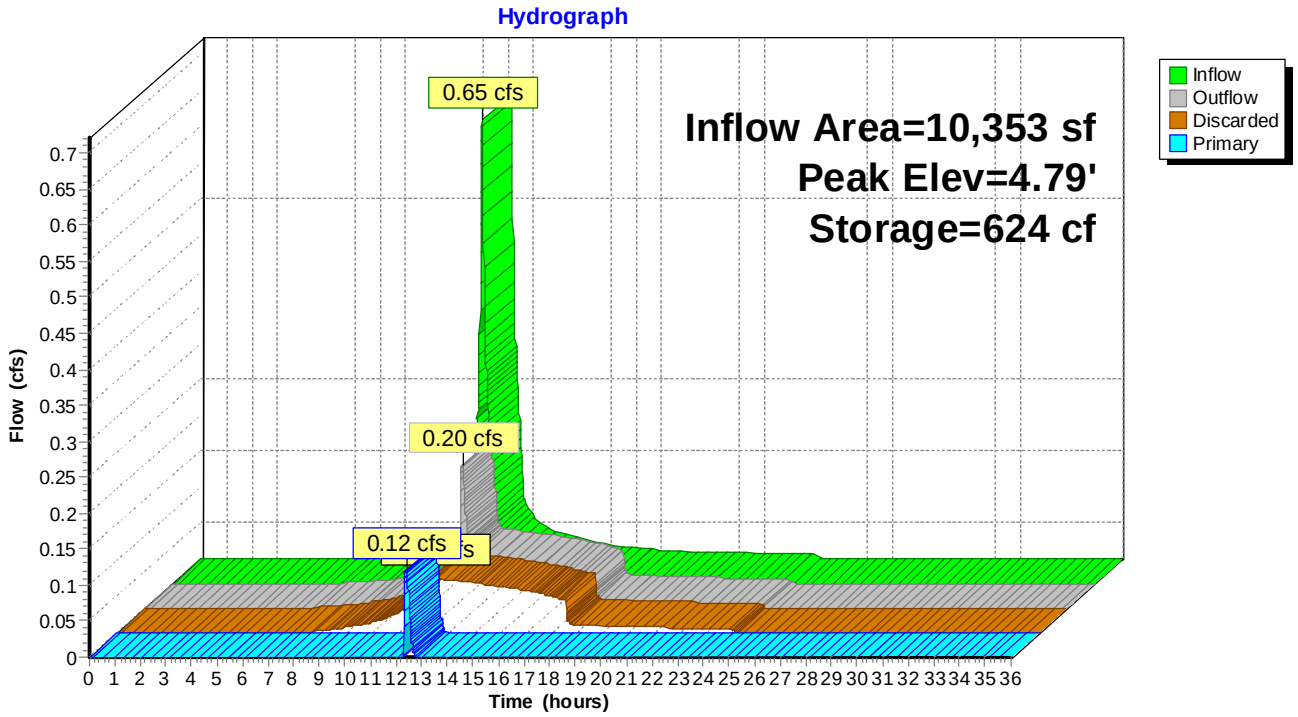
1,687.0 cf Field - 328.2 cf Chambers = 1,358.8 cf Stone x 40.0% Voids = 543.5 cf Stone Storage

Chamber Storage + Stone Storage = 871.7 cf = 0.020 af
Overall Storage Efficiency = 51.7%
Overall System Size = 45.19' x 18.67' x 2.00'

48 Chambers
62.5 cy Field
50.3 cy Stone



Pond 10P: Infiltration System

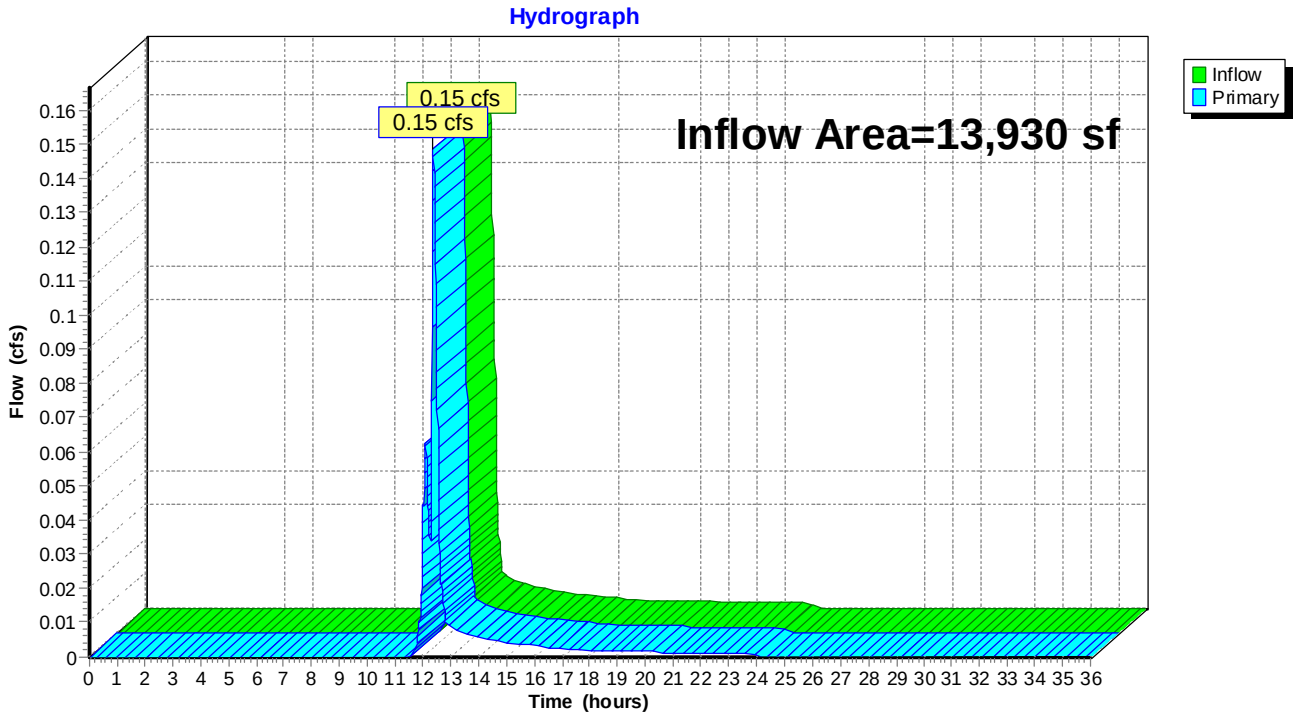


Summary for Link 10L-P: Coggeshall

Inflow Area = 13,930 sf, 74.64% Impervious, Inflow Depth = 0.27" for 2-Year event
Inflow = 0.15 cfs @ 12.38 hrs, Volume= 309 cf
Primary = 0.15 cfs @ 12.38 hrs, Volume= 309 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 10L-P: Coggeshall



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10S-A-P: Site Runoff Area=10,353 sf 86.23% Impervious Runoff Depth=3.76"
Tc=5.0 min CN=90 Runoff=1.05 cfs 3,245 cf

Subcatchment 10S-B-P: Site Runoff Area=3,577 sf 41.12% Impervious Runoff Depth=1.72"
Tc=5.0 min CN=67 Runoff=0.17 cfs 513 cf

Pond 10P: Infiltration System Peak Elev=4.92' Storage=674 cf Inflow=1.05 cfs 3,245 cf
Discarded=0.08 cfs 2,477 cf Primary=0.89 cfs 767 cf Outflow=0.97 cfs 3,245 cf

Link 10L-P: Coggeshall Inflow=1.05 cfs 1,280 cf
Primary=1.05 cfs 1,280 cf

Total Runoff Area = 13,930 sf Runoff Volume = 3,757 cf Average Runoff Depth = 3.24"
25.36% Pervious = 3,532 sf 74.64% Impervious = 10,398 sf

Summary for Subcatchment 10S-A-P: Site

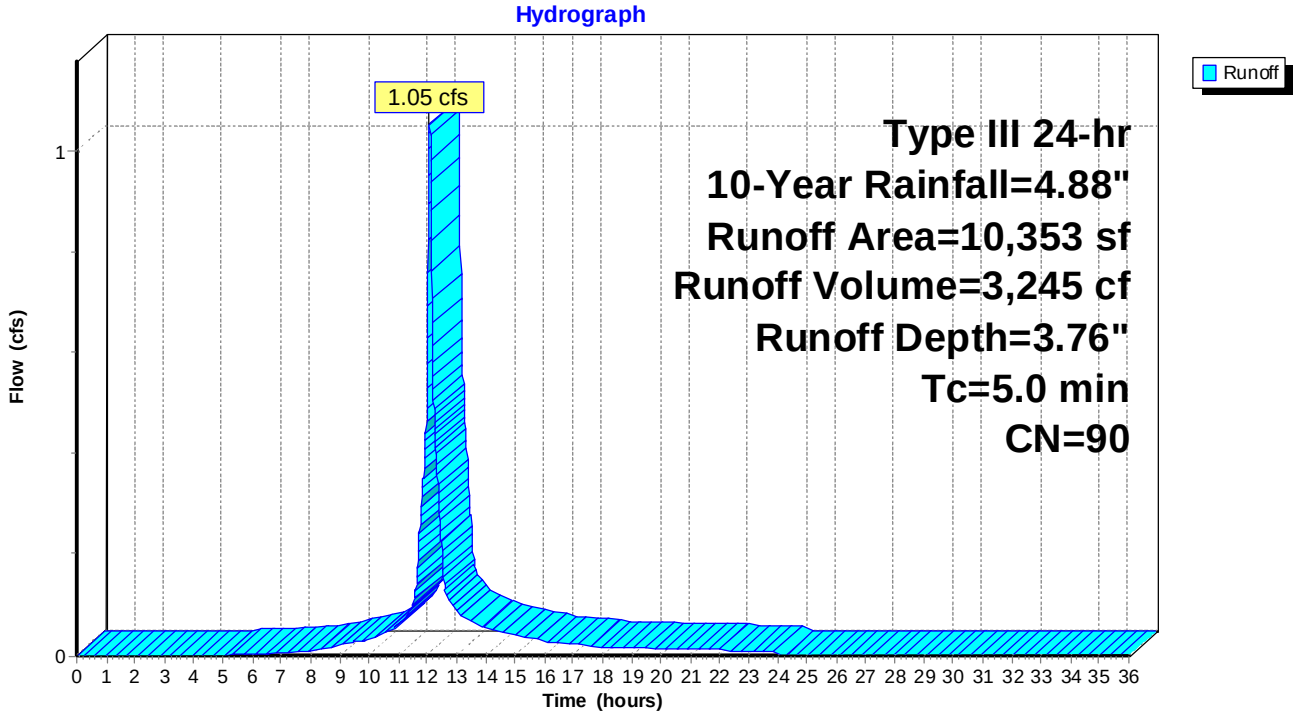
Runoff = 1.05 cfs @ 12.07 hrs, Volume= 3,245 cf, Depth= 3.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.88"

Area (sf)	CN	Description
1,426	39	>75% Grass cover, Good, HSG A
5,021	98	Paved parking, HSG A
3,906	98	Roofs, HSG A
10,353	90	Weighted Average
1,426		13.77% Pervious Area
8,927		86.23% Impervious Area

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

Subcatchment 10S-A-P: Site



Summary for Subcatchment 10S-B-P: Site

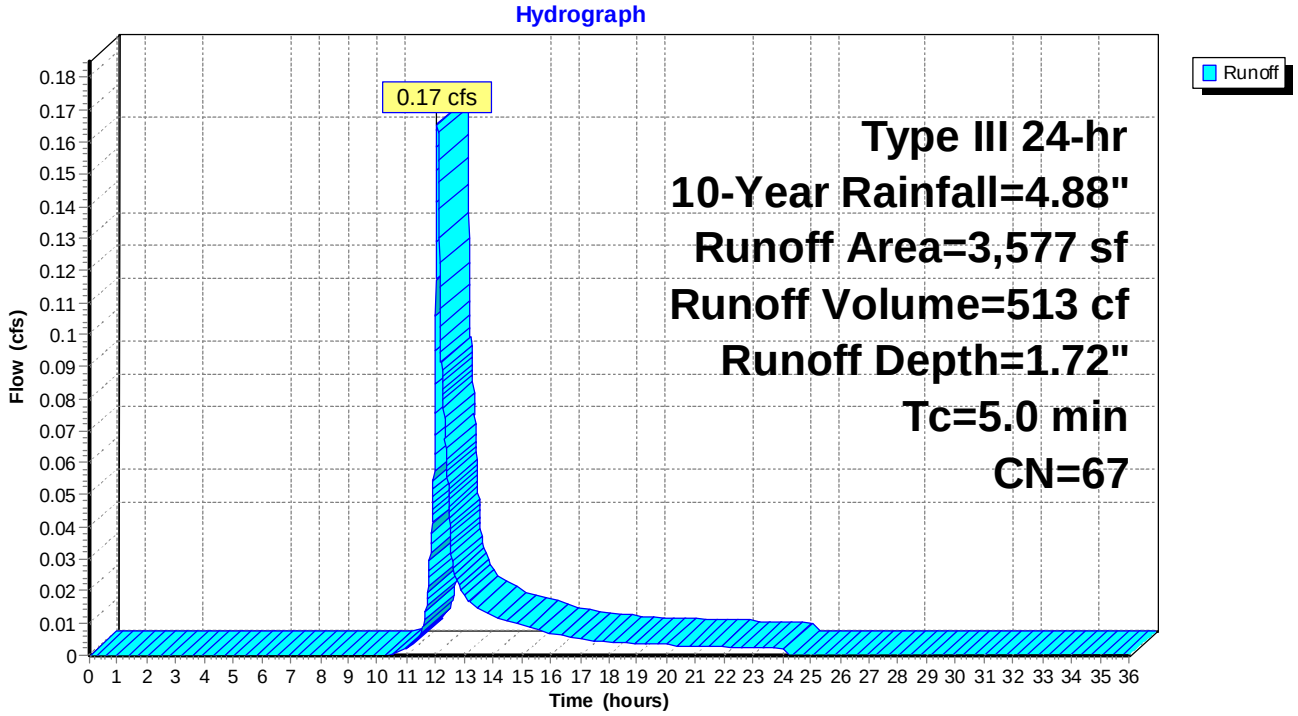
Runoff = 0.17 cfs @ 12.08 hrs, Volume= 513 cf, Depth= 1.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.88"

Area (sf)	CN	Description
1,774	39	>75% Grass cover, Good, HSG A
1,471	98	Paved parking, HSG A
332	76	Gravel roads, HSG A
3,577	67	Weighted Average
2,106		58.88% Pervious Area
1,471		41.12% Impervious Area

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

Subcatchment 10S-B-P: Site



Summary for Pond 10P: Infiltration System

Inflow Area = 10,353 sf, 86.23% Impervious, Inflow Depth = 3.76" for 10-Year event
Inflow = 1.05 cfs @ 12.07 hrs, Volume= 3,245 cf
Outflow = 0.97 cfs @ 12.10 hrs, Volume= 3,245 cf, Atten= 8%, Lag= 2.0 min
Discarded = 0.08 cfs @ 12.10 hrs, Volume= 2,477 cf
Primary = 0.89 cfs @ 12.10 hrs, Volume= 767 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 4.92' @ 12.10 hrs Surf.Area= 843 sf Storage= 674 cf

Plug-Flow detention time= 52.9 min calculated for 3,244 cf (100% of inflow)
Center-of-Mass det. time= 52.9 min (843.5 - 790.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	3.50'	544 cf	**18.67'W x 45.19'L x 2.00'H Field A** 1,687 cf Overall - 328 cf Embedded = 1,359 cf x 40.0% Voids
#2A	4.00'	328 cf	**ADS_StormTech SC-160LP +Cap** x 48 Inside #1 Effective Size= 18.0"W x 12.0"H => 0.96 sf x 7.12'L = 6.8 cf Overall Size= 25.0"W x 12.0"H x 7.56'L with 0.44' Overlap 8 Rows of 6 Chambers
		872 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	3.90'	**12.0" Round Culvert** L= 106.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 3.90' / 3.00' S= 0.0085 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	4.75'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#3	Discarded	3.50'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 1.50'

Discarded OutFlow Max=0.08 cfs @ 12.10 hrs HW=4.92' (Free Discharge)
↑—**3=Exfiltration** (Controls 0.08 cfs)

Primary OutFlow Max=0.88 cfs @ 12.10 hrs HW=4.92' (Free Discharge)
↑—**1=Culvert** (Passes 0.88 cfs of 2.72 cfs potential flow)
↑—**2=Sharp-Crested Rectangular Weir** (Weir Controls 0.88 cfs @ 1.33 fps)

Pond 10P: Infiltration System - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-160LP +Cap (ADS StormTech® SC-160LP with cap length)
Effective Size= 18.0"W x 12.0"H => 0.96 sf x 7.12'L = 6.8 cf
Overall Size= 25.0"W x 12.0"H x 7.56'L with 0.44' Overlap

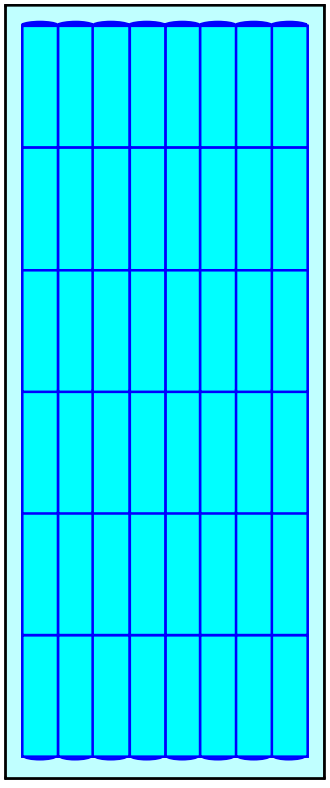
6 Chambers/Row x 7.12' Long +0.23' Cap Length x 2 = 43.19' Row Length +12.0" End Stone x 2 = 45.19' Base Length
8 Rows x 25.0" Wide + 12.0" Side Stone x 2 = 18.67' Base Width
6.0" Base + 12.0" Chamber Height + 6.0" Cover = 2.00' Field Height

48 Chambers x 6.8 cf = 328.2 cf Chamber Storage

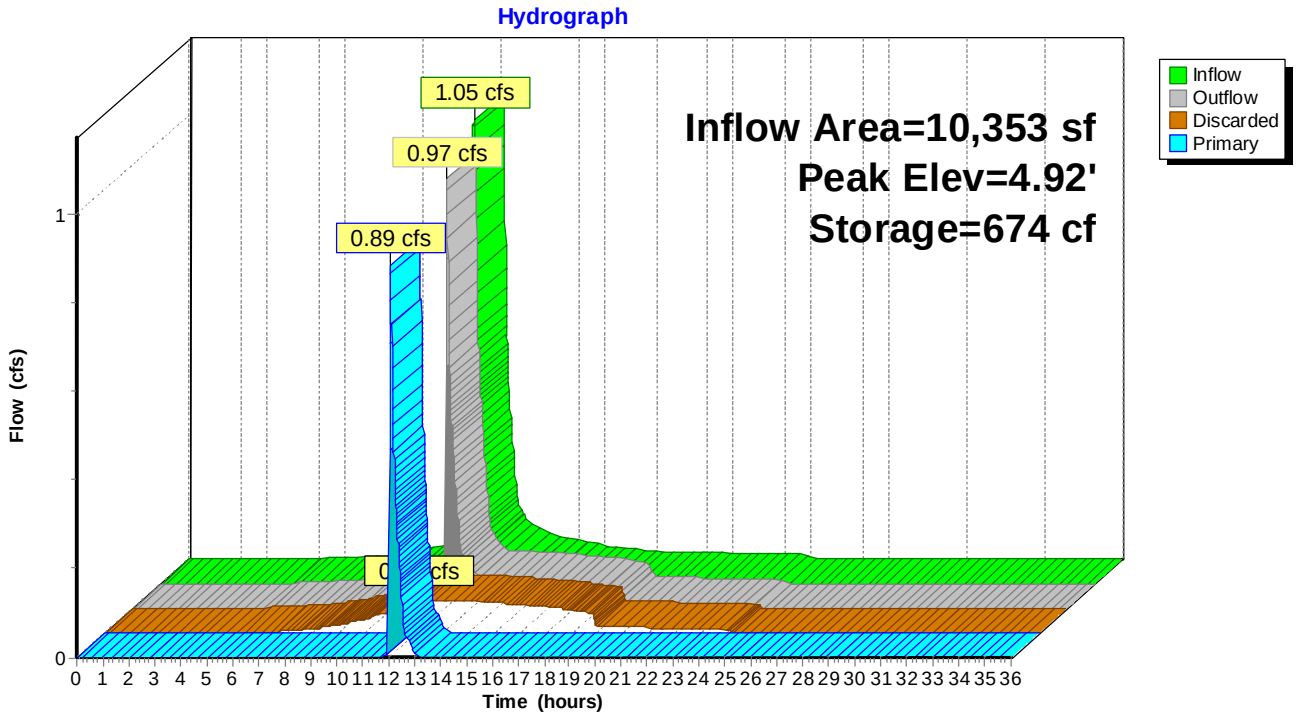
1,687.0 cf Field - 328.2 cf Chambers = 1,358.8 cf Stone x 40.0% Voids = 543.5 cf Stone Storage

Chamber Storage + Stone Storage = 871.7 cf = 0.020 af
Overall Storage Efficiency = 51.7%
Overall System Size = 45.19' x 18.67' x 2.00'

48 Chambers
62.5 cy Field
50.3 cy Stone



Pond 10P: Infiltration System

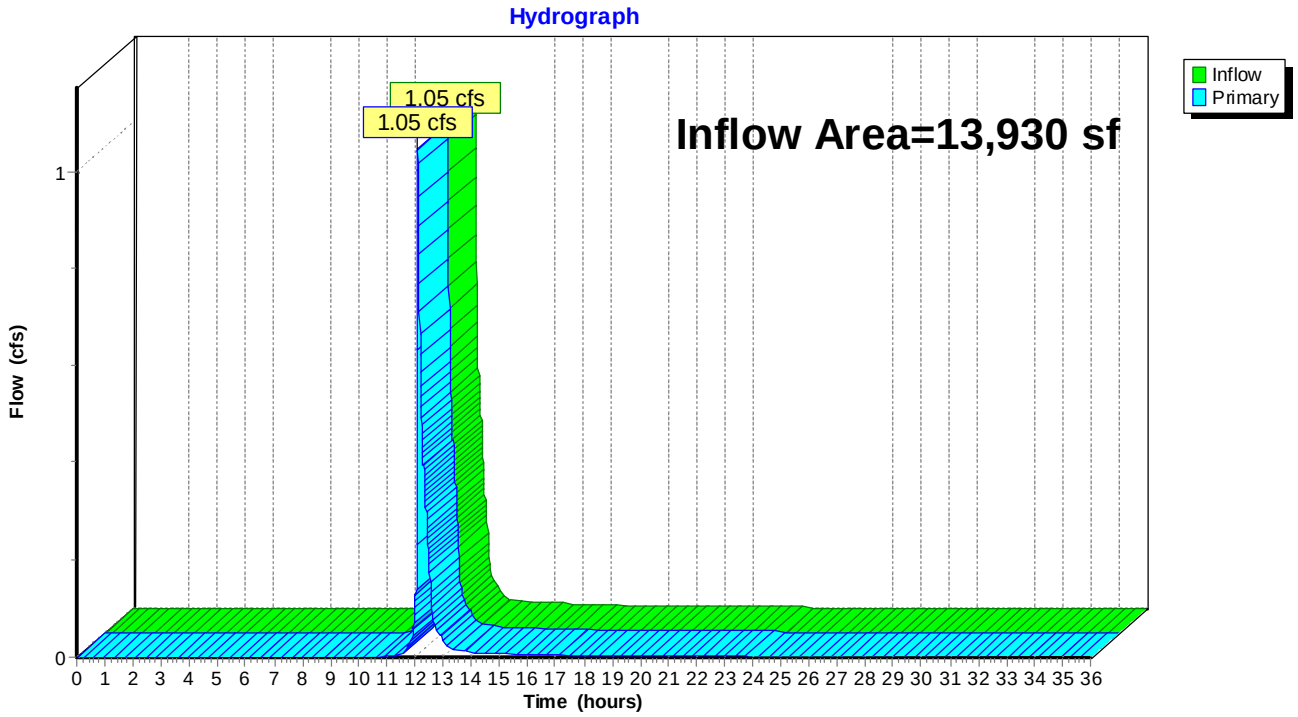


Summary for Link 10L-P: Coggeshall

Inflow Area = 13,930 sf, 74.64% Impervious, Inflow Depth = 1.10" for 10-Year event
Inflow = 1.05 cfs @ 12.10 hrs, Volume= 1,280 cf
Primary = 1.05 cfs @ 12.10 hrs, Volume= 1,280 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 10L-P: Coggeshall



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10S-A-P: Site Runoff Area=10,353 sf 86.23% Impervious Runoff Depth=4.94"
Tc=5.0 min CN=90 Runoff=1.36 cfs 4,265 cf

Subcatchment 10S-B-P: Site Runoff Area=3,577 sf 41.12% Impervious Runoff Depth=2.61"
Tc=5.0 min CN=67 Runoff=0.26 cfs 777 cf

Pond 10P: Infiltration System Peak Elev=4.96' Storage=690 cf Inflow=1.36 cfs 4,265 cf
Discarded=0.08 cfs 2,882 cf Primary=1.26 cfs 1,383 cf Outflow=1.34 cfs 4,265 cf

Link 10L-P: Coggeshall Inflow=1.52 cfs 2,159 cf
Primary=1.52 cfs 2,159 cf

Total Runoff Area = 13,930 sf Runoff Volume = 5,042 cf Average Runoff Depth = 4.34"
25.36% Pervious = 3,532 sf 74.64% Impervious = 10,398 sf

Summary for Subcatchment 10S-A-P: Site

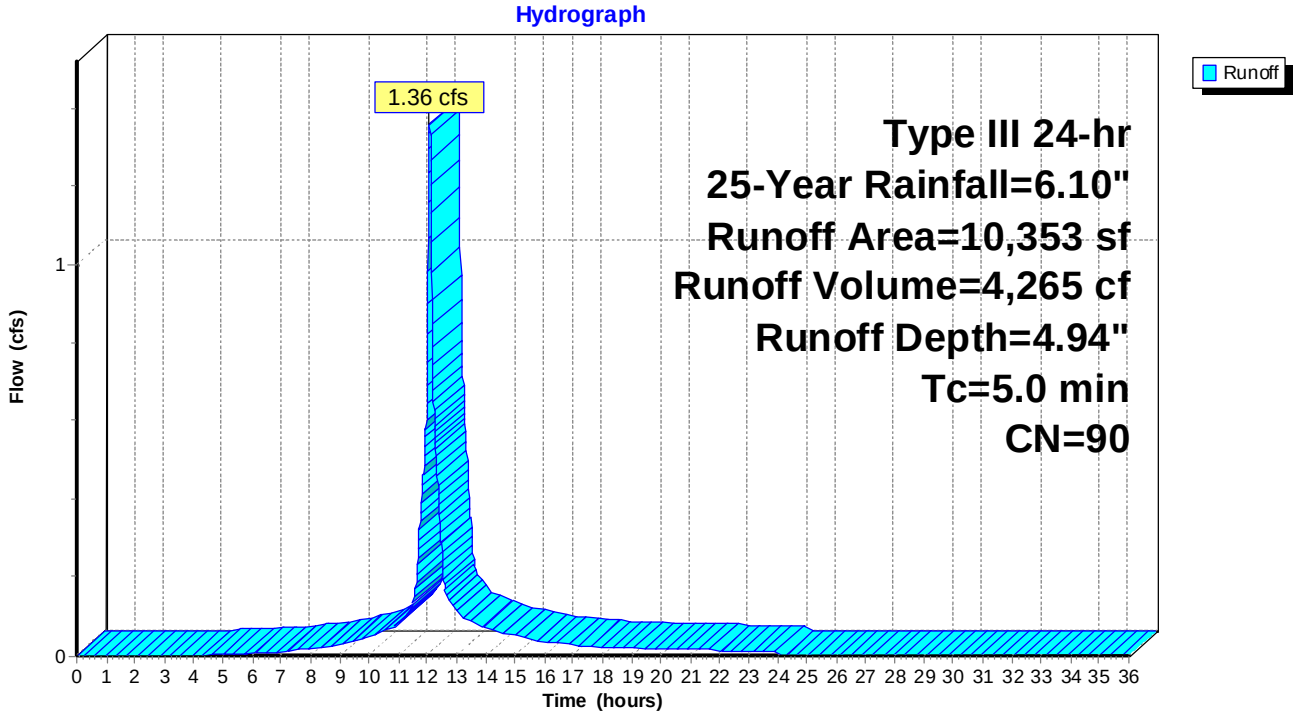
Runoff = 1.36 cfs @ 12.07 hrs, Volume= 4,265 cf, Depth= 4.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.10"

Area (sf)	CN	Description
1,426	39	>75% Grass cover, Good, HSG A
5,021	98	Paved parking, HSG A
3,906	98	Roofs, HSG A
10,353	90	Weighted Average
1,426		13.77% Pervious Area
8,927		86.23% Impervious Area

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

Subcatchment 10S-A-P: Site



Summary for Subcatchment 10S-B-P: Site

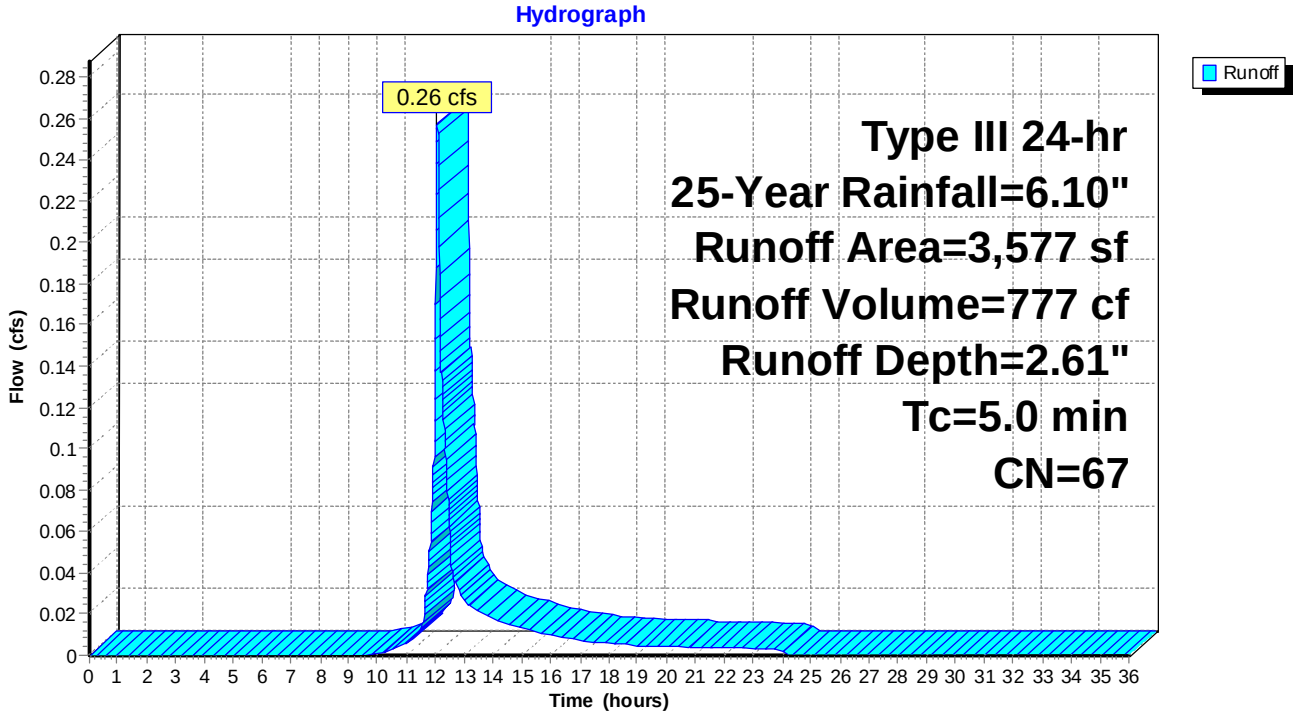
Runoff = 0.26 cfs @ 12.08 hrs, Volume= 777 cf, Depth= 2.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.10"

Area (sf)	CN	Description
1,774	39	>75% Grass cover, Good, HSG A
1,471	98	Paved parking, HSG A
332	76	Gravel roads, HSG A
3,577	67	Weighted Average
2,106		58.88% Pervious Area
1,471		41.12% Impervious Area

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

Subcatchment 10S-B-P: Site



Summary for Pond 10P: Infiltration System

Inflow Area = 10,353 sf, 86.23% Impervious, Inflow Depth = 4.94" for 25-Year event
Inflow = 1.36 cfs @ 12.07 hrs, Volume= 4,265 cf
Outflow = 1.34 cfs @ 12.08 hrs, Volume= 4,265 cf, Atten= 1%, Lag= 0.7 min
Discarded = 0.08 cfs @ 12.08 hrs, Volume= 2,882 cf
Primary = 1.26 cfs @ 12.08 hrs, Volume= 1,383 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 4.96' @ 12.08 hrs Surf.Area= 843 sf Storage= 690 cf

Plug-Flow detention time= 48.8 min calculated for 4,264 cf (100% of inflow)
Center-of-Mass det. time= 48.8 min (832.1 - 783.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	3.50'	544 cf	**18.67'W x 45.19'L x 2.00'H Field A** 1,687 cf Overall - 328 cf Embedded = 1,359 cf x 40.0% Voids
#2A	4.00'	328 cf	**ADS_StormTech SC-160LP +Cap** x 48 Inside #1 Effective Size= 18.0"W x 12.0"H => 0.96 sf x 7.12'L = 6.8 cf Overall Size= 25.0"W x 12.0"H x 7.56'L with 0.44' Overlap 8 Rows of 6 Chambers
		872 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	3.90'	**12.0" Round Culvert** L= 106.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 3.90' / 3.00' S= 0.0085 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	4.75'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#3	Discarded	3.50'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 1.50'

Discarded OutFlow Max=0.08 cfs @ 12.08 hrs HW=4.96' (Free Discharge)
↑—**3=Exfiltration** (Controls 0.08 cfs)

Primary OutFlow Max=1.26 cfs @ 12.08 hrs HW=4.96' (Free Discharge)
↑—**1=Culvert** (Passes 1.26 cfs of 2.83 cfs potential flow)
↑—**2=Sharp-Crested Rectangular Weir** (Weir Controls 1.26 cfs @ 1.50 fps)

Pond 10P: Infiltration System - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-160LP +Cap (ADS StormTech® SC-160LP with cap length)
Effective Size= 18.0"W x 12.0"H => 0.96 sf x 7.12'L = 6.8 cf
Overall Size= 25.0"W x 12.0"H x 7.56'L with 0.44' Overlap

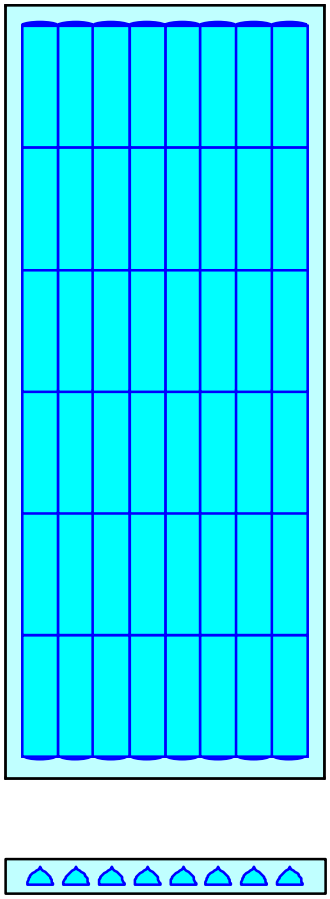
6 Chambers/Row x 7.12' Long +0.23' Cap Length x 2 = 43.19' Row Length +12.0" End Stone x 2 = 45.19' Base Length
8 Rows x 25.0" Wide + 12.0" Side Stone x 2 = 18.67' Base Width
6.0" Base + 12.0" Chamber Height + 6.0" Cover = 2.00' Field Height

48 Chambers x 6.8 cf = 328.2 cf Chamber Storage

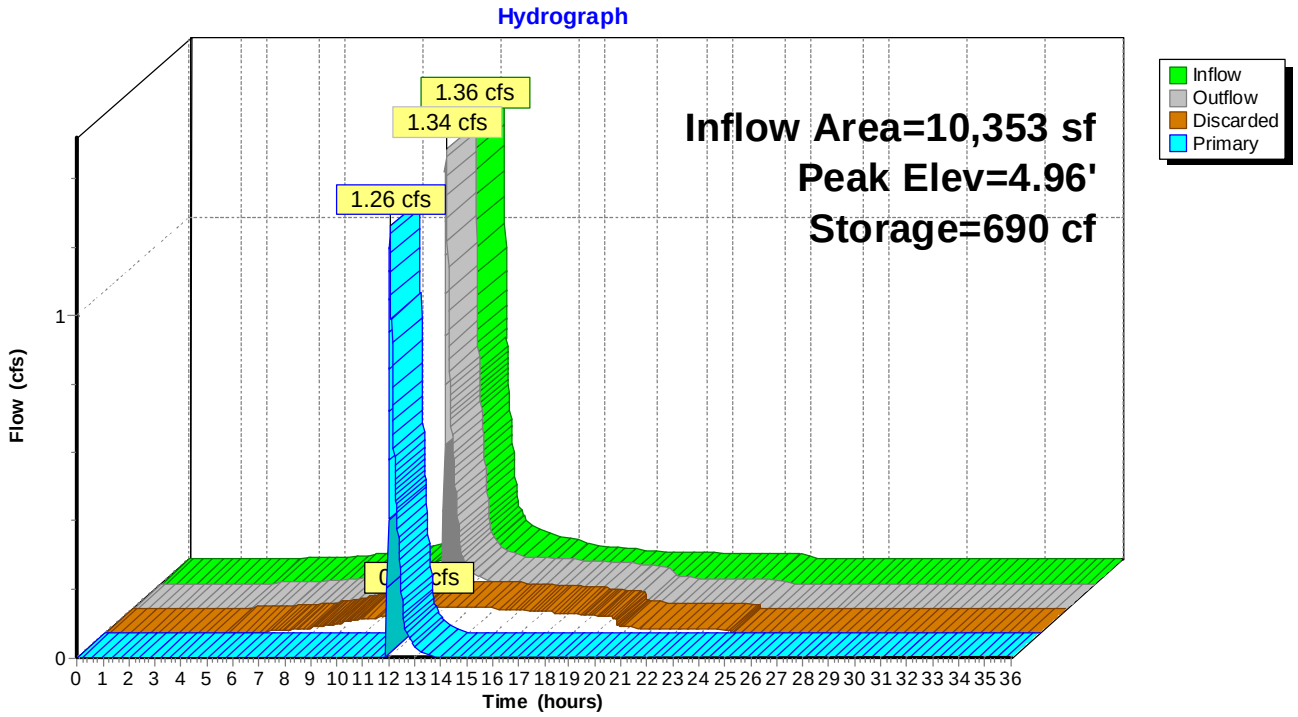
1,687.0 cf Field - 328.2 cf Chambers = 1,358.8 cf Stone x 40.0% Voids = 543.5 cf Stone Storage

Chamber Storage + Stone Storage = 871.7 cf = 0.020 af
Overall Storage Efficiency = 51.7%
Overall System Size = 45.19' x 18.67' x 2.00'

48 Chambers
62.5 cy Field
50.3 cy Stone



Pond 10P: Infiltration System

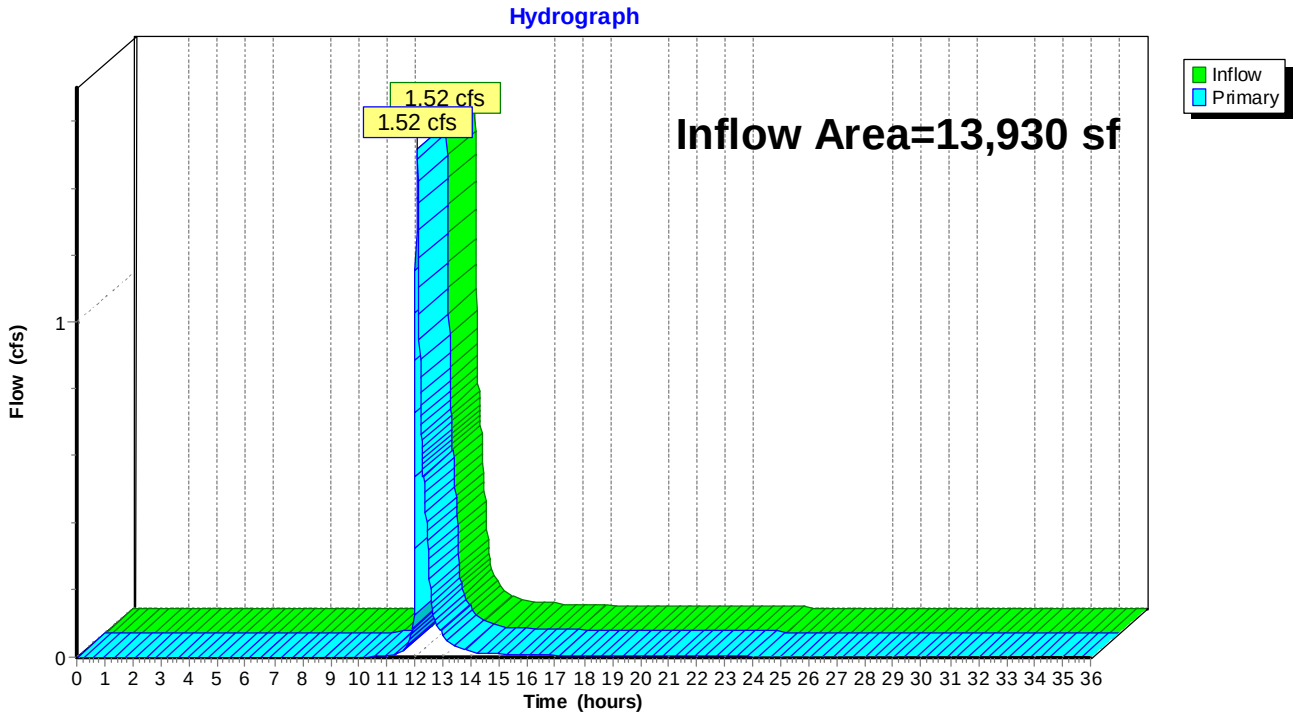


Summary for Link 10L-P: Coggeshall

Inflow Area = 13,930 sf, 74.64% Impervious, Inflow Depth = 1.86" for 25-Year event
Inflow = 1.52 cfs @ 12.08 hrs, Volume= 2,159 cf
Primary = 1.52 cfs @ 12.08 hrs, Volume= 2,159 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 10L-P: Coggeshall



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10S-A-P: Site Runoff Area=10,353 sf 86.23% Impervious Runoff Depth=7.36"
Tc=5.0 min CN=90 Runoff=1.98 cfs 6,348 cf

Subcatchment 10S-B-P: Site Runoff Area=3,577 sf 41.12% Impervious Runoff Depth=4.59"
Tc=5.0 min CN=67 Runoff=0.46 cfs 1,368 cf

Pond 10P: Infiltration System Peak Elev=5.03' Storage=712 cf Inflow=1.98 cfs 6,348 cf
Discarded=0.08 cfs 3,555 cf Primary=1.88 cfs 2,792 cf Outflow=1.96 cfs 6,348 cf

Link 10L-P: Coggeshall Inflow=2.34 cfs 4,161 cf
Primary=2.34 cfs 4,161 cf

Total Runoff Area = 13,930 sf Runoff Volume = 7,716 cf Average Runoff Depth = 6.65"
25.36% Pervious = 3,532 sf 74.64% Impervious = 10,398 sf

Summary for Subcatchment 10S-A-P: Site

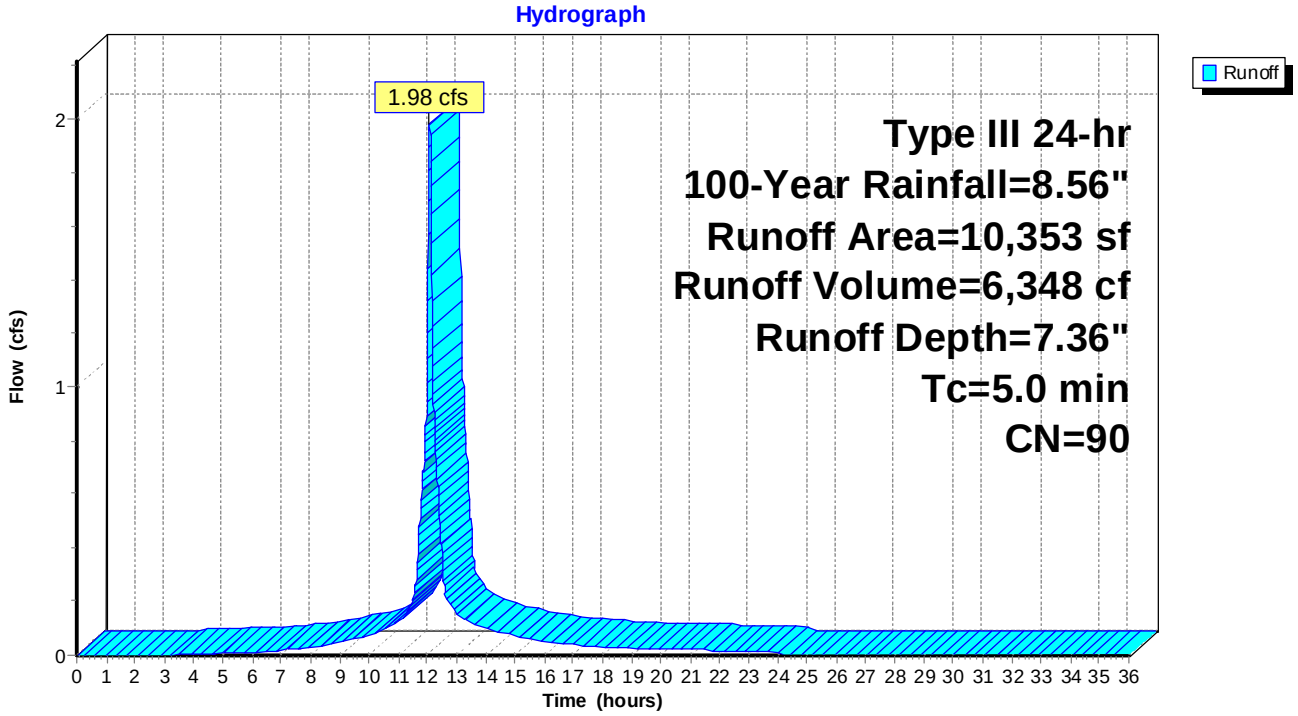
Runoff = 1.98 cfs @ 12.07 hrs, Volume= 6,348 cf, Depth= 7.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.56"

Area (sf)	CN	Description
1,426	39	>75% Grass cover, Good, HSG A
5,021	98	Paved parking, HSG A
3,906	98	Roofs, HSG A
10,353	90	Weighted Average
1,426		13.77% Pervious Area
8,927		86.23% Impervious Area

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

Subcatchment 10S-A-P: Site



Summary for Subcatchment 10S-B-P: Site

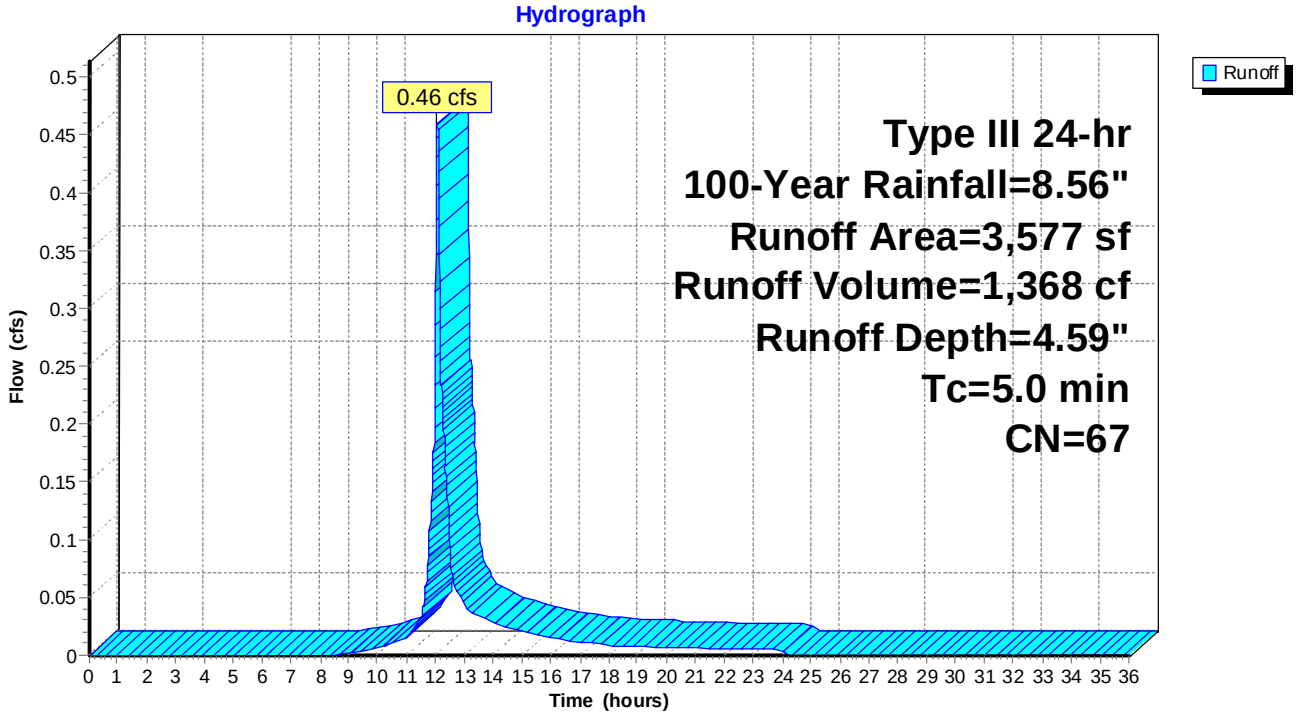
Runoff = 0.46 cfs @ 12.08 hrs, Volume= 1,368 cf, Depth= 4.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.56"

Area (sf)	CN	Description
1,774	39	>75% Grass cover, Good, HSG A
1,471	98	Paved parking, HSG A
332	76	Gravel roads, HSG A
3,577	67	Weighted Average
2,106		58.88% Pervious Area
1,471		41.12% Impervious Area

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

Subcatchment 10S-B-P: Site



Summary for Pond 10P: Infiltration System

Inflow Area = 10,353 sf, 86.23% Impervious, Inflow Depth = 7.36" for 100-Year event
Inflow = 1.98 cfs @ 12.07 hrs, Volume= 6,348 cf
Outflow = 1.96 cfs @ 12.08 hrs, Volume= 6,348 cf, Atten= 1%, Lag= 0.6 min
Discarded = 0.08 cfs @ 12.08 hrs, Volume= 3,555 cf
Primary = 1.88 cfs @ 12.08 hrs, Volume= 2,792 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 5.03' @ 12.08 hrs Surf.Area= 843 sf Storage= 712 cf

Plug-Flow detention time= 44.1 min calculated for 6,346 cf (100% of inflow)
Center-of-Mass det. time= 44.0 min (817.1 - 773.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	3.50'	544 cf	**18.67'W x 45.19'L x 2.00'H Field A** 1,687 cf Overall - 328 cf Embedded = 1,359 cf x 40.0% Voids
#2A	4.00'	328 cf	**ADS_StormTech SC-160LP +Cap** x 48 Inside #1 Effective Size= 18.0"W x 12.0"H => 0.96 sf x 7.12'L = 6.8 cf Overall Size= 25.0"W x 12.0"H x 7.56'L with 0.44' Overlap 8 Rows of 6 Chambers
		872 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	3.90'	**12.0" Round Culvert** L= 106.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 3.90' / 3.00' S= 0.0085 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	4.75'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#3	Discarded	3.50'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 1.50'

Discarded OutFlow Max=0.08 cfs @ 12.08 hrs HW=5.03' (Free Discharge)
↑—**3=Exfiltration** (Controls 0.08 cfs)

Primary OutFlow Max=1.88 cfs @ 12.08 hrs HW=5.03' (Free Discharge)
↑—**1=Culvert** (Passes 1.88 cfs of 2.99 cfs potential flow)
↑—**2=Sharp-Crested Rectangular Weir** (Weir Controls 1.88 cfs @ 1.72 fps)

Pond 10P: Infiltration System - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-160LP +Cap (ADS StormTech® SC-160LP with cap length)
Effective Size= 18.0"W x 12.0"H => 0.96 sf x 7.12'L = 6.8 cf
Overall Size= 25.0"W x 12.0"H x 7.56'L with 0.44' Overlap

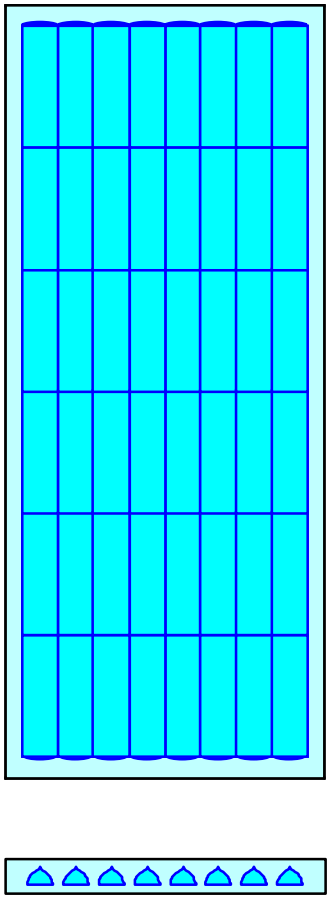
6 Chambers/Row x 7.12' Long +0.23' Cap Length x 2 = 43.19' Row Length +12.0" End Stone x 2 = 45.19' Base Length
8 Rows x 25.0" Wide + 12.0" Side Stone x 2 = 18.67' Base Width
6.0" Base + 12.0" Chamber Height + 6.0" Cover = 2.00' Field Height

48 Chambers x 6.8 cf = 328.2 cf Chamber Storage

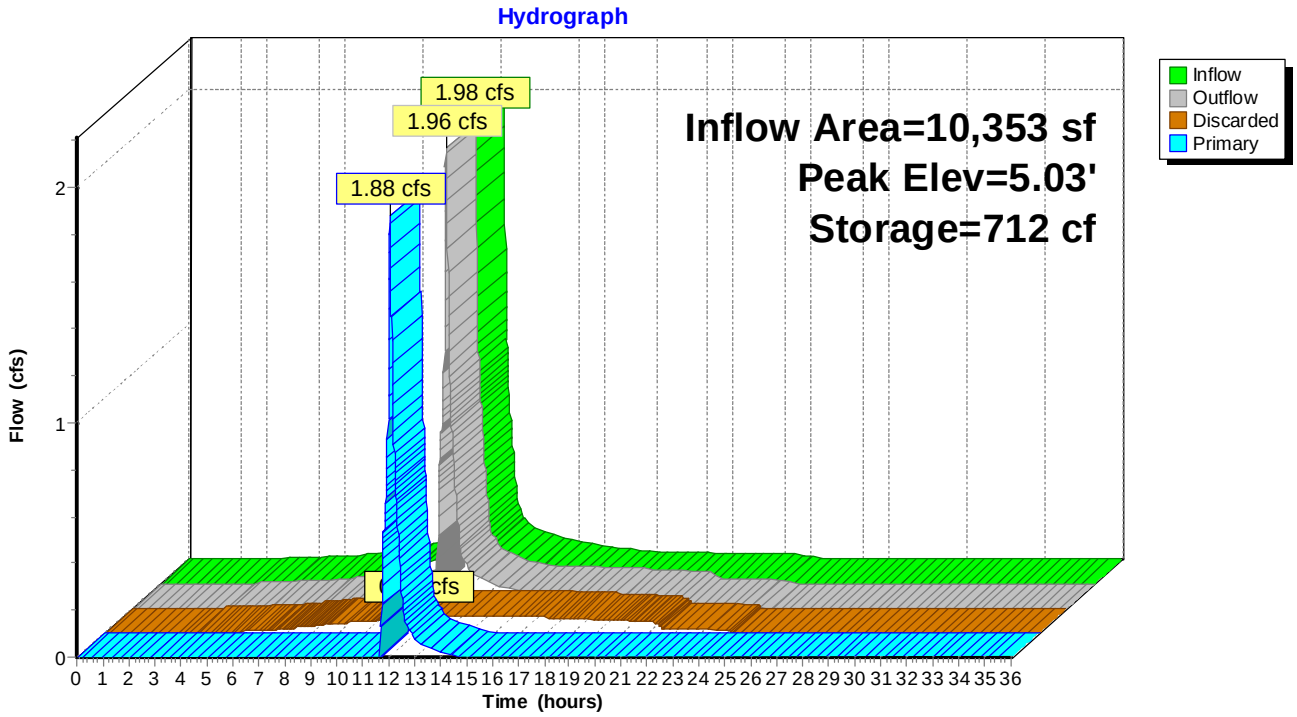
1,687.0 cf Field - 328.2 cf Chambers = 1,358.8 cf Stone x 40.0% Voids = 543.5 cf Stone Storage

Chamber Storage + Stone Storage = 871.7 cf = 0.020 af
Overall Storage Efficiency = 51.7%
Overall System Size = 45.19' x 18.67' x 2.00'

48 Chambers
62.5 cy Field
50.3 cy Stone



Pond 10P: Infiltration System

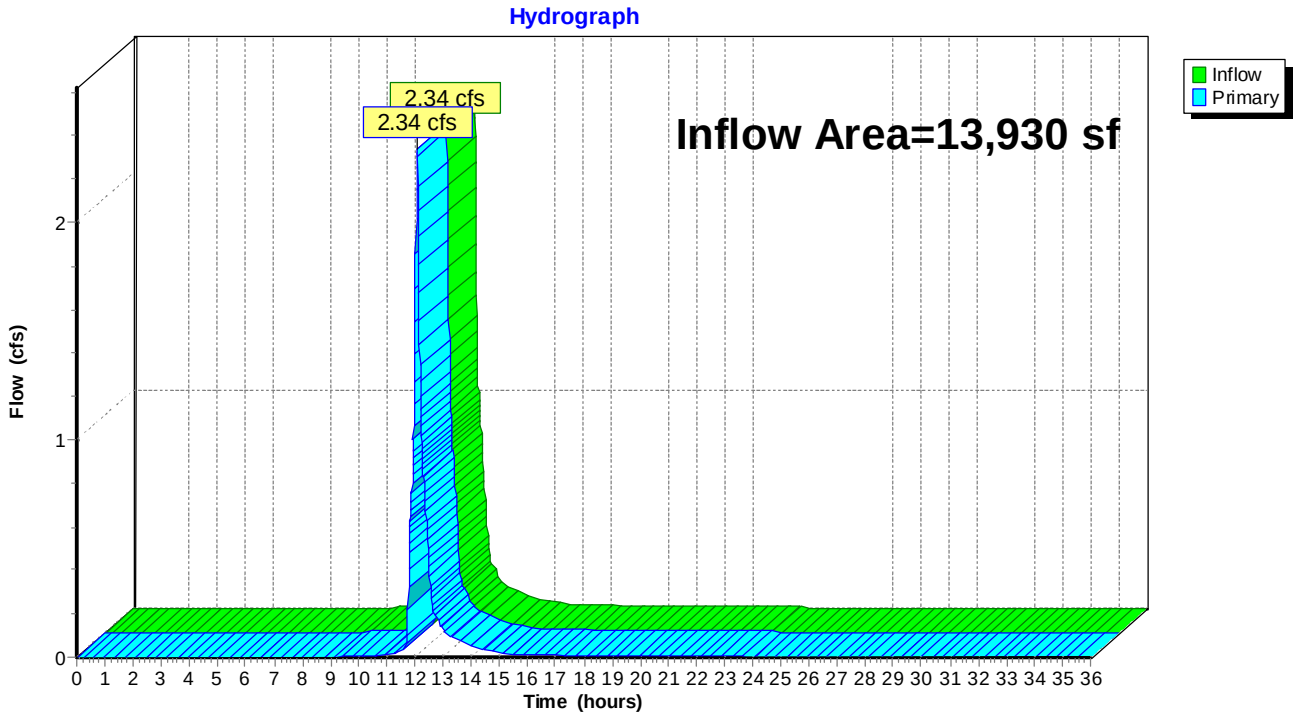


Summary for Link 10L-P: Coggeshall

Inflow Area = 13,930 sf, 74.64% Impervious, Inflow Depth = 3.58" for 100-Year event
Inflow = 2.34 cfs @ 12.08 hrs, Volume= 4,161 cf
Primary = 2.34 cfs @ 12.08 hrs, Volume= 4,161 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Link 10L-P: Coggeshall



Appendix D

Storm Sewer Pipe Sizing Calculations

NOAA Atlas 14, Volume 10, Version 3
Location name: New Bedford, Massachusetts, USA*
Latitude: 41.6563°, Longitude: -70.9205°
Elevation: 7.63 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/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	3.52 (2.87-4.31)	4.37 (3.56-5.35)	5.76 (4.68-7.08)	6.91 (5.58-8.56)	8.51 (6.62-11.0)	9.67 (7.38-12.8)	11.0 (8.12-15.0)	12.5 (8.60-17.2)	15.0 (9.85-21.2)	17.1 (11.0-24.6)
10-min	2.49 (2.03-3.05)	3.10 (2.52-3.79)	4.08 (3.31-5.02)	4.90 (3.95-6.04)	6.02 (4.69-7.78)	6.86 (5.23-9.05)	7.76 (5.75-10.7)	8.89 (6.10-12.2)	10.6 (6.98-15.0)	12.1 (7.77-17.4)
15-min	1.96 (1.59-2.39)	2.43 (1.98-2.97)	3.20 (2.60-3.93)	3.84 (3.10-4.74)	4.73 (3.68-6.10)	5.38 (4.10-7.09)	6.09 (4.51-8.35)	6.97 (4.78-9.58)	8.33 (5.48-11.8)	9.51 (6.10-13.7)
30-min	1.40 (1.14-1.71)	1.74 (1.41-2.13)	2.29 (1.86-2.81)	2.75 (2.22-3.40)	3.38 (2.63-4.37)	3.85 (2.93-5.08)	4.36 (3.23-5.98)	4.99 (3.43-6.86)	5.96 (3.92-8.44)	6.81 (4.36-9.80)
60-min	0.909 (0.741-1.11)	1.13 (0.920-1.38)	1.49 (1.21-1.83)	1.79 (1.44-2.21)	2.20 (1.72-2.84)	2.51 (1.91-3.31)	2.84 (2.10-3.89)	3.25 (2.23-4.46)	3.88 (2.55-5.49)	4.43 (2.84-6.38)
2-hr	0.622 (0.510-0.756)	0.772 (0.633-0.940)	1.02 (0.831-1.24)	1.22 (0.992-1.50)	1.50 (1.18-1.93)	1.71 (1.32-2.24)	1.94 (1.45-2.63)	2.22 (1.54-3.01)	2.65 (1.76-3.71)	3.02 (1.96-4.30)
3-hr	0.490 (0.403-0.593)	0.606 (0.499-0.735)	0.796 (0.652-0.968)	0.954 (0.777-1.17)	1.17 (0.923-1.49)	1.33 (1.03-1.73)	1.51 (1.13-2.03)	1.72 (1.20-2.32)	2.05 (1.38-2.85)	2.34 (1.53-3.30)
6-hr	0.319 (0.264-0.384)	0.389 (0.322-0.469)	0.505 (0.416-0.610)	0.600 (0.492-0.728)	0.732 (0.581-0.924)	0.829 (0.646-1.07)	0.935 (0.708-1.25)	1.06 (0.752-1.42)	1.26 (0.855-1.73)	1.43 (0.946-1.99)
12-hr	0.198 (0.165-0.237)	0.238 (0.198-0.285)	0.303 (0.251-0.363)	0.357 (0.295-0.430)	0.431 (0.345-0.539)	0.486 (0.381-0.619)	0.546 (0.416-0.717)	0.616 (0.441-0.814)	0.722 (0.497-0.979)	0.812 (0.545-1.12)
24-hr	0.118 (0.099-0.141)	0.141 (0.118-0.168)	0.178 (0.149-0.212)	0.209 (0.173-0.250)	0.251 (0.202-0.310)	0.283 (0.223-0.355)	0.316 (0.243-0.409)	0.355 (0.257-0.463)	0.411 (0.286-0.550)	0.458 (0.311-0.622)
2-day	0.068 (0.057-0.080)	0.081 (0.068-0.095)	0.102 (0.086-0.121)	0.120 (0.100-0.142)	0.144 (0.117-0.176)	0.162 (0.129-0.201)	0.181 (0.140-0.231)	0.202 (0.148-0.261)	0.232 (0.164-0.307)	0.257 (0.177-0.344)
3-day	0.050 (0.042-0.058)	0.059 (0.050-0.069)	0.073 (0.062-0.087)	0.086 (0.072-0.101)	0.102 (0.083-0.125)	0.115 (0.092-0.142)	0.128 (0.099-0.162)	0.143 (0.105-0.183)	0.163 (0.116-0.214)	0.180 (0.125-0.239)
4-day	0.040 (0.034-0.047)	0.047 (0.040-0.055)	0.058 (0.049-0.069)	0.068 (0.057-0.080)	0.080 (0.066-0.098)	0.090 (0.072-0.111)	0.100 (0.078-0.126)	0.111 (0.083-0.142)	0.127 (0.091-0.165)	0.139 (0.097-0.183)
7-day	0.027 (0.023-0.032)	0.031 (0.027-0.037)	0.038 (0.032-0.044)	0.044 (0.037-0.051)	0.051 (0.042-0.062)	0.057 (0.046-0.069)	0.063 (0.049-0.078)	0.069 (0.052-0.088)	0.078 (0.056-0.100)	0.084 (0.059-0.110)
10-day	0.022 (0.019-0.025)	0.025 (0.021-0.029)	0.030 (0.025-0.035)	0.034 (0.029-0.039)	0.039 (0.032-0.047)	0.044 (0.035-0.053)	0.048 (0.037-0.059)	0.052 (0.039-0.065)	0.058 (0.042-0.074)	0.062 (0.044-0.080)
20-day	0.015 (0.013-0.017)	0.017 (0.014-0.019)	0.019 (0.017-0.022)	0.022 (0.019-0.025)	0.025 (0.020-0.029)	0.027 (0.022-0.032)	0.029 (0.023-0.035)	0.031 (0.024-0.039)	0.034 (0.025-0.043)	0.036 (0.026-0.046)
30-day	0.012 (0.011-0.014)	0.014 (0.012-0.016)	0.016 (0.013-0.018)	0.017 (0.015-0.020)	0.019 (0.016-0.023)	0.021 (0.017-0.025)	0.023 (0.018-0.027)	0.024 (0.019-0.030)	0.026 (0.019-0.032)	0.027 (0.020-0.034)
45-day	0.010 (0.009-0.012)	0.011 (0.010-0.013)	0.013 (0.011-0.014)	0.014 (0.012-0.016)	0.015 (0.013-0.018)	0.017 (0.014-0.019)	0.018 (0.014-0.021)	0.019 (0.015-0.023)	0.020 (0.015-0.025)	0.021 (0.015-0.026)
60-day	0.009 (0.008-0.010)	0.010 (0.008-0.011)	0.011 (0.009-0.012)	0.012 (0.010-0.013)	0.013 (0.011-0.015)	0.014 (0.012-0.016)	0.015 (0.012-0.018)	0.016 (0.012-0.019)	0.017 (0.013-0.021)	0.017 (0.013-0.022)

[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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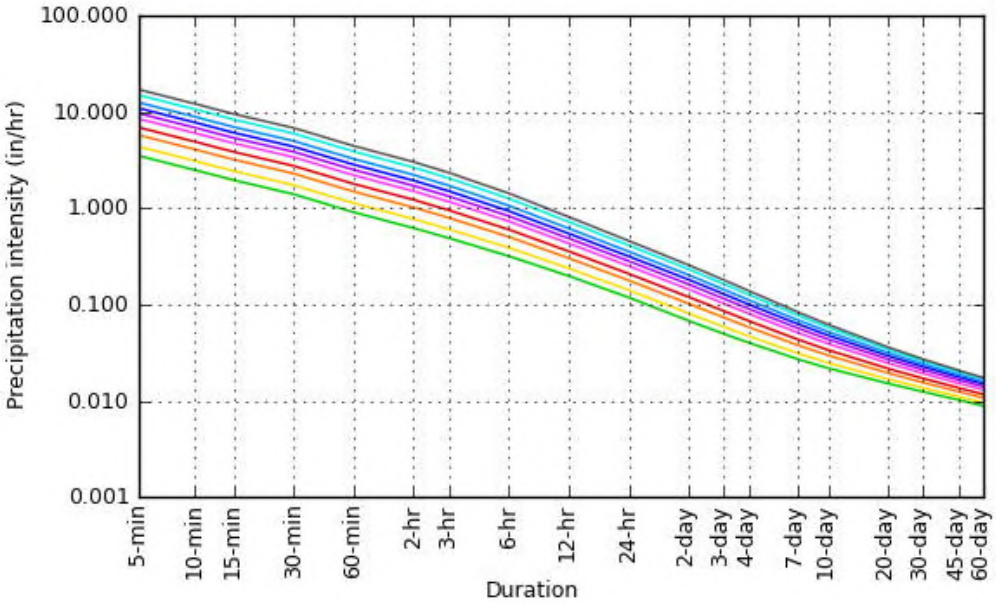
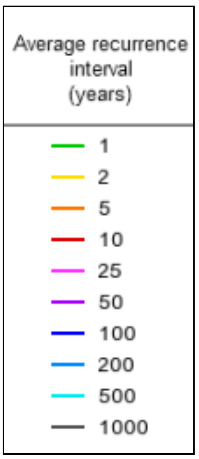
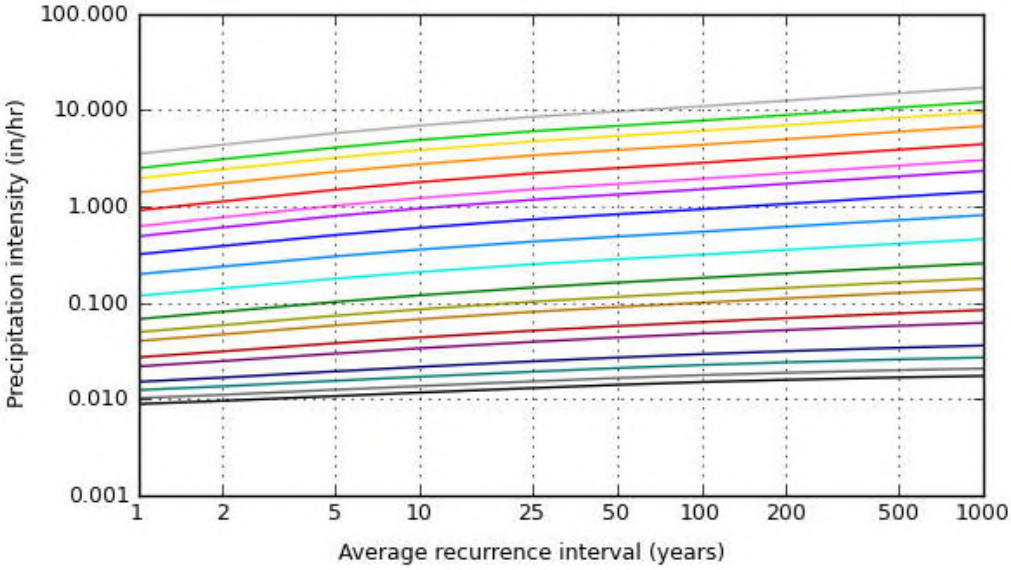
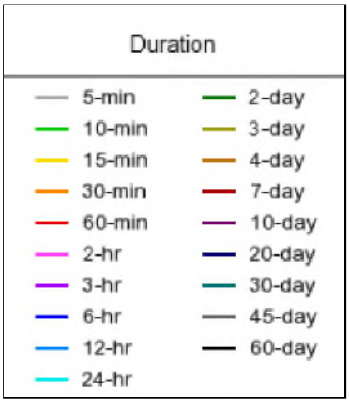
PF graphical

PDS-based intensity-duration-frequency (IDF) curves
Latitude: 41.6563°, Longitude: -70.9205°









NOAA Atlas 14, Volume 10, Version 3 Created (GMT): Thu Dec 24 15:22:49 2020

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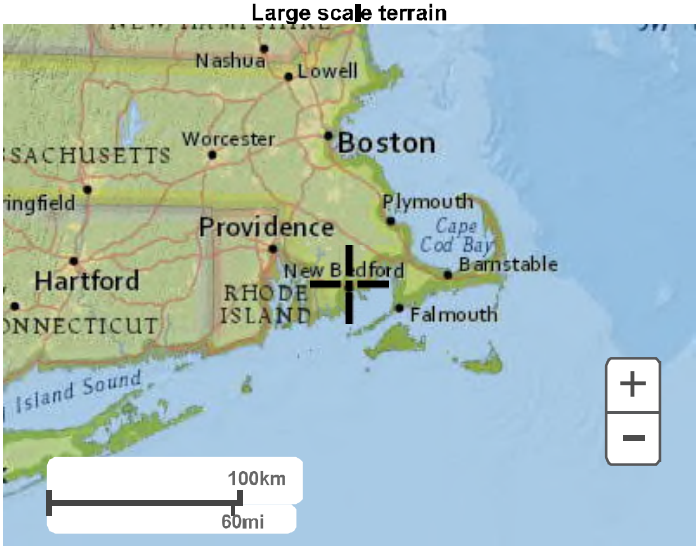
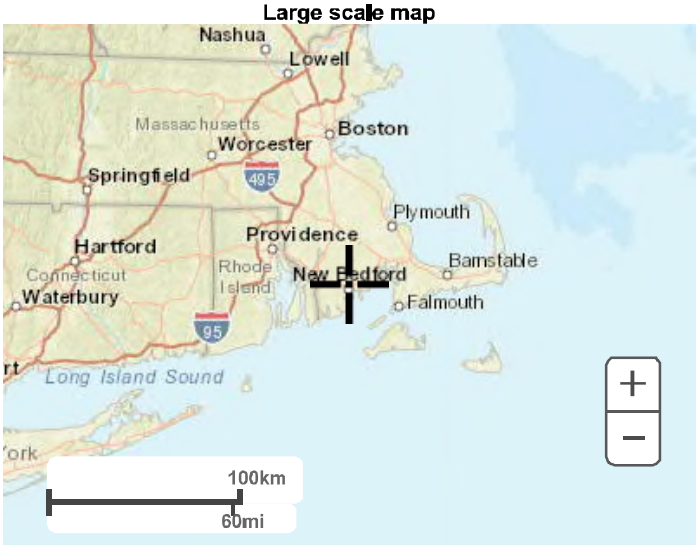
Maps & aerials

Small scale terrain

Large scale terrain



Large scale map



Large scale aerial

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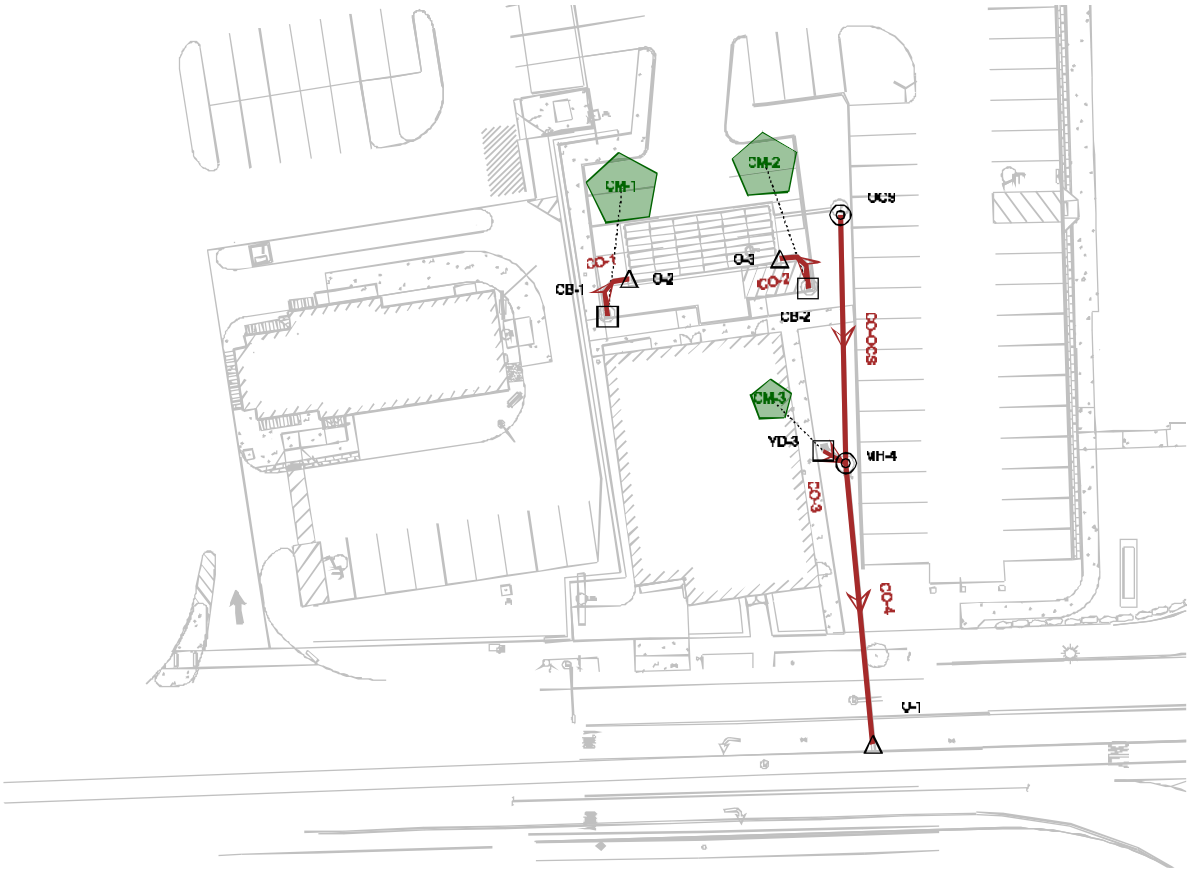
US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Scenario: 25YR



FlexTable: Catchment Table

Label	Area (User Defined) (ft²)	Runoff Coefficient (Rational)	Catchment CA (ft²)	Time of Concentration (min)	Outflow Element	Catchment Intensity (in/h)	Catchment Rational Flow (cfs)
CM-1	2,840.000	0.864	2,453.760	5.000	CB-1	8.510	0.48
CM-2	3,234.000	0.708	2,289.672	5.000	CB-2	8.510	0.45
CM-3	1,244.000	0.468	582.192	5.000	YD-3	8.510	0.11

FlexTable: Conduit Table

Label	Start Node	Stop Node	Invert (Start) (ft)	Invert (Stop) (ft)	Length (Unified) (ft)	Slope (Calculated) (ft/ft)	Diameter (in)	Manning's n	Material	System CA (ft²)	System Intensity (in/h)	Flow (cfs)	Capacity (Full Flow) (cfs)	Velocity (ft/s)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
CO-1	CB-1	O-2	4.10	4.00	15.9	0.006	8.0	0.012	Corrugated HDPE (Smooth Interior)	2,453.760	8.510	0.48	1.04	1.38	4.98	4.96
CO-2	CB-2	O-3	4.10	4.00	15.6	0.006	8.0	0.012	Corrugated HDPE (Smooth Interior)	2,289.672	8.510	0.45	1.05	1.29	4.98	4.96
CO-3	YD-3	MH-4	3.40	3.20	7.5	0.027	12.0	0.012	Corrugated HDPE (Smooth Interior)	582.192	8.510	0.11	6.30	3.08	3.58	3.60
CO-4	MH-4	O-1	3.10	2.40	82.7	0.008	12.0	0.012	Corrugated HDPE (Smooth Interior)	582.192	8.490	1.37	3.55	4.23	3.60	2.83
CO-OCS	OCS	MH-4	3.80	3.20	72.8	0.008	12.0	0.012	Corrugated HDPE (Smooth Interior)	0.000	8.510	1.26	3.50	4.10	4.27	3.61

FlexTable: Catch Basin Table

Label	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Inlet Drainage Area (ft²)	Inlet C	Local Flow Time (min)	Flow (Known) (cfs)	Flow (Captured) (cfs)	Spread / Top Width (ft)	Inlet Location	Inlet
CB-1	5.90	4.10	2,840.000	0.864	5.000	0.00	0.48	3.1	In Sag	Combination Type C Single Grate - Grate Type A - Plain Curb
CB-2	6.00	4.10	3,234.000	0.708	5.000	0.00	0.45	2.9	In Sag	Combination Type C Single Grate - Grate Type A - Plain Curb
YD-3	6.10	3.40	1,244.000	0.468	5.000	0.00	0.11	3.4	In Sag	Yard Drain

FlexTable: Manhole Table

Label	Elevation (Ground) (ft)	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Flow (Total Out) (cfs)	Hydraulic Grade Line (Out) (ft)	Local Flow Time (min)	Flow (Known) (cfs)
MH-4	7.00	7.00	3.10	1.37	3.60	5.000	0.00
OCS	8.10	8.10	3.80	1.26	4.27	5.000	1.26

FlexTable: Outfall Table

Label	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Boundary Condition Type	Elevation (User Defined Tailwater) (ft)	Hydraulic Grade (ft)	Flow (Total Out) (cfs)
O-1	5.65	2.40	Free Outfall		2.83	1.37
O-2	6.50	4.00	User Defined Tailwater	4.96	4.96	0.48
O-3	6.40	4.00	User Defined Tailwater	4.96	4.96	0.45

FUSS & O'NEILL

Appendix E

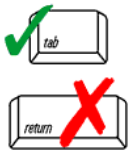
Stormwater Management Checklist

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.

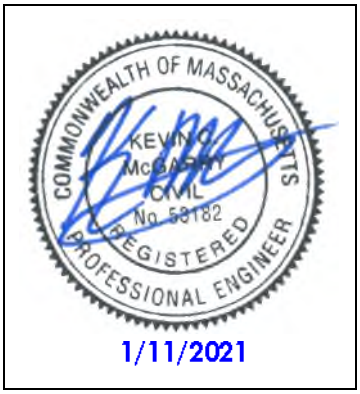
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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

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): Subsurface Infiltration System

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.

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Appendix F

BMP Sizing Calculations

Subsurface Infiltration System

Objective: Size Best Management Practice (BMP) in accordance with Standards 3 and 4 of the MA Stormwater Handbook. BMP shall be sized to infiltrate the required recharge volume (Standard 3) and provide treatment for the required water quality volume (Standard 4).

1) Calculate Required Recharge Volume (Standard 3)

$R_v = (F/12)*(A_{IMP})$ = 524 cf

F (target depth factor)	0.6	in (soil group A, Table 2.3.2 of MA Stormwater Handbook)
A_{IMP} (impervious area)	10,486	sf

2) Calculate Drawdown Time (Standard 3)

T_d=Storage Volume / (K*(1'/12")*Bottom Area)= 4 hours

Storage Volume	605	cf at lowest el. 4.75 orifice elevation (from HydroCad)
K (sat. hydraulic conductivity)	2.41	in/hr (Rawls Rate for loamy sand, Table 2.3.3 of MA Stormwater Handbook)
Bottom Area	843	sf (from HydroCAD)

4 < 72 hrs

3) Calculate Water Quality Volume (WQv) (Standard 4)

$V_{WQ} = (D_{WQ}/12)*(A_{IMP})$ = 548 cf

D_{WQ} (water quality depth)	1	
A_{IMP} (impervious area)	6,580	

4) Size BMP to store greater of V_{WQ} and R_V

V_{WQ} = 548 cf

R_V = 524 cf

Actual Storage= 605 cf (from HydroCAD)

605 > 548

Elevation	Surface Area (SF)	Cumulative Storage (CF)	
4.55	843	502	
4.60	843	529	
4.65	843	556	
4.70	843	581	
4.75	843	**605**	Lowest orifice at elevation 4.75(from HydroCad)
4.80	843	627	
4.85	843	648	

Subsurface Isolator Row

Objective: Size Best Management Practice (BMP) in accordance with Standard 4 of the MA Stormwater Handbook. BMP shall be sized to provide pretreatment for 25% of the Total Suspended Solids (TSS) (Standard 4).

1) Calculate Drawdown Time (Standard 3)

T_d=Storage Volume / (K*(1'/12")*Bottom Area)=	2	hours			
			Storage Volume	82	12 chambers with 6.8 cf storage per chamber
			K (sat. hydraulic conductivity)	2.41	in/hr (Rawls Rate for loamy sand, Table 2.3.3 of MA Stormwater Handbook)
			Bottom Area	178	sf
2	**<**	**72 hrs**			

2) Calculate Water Quality Volume (WQv)

V_{WQ} =(D_{WQ}/ 12)*(A_{IMP})=	55	cf		
			D_{WQ} (water quality depth)	0.1
			A_{IMP} (impervious area)	6,580

3) Size BMP to store V_{WQ}

V_{WQ}=	55	cf	
Actual Storage=	82	cf	12 chambers with 6.8 cf storage per chamber
82	**>**	**55**	

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Appendix G

TSS Removal Calculations

Project:	Ascend Cannabis Dispensary	**Prepared By:**	JHD
Site Location:	New Bedford, MA	**Date:**	1/8/2021
Project Number:	20191061.T10		
Outfall Location:	Subsurface Inf. Chamber		
Treatment Train:	Deep Sump CB to Inf. Chamber		

BMP	TSS Removal Efficiency	Starting TSS Load	TSS Removed	TSS Remaining
Deep Sump Catch Basins	25%	1.00	0.25	0.75
Subsurface Infiltration Isolator Rows	25%	0.75	0.19	0.56
Subsurface Infiltration Chambers	80%	0.56	0.45	0.11
		0.11	0.00	0.11

Total TSS Removal Efficiency =	**89%**

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Appendix H

Long-Term Operation and Maintenance Plan

Long-Term Operation and Maintenance Plan
Ascend Cannabis Dispensary

115 Coggeshall Street
New Bedford, Massachusetts

PREPARED FOR:

Ascend Mass, LLC

500 Totten Pond Road
Cambridge, MA

January 8, 2021

FUSS & O'NEILL

108 Myrtle Street
Quincy, MA 02171

Project No. 201910610.T10

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Table of Contents

Long-Term Operation and Maintenance Plan
Ascend Cannabis Dispensary

1 Introduction

The purpose of this Long-Term Operation and Maintenance Plan (O&M Plan) is to outline the requirements for source control and pollution prevention for the proposed cannabis dispensary located at 115 Coggeshall Street in New Bedford, MA. The site is currently developed with a building and associated site improvements. The site is bounded by commercial properties to the north, east and west, and Coggeshall Street to the south. The project location is depicted on the Site Location Map attached as *Figure 1* in this report.

The project includes the redevelopment of the existing building along with parking lot, driveway, sidewalks, stormwater infrastructure, utilities, and landscaping. The overall drainage pattern of the site will be unchanged by the project.

The Stormwater Management system is comprised of one subsurface infiltration system and a storm sewer system which includes catch basins with deep sumps. Through these best management practices (BMPs), reduction in stormwater peak discharge, groundwater recharge, and stormwater treatment are achieved. A map depicting the location of the BMPs is provided in *Figure 2*.

The long-term requirements include following proper site operation procedures and implementing an inspection and maintenance program to ensure the success and minimize the deterioration of the stormwater system over time. The Contractor is responsible for implementing this O&M Plan during construction. The Owner (Ascend LLC) is responsible thereafter. Maintenance operations shall be funded by the Owner. In the event the facility becomes owned by different entities, this Long-Term Operation and Maintenance Plan shall be transferred to the future owners/operators. Checklists to assist with the inspection and maintenance activities are provided in *Appendix A*.

This plan has been prepared in accordance with the requirements set forth in Standard 4 and Standard 9 of the Massachusetts Stormwater Handbook.

2 Pollution Prevention

The following pollution prevention activities shall be conducted to minimize potential impacts on stormwater runoff quality. The Contractor is responsible for all activities during construction. The Owner is responsible thereafter.

2.1 Good Housekeeping

Good housekeeping shall be implemented to minimize the impacts to protected areas by pollutants, soil, and fugitive sediment. The site shall be kept in good working order. Trash shall be kept in covered containers (i.e., dumpsters) to prevent waste from escaping. Fugitive litter that is deposited on the site shall be removed and placed in a proper enclosed container.

2.2 Vehicle Washing

There are no provisions for accommodating vehicle washing as part of the cannabis dispensary. If vehicle washing is required by facility staff, the O&M Plan shall be amended to include vehicle washing practices.

2.3 Chemical and Petroleum Products

All chemical and petroleum product containers stored on the site (excluding those contained within vehicles and equipment) shall be provided with impermeable containment which will hold at least 110% of the volume of the largest container, or 10% of the total volume of all containers in the area, whichever is larger, without overflow from the containment area. All chemicals and their containers shall be stored under a roofed area. Containers of 100 gallon capacity or more may be stored without a roof only if stored in a double-walled tank. On-site vehicles shall be monitored for leaks and receive maintenance as needed.

2.3.1 Spill Control Practices

Any discharge of waste oil or other pollutant to the stormwater system will be reported immediately to the Massachusetts Department of Environmental Protection (MA DEP). The Owner will be responsible for any incident of groundwater contamination resulting from the improper discharge of pollutants to the stormwater system, and may be required by MA DEP to remediate incidents that may impact groundwater quality. Should property ownership be transferred, the subsequent owner/operator will be informed of the legal responsibilities associated with operation of the stormwater system, as indicated above.

The following practices shall be implemented to mitigate spills of material and prevent their release to the waters of the Commonwealth:

- Manufacturers' recommended methods for spill cleanup shall be clearly posted and site personnel will be made aware of the procedures and the location of the information and cleanup supplies.

- Materials and equipment necessary for spill cleanup will be kept in material storage areas. Equipment and materials will include but not be limited to brooms, dust pans, mops, rags, gloves, goggles, kitty litter, sand, sawdust, and plastic and metal trash containers specifically for this purpose.

- Spills will be cleaned up immediately after discovery.

- Spills of toxic or hazardous material will be reported to the appropriate State and local government agency, regardless of size.

2.4 Landscaped Areas

Lawn areas will be mowed during the growing seasons as required to maintain a healthy stand of vegetation. This is typically once a week but can vary depending on weather conditions. If bagged, grass clippings are to be removed from the site and legally disposed of at an off-site location.

Fertilizers, if required for the maintenance of lawn areas, will be applied only in the amounts recommended by the manufacturer. If kept on site, fertilizers will be stored in a covered area. The contents of any partially used bags of fertilizer will be transferred to a sealable plastic bin to avoid spills.

2.5 Pet Waste Management

There are no provisions for accommodating pets as part of the cannabis dispensary. If pets or service animals are required by facility staff, the O&M Plan shall be amended to include pet waste management practices.

2.6 Snow Management

Stormwater runoff caused by snow melt must be properly managed to prevent erosion and pollution. Therefore, a snow management plan has been developed to identify storage areas throughout the site.

Determine the best areas on the site to stockpile snow, keeping pedestrians car routes cleared. Also take into consideration the locations of BMPs to ensure proper functioning of the stormwater management system.

- Keep pedestrian and emergency routes cleared. Ensure stockpiles do not obstruct sight lines at driveway or road intersections.
- Snow removed from the parking lot will be stored in the marked location on the grassed area to the east of the parking lot.
- Snow removed from the delivery driveway will be stored in the adjacent grassed area to the south of the building.
- Snow removed from the sidewalks will be stored in the adjacent lawn areas.
- Snow will be stockpiled onsite until the available capacity is exceeded at which point it will be loaded into trucks and properly disposed of at an off-site location.

A Snow Storage Plan is provided as *Figure 3*.

3 Inspection and Maintenance Requirements for Permanent Stormwater Controls

The following inspection and maintenance activities shall be conducted to ensure the success and minimize the deterioration of the stormwater system over time. A map depicting the location of the components of the stormwater management system is provided in *Figure 2*. Checklists to assist with the inspection and maintenance activities are provided in *Appendix A*.

3.1 Subsurface Infiltration System

The recommended manufacturer Operation and Maintenance has been included in *Appendix B*.

3.2 Drainage Structures

3.2.1 Post-Construction Inspections

Immediately prior to the end of construction and acceptance by the Owner, the Contractor shall clean all drainage structures.

3.2.2 Quarterly Inspections

Drainage structures shall be inspected four times per year, at minimum. Sediment shall be removed at least twice per year, or when the depth reaches half the height between the bottom of the structure and the lowest pipe invert elevation. Inspections shall include checking for debris, sediment, and hydrocarbons, and structural integrity or damage. Deficiencies must be corrected immediately. Disposal of the accumulated sediment and hydrocarbons must be in accordance with applicable local, state, and federal guidelines and regulations. Grates shall not be welded to the frame so the structures can be easily inspected and maintained.

3.3 Anticipated Costs

The annual cost for the inspections and maintenance for the property is estimated to be from $11,000 to $17,000 per year, if performed by an independent third party. A budgetary opinion of cost for the maintenance is included in *Appendix C*.

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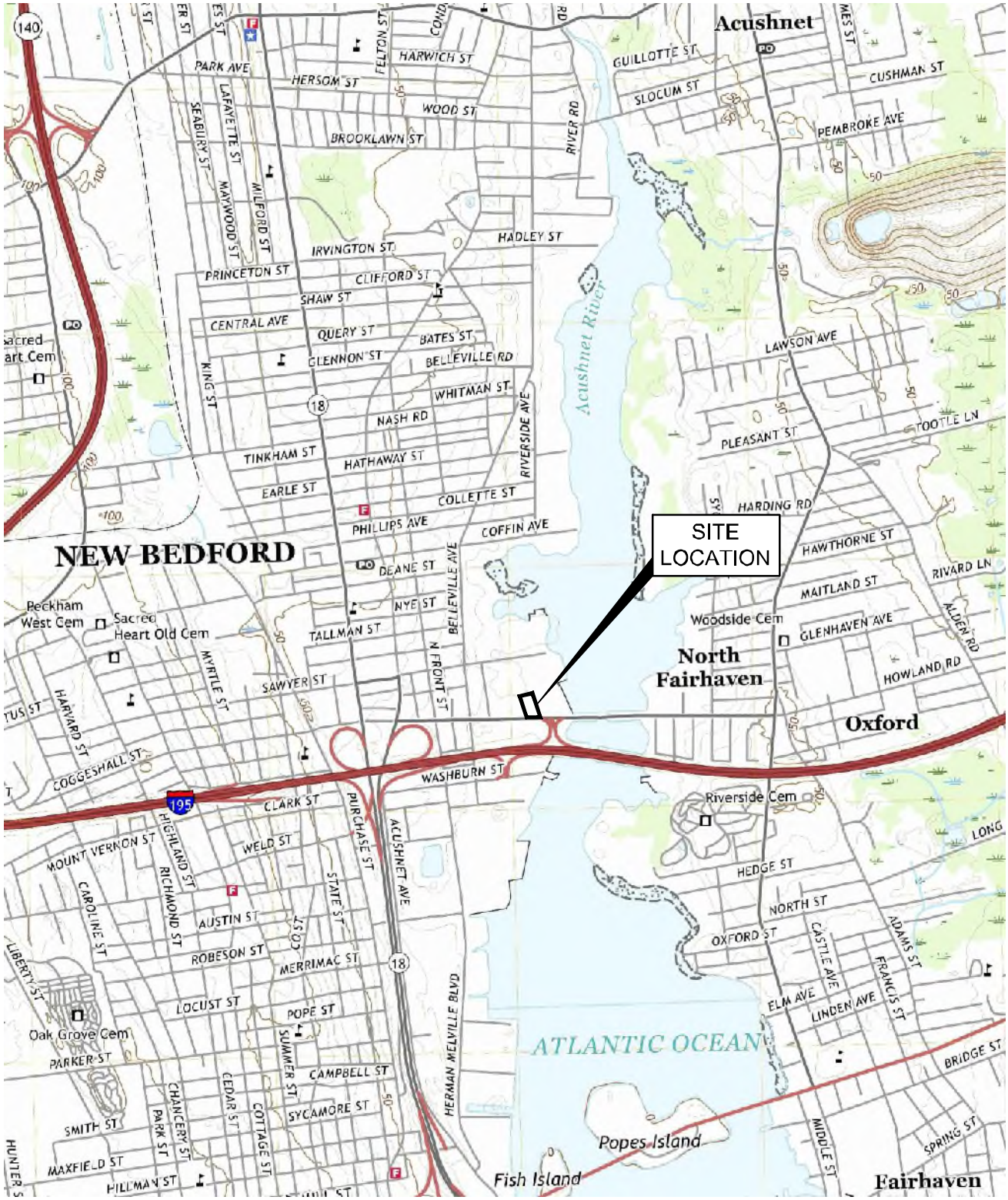
Figure 1

Site Location Map



MAP REFERENCE:
THIS MAP WAS PREPARED FROM THE FOLLOWING USGS 7.5 MINUTE SERIES TOPOGRAPHICAL MAP:
NEW BEDFORD NORTH QUADRANGLE, MASSACHUSETTS, 2018

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DATUM:	
HORZ.:	
VERT.:	

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GRAPHIC SCALE

FUSS & O'NEILL
108 MYRTLE STREET, SUITE 502
QUINCY, MA 02171
617.252.4675
www.fando.com

ASCEND MASS, LLC

SITE LOCATION MAP

115 COGGESHALL STREET

NEW BEDFORD MASSACHUSETTS

PROJ. No.: 20191361.T10
DATE: 01/08/2020

FIGURE 1

File Path: J:\DW\GIP\20 91361 T10 Civil\Plan\20 91361T10 LOC01.dwg Layout: FIGURE 1 Plotted: Tue, December 31, 2020 - 11:20 AM User: jenninge
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LAYER STATE:
MS VIEW:

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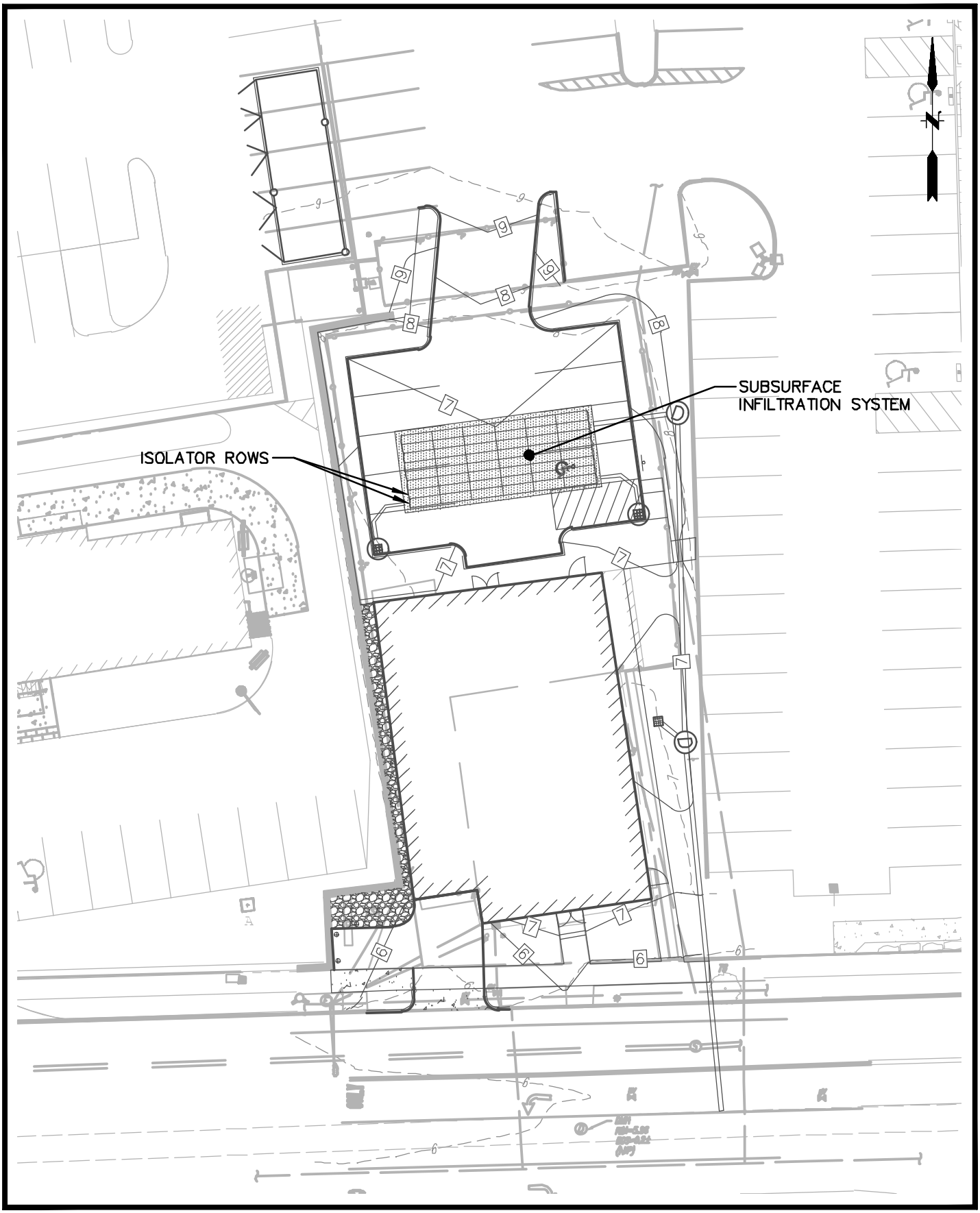
Figure 2

BMP Location Plan



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ASCEND MASS, LLC

BMP LOCATION PLAN

115 COGGESHALL STREET

NEW BEDFORD MASSACHUSETTS

PROJ. No.: 20191361.T10
DATE: 01/08/2021

FIGURE 2

File Path: J:\DW\GIP\20 91361\T10\Civil\Plan\20 91361T10 RMP01.dwg Layout: FIG 2 Plotted: Thu, January 07, 202 - 9:07 PM User: jdeninger
Plotter: DWG TO PDF.PC3 CTB File: FC.STB
MS VIEW: LAYER STATE:

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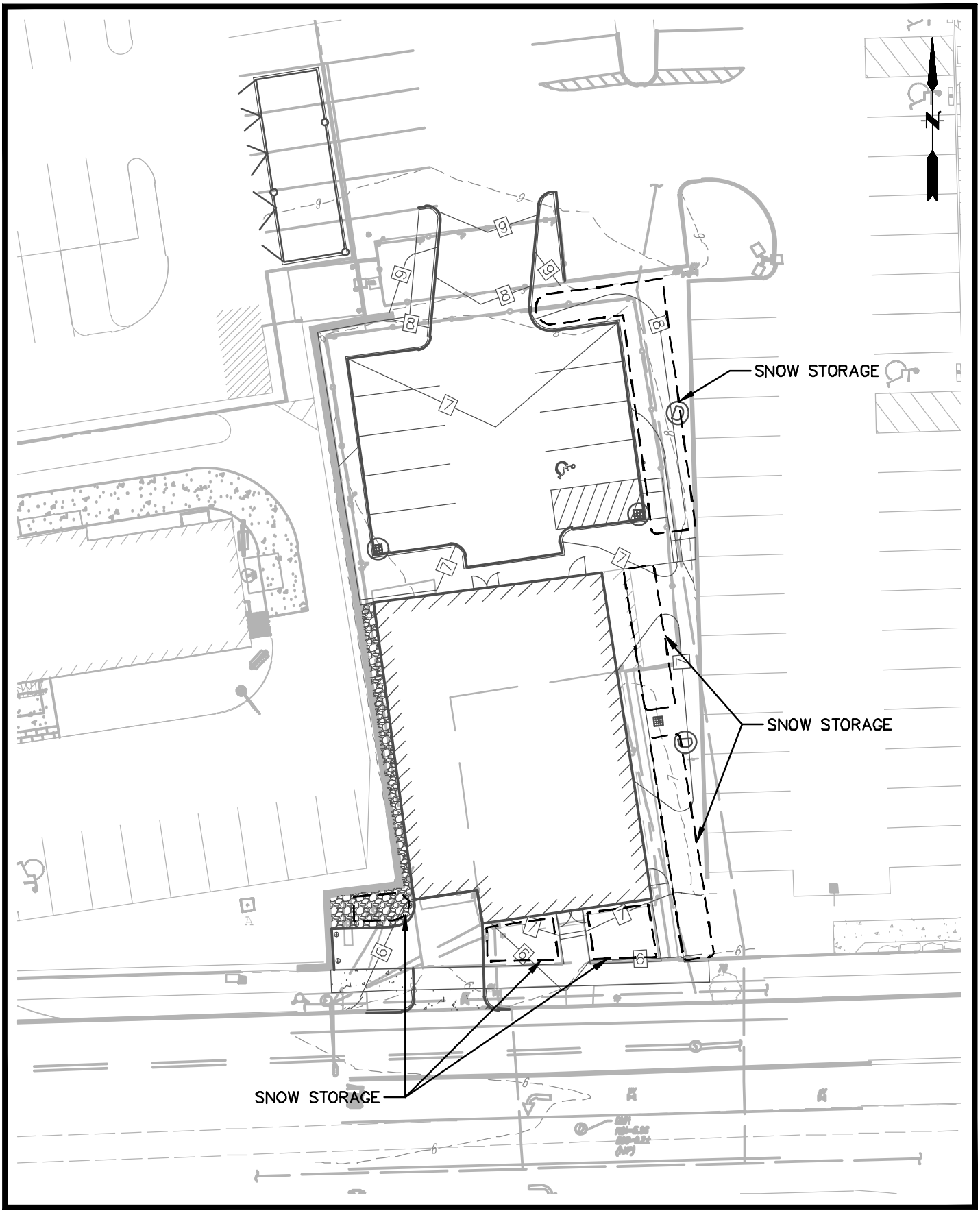
Figure 3

Snow Storage Plan



SCALE:
HORZ.: 1" = 30'
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DATUM:
HORZ.:
VERT.:
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GRAPHIC SCALE

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ASCEND MASS, LLC

SNOW STORAGE PLAN

115 COGGESHALL STREET

NEW BEDFORD MASSACHUSETTS

PROJ. No.: 20191361.T10
DATE: 01/08/2021

FIGURE 3

File Path: J:\DW\GIP\20`91361\T10\CivilPlan\20`91361T10_RMP01.dwg Layout: FIG 3 Plotted: Thu, January 07, 202` - 9:08 PM User: jdeninger
Plotter: DWG TO PDF.PC3 CTB File: FC.STB
LAYER STATE:
MS VIEW:

Appendix A

Operation, Maintenance and Management Inspection Checklist

Operation, Maintenance, and Management Inspection Checklists
Master Checklist
Ascend Cannabis Dispensary

Inspection Year: _____

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Subsurface Infiltration System												
Semi-Annual Inspection												
Drainage Structures												
Quarterly Inspection												

Operation, Maintenance, and Management Inspection Checklists
Subsurface Infiltration System
Ascend Cannabis Dispensary

Inspector Name: _____

Inspection Date: _____

Reviewed By: _____

Review Date: _____

Type of Inspection (Circle One):

Yearly

BMP Name:

_____

No	Monthly	Quarterly	Item	Criteria	Satisfactory	Unsatisfactory	Notes
1			Trash/Debris	System is free of debris, litter, and waste.			
2			Concrete Surfaces	Concrete surfaces are structurally sound and have negligible spalling and cracking.			
3			Sediment	Depth of Sediment is less than three inches.			

4			Clogging	System appears to be draining freely and not clogged.			
5			Oil/Grease	Oil and grease is not evident in the system.			
6			Inlet Structures	River stone inlets do not show scouring.			
7			Inlet & Outlet Structures	Structures are free of blockage and are structurally sound.			

Operation, Maintenance, and Management Inspection Checklists
Drainage Structures
Ascend Cannabis Dispensary

Inspector Name: _____

Inspection Date: _____

Reviewed By: _____

Review Date: _____

Type of Inspection (Circle One):

Quarterly

Structure Name:

_____

No	Quarterly	Item	Criteria	Satisfactory	Unsatisfactory	Notes
1		Trash/Debris	Structure is free of debris, litter, and waste.			
2		Sediment	Depth of sediment is less than half the height between the bottom of the structure and the lowest pipe invert elevation and has been removed within the last six months.			
3		Concrete Surfaces	Concrete surfaces are structurally sound and have negligible spalling and cracking.			

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Appendix B

Subsurface Infiltration Systems Operation & Maintenance Manual

StormTech
Detention · Retention · Water Quality
An ADS company

Isolator® Row O&M Manual

THE MOST ADVANCED NAME IN WATER MANAGEMENT SOLUTIONS™

ADS®

THE ISOLATOR® ROW

INTRODUCTION

An important component of any Stormwater Pollution Prevention Plan is inspection and maintenance. The StormTech Isolator Row is a technique to inexpensively enhance Total Suspended Solids (TSS) removal and provide easy access for inspection and maintenance.

THE ISOLATOR ROW

The Isolator Row is a row of StormTech chambers, either SC-160LP, SC-310, SC-310-3, SC-740, DC-780, MC-3500 or MC-4500 models, that is surrounded with filter fabric and connected to a closely located manhole for easy access. The fabric-wrapped chambers provide for settling and filtration of sediment as storm water rises in the Isolator Row and ultimately passes through the filter fabric. The open bottom chambers and perforated sidewalls (SC-310, SC- 310-3 and SC-740 models) allow storm water to flow both vertically and horizontally out of the chambers. Sediments are captured in the Isolator Row protecting the storage areas of the adjacent stone and chambers from sediment accumulation.

Two different fabrics are used for the Isolator Row. A woven geotextile fabric is placed between the stone and the Isolator Row chambers. The tough geotextile provides a media for storm water filtration and provides a durable surface for maintenance operations. It is also designed to prevent scour of the underlying stone and remain intact during high pressure jetting. A non-woven fabric is placed over the chambers to provide a filter media for flows passing through the perforations in the sidewall of the chamber. The non-woven fabric is not required over the SC-160LP, DC-780, MC-3500 or MC-4500 models as these chambers do not have perforated side walls.

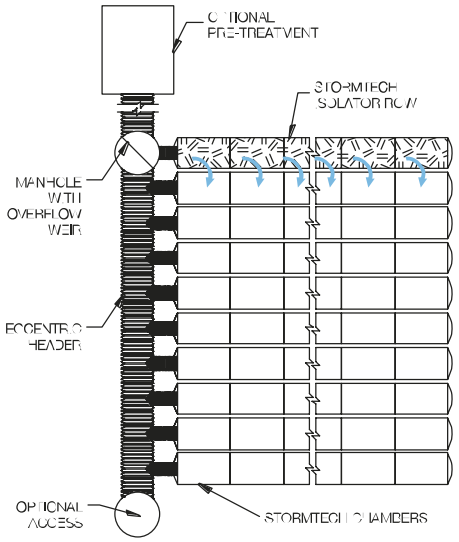
The Isolator Row is typically designed to capture the "first flush" and offers the versatility to be sized on a volume basis or flow rate basis. An upstream manhole not only provides access to the Isolator Row but typically includes a high flow weir such that storm water flowrates or volumes that exceed the capacity of the Isolator Row overtop the over flow weir and discharge through a manifold to the other chambers.

The Isolator Row may also be part of a treatment train. By treating storm water prior to entry into the chamber system, the service life can be extended and pollutants such as hydrocarbons can be captured. Pre-treatment best management practices can be as simple as deep sump catch basins, oil-water separators or can be innovative storm water treatment devices. The design of the treatment train and selection of pretreatment devices by the design engineer is often driven by regulatory requirements. Whether pretreatment is used or not, the Isolator Row is recommended by StormTech as an effective means to minimize maintenance requirements and maintenance costs.

Note: See the StormTech Design Manual for detailed information on designing inlets for a StormTech system, including the Isolator Row.

Looking down the Isolator Row from the manhole opening, woven geotextile is shown between the chamber and stone base.

StormTech Isolator Row with Overflow Spillway (not to scale)



ISOLATOR ROW INSPECTION/MAINTENANCE

INSPECTION

The frequency of inspection and maintenance varies by location. A routine inspection schedule needs to be established for each individual location based upon site specific variables. The type of land use (i.e. industrial, commercial, residential), anticipated pollutant load, percent imperviousness, climate, etc. all play a critical role in determining the actual frequency of inspection and maintenance practices.

At a minimum, StormTech recommends annual inspections. Initially, the Isolator Row should be inspected every 6 months for the first year of operation. For subsequent years, the inspection should be adjusted based upon previous observation of sediment deposition.

The Isolator Row incorporates a combination of standard manhole(s) and strategically located inspection ports (as needed). The inspection ports allow for easy access to the system from the surface, eliminating the need to perform a confined space entry for inspection purposes.

If upon visual inspection it is found that sediment has accumulated, a stadia rod should be inserted to determine the depth of sediment. When the average depth of sediment exceeds 3 inches throughout the length of the Isolator Row, clean-out should be performed.

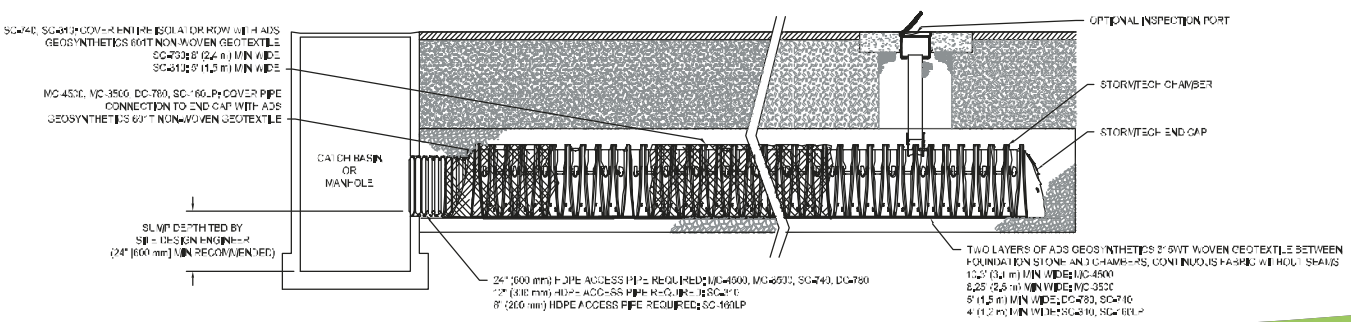
MAINTENANCE

The Isolator Row was designed to reduce the cost of periodic maintenance. By "isolating" sediments to just one row, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided via a manhole(s) located on the end(s) of the row for cleanout. If entry into the manhole is required, please follow local and OSHA rules for a confined space entries.

Maintenance is accomplished with the JetVac process. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row while scouring and suspending sediments. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/JetVac combination vehicles. Selection of an appropriate JetVac nozzle will improve maintenance efficiency. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45" are best. Most JetVac reels have 400 feet of hose allowing maintenance of an Isolator Row up to 50 chambers long. **The JetVac process shall only be performed on StormTech Isolator Rows that have AASHTO class 1 woven geotextile (as specified by StormTech) over their angular base stone.**

StormTech Isolator Row (not to scale)

Note: Non-woven fabric is only required over the inlet pipe connection into the end cap for SC-160LP, DC-780, MC-3500 and MC-4500 chamber models and is not required over the entire Isolator Row.



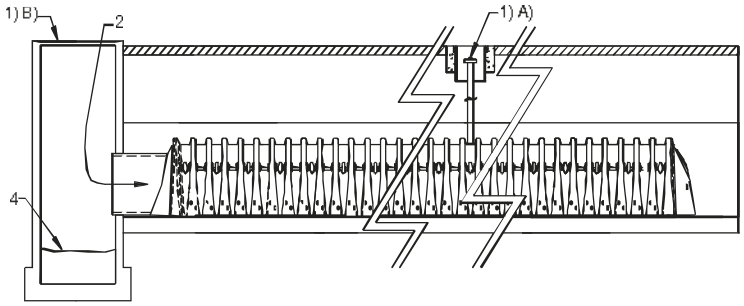
ISOLATOR ROW STEP BY STEP MAINTENANCE PROCEDURES

STEP 1
Inspect Isolator Row for sediment.
- A) Inspection ports (if present)
  - i. Remove lid from floor box frame
  - ii. Remove cap from inspection riser
  - iii. Using a flashlight and stadia rod,measure depth of sediment and record results on maintenance log.
  - iv. If sediment is at or above 3 inch depth, proceed to Step 2. If not, proceed to Step 3.
- B) All Isolator Rows
  - i. Remove cover from manhole at upstream end of Isolator Row
  - ii. Using a flashlight, inspect down Isolator Row through outlet pipe
    1. Mirrors on poles or cameras may be used to avoid a confined space entry
    2. Follow OSHA regulations for confined space entry if entering manhole
  - iii. If sediment is at or above the lower row of sidewall holes (approximately 3 inches), proceed to Step 2. If not, proceed to Step 3.

STEP 2
Clean out Isolator Row using the JetVac process.
- A) A fixed floor cleaning nozzle with rear facing nozzle spread of 45 inches or more is preferable
- B) Apply multiple passes of JetVac until backflush water is clean
- C) Vacuum manhole sump as required

STEP 3
Replace all caps, lids and covers, record observations and actions.

STEP 4
Inspect & clean catch basins and manholes upstream of the StormTech system.



SAMPLE MAINTENANCE LOG

Date	Stadia Rod Readings		Sediment Depth (1)–(2)	Observations/Actions	Inspector
	Fixed point to chamber bottom (1)	Fixed point to top of sediment (2)			
3/15/11	6.3 ft	none		New installation. Fixed point is CI frame at grade	DJM
9/24/11		6.2	0.1 ft	Some grit felt	SM
6/20/13		5.8	0.5 ft	Mucky feel, debris visible in manhole and in Isolator Row, maintenance due	NV
7/7/13	6.3 ft		0	System jetted and vacuumed	DJM

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A division of ADS

Advanced Drainage Systems, Inc.
4640 Trueman Blvd., Hilliard, OH 43026
1-800-821-6710 www.ads-pipe.com

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Appendix C

Annual O&M Budgetary Opinion of Cost

FUSS & O'NEILL

FUSS & O'NEILL, INC.

108 Myrtle Street, Suite 502
Quincy, MA 02171

BUDGETARY OPINION OF COST	DATE PREPARED 01/08/21	SHEET 1 OF 1
PROJECT : Ascend Cannabis Dispensary	BASIS :	
LOCATION : Coggeshall Street, New Bedford, MA		
DESCRIPTION Long Term Stormwater O&M Costs	ESTIMATOR : JHD	CHECKED BY : KCM

Since Fuss & O'Neill has no control over the cost of labor, materials, equipment or services furnished by others, or over the Contractor(s)' methods of determining prices, or over competitive bidding or market conditions, Fuss & O'Neill's opinion of probable Total Project Costs and Construction Cost are made on the basis of Fuss & O'Neill's experience and qualifications and represent Fuss & O'Neill's best judgment as an experienced and qualified professional engineer, familiar with the construction industry; but Fuss & O'Neill cannot and does not guarantee that proposals, bids or actual Total Project or Construction Costs will not vary from opinions of probable cost prepared by Fuss & O'Neill. If prior to the bidding or negotiating Phase the Owner wishes greater assurance as to Total Project or Construction Costs, the Owner shall employ an independent cost estimator.

ITEM NO.	ITEM DESCRIPTION	UNIT MEAS.	NO. UNITS	PER UNIT	TOTAL COST
1	Site Inspections[2]	EA	4	$ 500.00	$ 2,000.00
2	Monthly Removal of Trash[3]	EA	12	$ 125.00	$ 1,500.00
3	Sediment Removal[5]	EA	4	$ 1,000.00	$ 4,000.00
4	Vacuum Truck - Drainage Structures & Infiltration Systems [6]	DAY	2	$ 2,800.00	$ 5,600.00
					$ 13,100.00
				TOTAL COST (-15% TO +30% ROUNDED)	**$11,000 TO $17,000**

Notes

1. The following equipment and labor rates were used for this estimate: Site Inspector - $1,000/day; Laborer - $500/day; Skidsteer & Operator - $1,000/day; Dump Truck - $500/day; Vacum Truck - $1800/day
2. Assume a Site Inspector is required for 1/4 day per inspection.
3. Assumes 1 Laborer for a 1/4 day.
4. Assumes mowing is done as part of normal landscaping maintenance.
5. Assumes 1 Laborer, 1 Skidsteer & Operator, and 1 Dump Truck for 1/2 day.
6. Assumes 2 Laborers and 1 Vaccum Truck for 1/4 Day.