STONEFIELD

STORMWATER MANAGEMENT REPORT

PROPOSED STARBUCKS WITH DRIVE -THRU FACILITIES
BLOCK 93, LOT 168, 169, & 275
0 & 8 MITCHELL STREET & 171 COGGESHALL STREET
CITY OF NEW BEDFORD
BRISTOL COUNTY, MASSACHUSETTS

PREPARED FOR:

ALRIG USA DEVELOPMENT, LLC

PREPARED BY:

STONEFIELD ENGINEERING & DESIGN, LLC
JULY 1, 2021
BOS-200026

JAKE MODESTOW PE
MASSACHUSETTS PROFESSIONAL ENGINEER LICENSE # 65336

I CERTIFY UNDER PENALTY OF LAW THAT I HAVE PERSONALLY EXAMINED AND AM FAMILIAR WITH THE INFORMATION SUBMITTED IN THIS DOCUMENT AND ALL ATTACHMENTS AND THAT, BASED ON MY INQUIRY OF THOSE INDIVIDUALS IMMEDIATELY RESPONSIBLE FOR OBTAINING AND PREPARING THE INFORMATION, I BELIEVE THAT THE INFORMATION IS TRUE, ACCURATE, AND COMPLETE. I AM AWARE THAT THERE ARE SIGNIFICANT PENALTIES FOR KNOWINGLY SUBMITTING FALSE INFORMATION, INCLUDING THE POSSIBILITY OF FINE AND IMPRISONMENT

REPORT CONTENTS

APPENDICIES

1.0 PROJECT DESCRIPTION

ALRIG USA Development, LLC is proposing the construction of a proposed Starbucks with Drive-Thru Facilities. The subject property is designated Block 93, Lot 168, 169 & 275 located at 0 & 8 Mitchell Street & 171 Coggeshall Street.

The total project area is 35,212 SF (0.81 acres), the total area of new impervious surfaces is 11,442 SF (0.26 acres), and the total area of disturbance is 36,439.70 SF (0.84 acres). Project Figures can be found in **Appendix A** of this Report.

This Stormwater Management Report has been prepared to analyze the potential stormwater runoff impacts of the proposed project and discuss the measures proposed to conform to the stormwater management requirements set forth by the City of New Bedford and the Massachusetts Department of Environmental Protection.

2.0 EXISTING CONDITIONS

The project site is currently developed by existing masonry buildings with areas of 2,115 SF and 2,270 SF, and associated utilities, paving, and fencing that will be demolished during construction. The site is bounded by Coggeshall Street to the south, Mitchell Street to the west, shopping center to the north, and fast food restaurant to the east. There is an existing 1,365 SF masonry building that will remain and not be impacted that bounds the site to the southwest. The site is accessed by two driveways, each one located on Coggeshall Street and Mitchell Street.

2.1 EXISTING DRAINAGE AREAS

Under existing conditions, the site is comprised of two (2) drainage areas. The high points of the site are located along the western and northern boundaries of the site and flows to two locations. The first location is to inlets along the east portion of the site that are collected and conveyed in the combined sewer system that runs along Coggeshall Street. The second location is in the northeastern portion of the site where there is an existing low point in the grass area, which is assumed that is being infiltrated onsite. As part of the existing analysis, we are using one drainage area of the entire site to compare the pre vs post development analysis.

TABLE 1: EXISTING DRAINAGE AREAS

Drainage Area	Description	Area Extents (SF)	Impervious Area (SF)	Time of Concentration (Min)
EX-1	Existing Site Area	35,212	15,841	6.0

** The minimum time of concentration was utilized. Refer to Section 4.0 for more information regarding design parameters.*

Detailed information regarding each drainage area can be found on the Existing Drainage Area Map in **Appendix G** of this Report.

2.2 PROJECT SOILS

Per the National Resource Conservation Service (NRCS) data, the soil underlying the project site consists of:

TABLE 2: NRCS PROJECT SOILS

Soil Unit Code	Soil Description	Approximate Project Coverage	Hydrologic Soil Group
602	Urban land	100%	N/A*

** Hydrologic soil group classification not defined by NRCS*

The hydrologic soil group classifications above have been utilized in the landcover data for the stormwater analysis performed on the project. As the hydrologic soil group classification is not defined by the NRCS, it will be modeled as a B type soil under existing condition and proposed conditions based on the geotechnical report and the provided infiltration rates.

3.0 PROPOSED CONDITIONS

Under the proposed development plan, the 35,212 SF project area will be developed with a proposed Starbucks with Drive-Thru Facilities with a footprint of 2,280 SF. Parking lot will be provided with curbing and full depth pavement. Additional improvements on site are stormwater features, utilities, landscaping, and lighting. One underground ADS StormTech facility is proposed in order to meet the necessary stormwater requirements.

3.1 PROPOSED DRAINAGE AREAS

Under proposed conditions the site is comprised of one (1) drainage area. The underground infiltration basin in the parking area located south of the proposed building and running parallel to the drive thru area. This system provides water quantity, water quality, and groundwater recharge for the entire site. Runoff from the entire site flows directly into the subsurface system isolator rows. An outlet control structure downstream of the system will manage the discharge from the system. The bottom of the infiltration system is at an elevation of 3 feet, which is 2 feet above the groundwater table as referenced in the geotechnical report.

TABLE 3: PROPOSED DRAINAGE AREAS

Drainage Area	Description	Area Extents (SF)	Impervious Area (SF)	Time of Concentration (Min)
P-1	Proposed Site Area	35,212	27,463	6.0

** The minimum time of concentration was utilized. Refer to Section 4.0 for more information regarding design parameters.*

Detailed information regarding each drainage area can be found on the Proposed Drainage Area Map in **Appendix G** of this Report.

4.0 ANALYSIS METHODOLOGY & DESIGN PARAMETERS

4.1 HYDROLOGIC & HYDRAULIC ANALYSES

The existing and proposed drainage areas have been analyzed utilizing a modified version of the NRCS SCS TR-20 method. The analysis program "HydroCAD" Version 10.00 by HydroCAD Software Solutions LLC was used to calculate and plot the runoff hydrographs. The program incorporates the time of concentration, CN values, 24 hour rainfall events, and project drainage areas to calculate the runoff characteristics. Key variables utilized include the SCS Unit Hydrograph, a minimum time of concentration of 6.0 minutes, separate runoff calculations for impervious and pervious areas, and dynamic storage and conveyance routing to account for any variable tailwater conditions.

4.2 MASSACHUSETTS STORMWATER DESIGN PARAMETERS

The proposed total project area is 35,212 SF (0.81 acres) and the proposed building has a footprint of 2,280 SF (0.05 acres). Per the applicable stormwater standards, the project is classified as a new development and is subject to stormwater regulations for stormwater quantity, quality, and groundwater recharge regulations.

TABLE 4: PROJECT STORMWATER DESIGN INTENT SUMMARY TABLE

Design Parameters	Design Intent for Compliance
Stormwater Quantity	Design stormwater management measures so that the post-construction peak runoff rates for the 2-, 10-, and 100- year storm events are ,respectively, reduced compared to the pre-construction peak runoff rates.
Groundwater Recharge	Stormwater management measures shall be designed for the required recharge volume based on target depth factor associated with each Hydrologic Soil Group and total impervious area in the proposed condition. The size of the basin must be able to hold the entire required recharge volume and completely drain this volume in 72 hours or less.
Stormwater Quality	Stormwater management measures shall be designed to reduce the post-construction load of total suspended solids (TSS) in stormwater runoff generated from the water quality storm by 80% of the anticipated load from the developed site. Additionally, the water quality treatment volume required shall be designed for the 0.5 inch water quality depth times the total impervious area of the proposed site.

4.3 SUBSURFACE INVESTIGATION

A subsurface investigation was conducted by Terracon Associates, Inc. on May 27, 2021. A total of six (6) tests were performed. The full investigation report and testing results can be found in **Appendix C**.

5.0 PROJECT ANALYSIS RESULTS

5.1 STORMWATER QUANTITY CONTROL

Runoff is controlled through the implementation of one ADS StormTech Underground basins. To analyze runoff quantities between the existing and proposed drainage areas, one (1) point of interest were selected:

TABLE 5: QUANTITY COMPARISON POINTS OF INTEREST

Point of Interest	Area Description	Existing Tributary Drainage Areas	Proposed Tributary Drainage Areas
POI - 1	Site Area	EX-1	P-1

The following tables summarize the results for the 2-year, 10-year, and 100-year storm events for each project point of interest:

TABLE 6: PEAK DISCHARGE TO POI-1

Storm Event	Pre-Development Peak Discharge	Post-Development Peak Discharge	Reduction Achieved
2-Year	1.42 CFS	1.16 CFS	18.3%
10-Year	2.50 CFS	2.39 CFS	4.4%
100-Year	5.39 CFS	5.01 CFS	7.1%

As shown in the table above, peak stormwater discharge rates are reduced by at least the required amount for each storm event. Project hydrographs and more detailed data can be found in **Appendix D** of this Report.

5.2 SOIL EROSION & SEDIMENT CONTROL

A Soil Erosion & Sediment Control Plan has been prepared in accordance with the latest edition of the "Massachusetts Erosion and Sediment Control Guideline for Urban and Suburban Areas". Proposed temporary measures during construction include silt fencing, stabilized construction entrances, inlet filters, and cover for soil stabilization. Permanent post-construction measures include conduit outlet projection and native vegetation. No land disturbance will occur until a permit has been obtained from the Soil Conservation District.

5.3 STORMWATER OPERATIONS & MAINTENANCE

Operation and Maintenance Plan will be submitted for approval to the City of New Bedford prior to the start of construction..

6.0 MASSACHUSETTS STORMWATER HANDBOOK STANDARDS

The following outlines how the proposed project meets the stormwater management standards (Standards) outlined in the Massachusetts Stormwater Handbook. This project is considered a new development. The stormwater management checklist is provided in **Appendix E**.

STANDARD 1: NO UNTREATED DISCHARGE OR EROSION TO WETLANDS

All stormwater is captured onsite, treated, and discharged. There are no wetlands indicated on the survey on or near the adjacent project site.

STANDARD 2: PEAK RATE ATTENUATION

The 2-, 10-, and 100-year storm events will be reduced from pre-development to post-development. One subsurface infiltration system with an outlet control structure has been provided to meet this requirement. Peak flow results can be viewed in **Appendix D**.

TABLE 6: PEAK DISCHARGE TO POI-1

Storm Event	Pre-Development Peak Discharge	Post-Development Peak Discharge	Reduction Achieved
2-Year	1.42 CFS	1.16 CFS	18.3%
10-Year	2.50 CFS	2.39 CFS	4.4%
100-Year	5.39 CFS	5.01 CFS	7.1%

STANDARD 3: STORMWATER GROUNDWATER RECHARGE

The subsurface infiltration system will allow for groundwater recharge. Using the static method, the system is filled to the elevation associated with the required recharge volume prior to discharge. This is outlined in the calculations below. Drawdown calculations and provided volume calculations are provided in **Appendix D**.

Rv = F x impervious area

Rv = ($F_{HSG \text{“B”}}$) x (impervious area)

Rv = [(0.35 inches/12 inches/foot)][(0.63 acre)(43,560 square feet/acre)]

Rv = 795.75 cubic feet

Rv = 795.75 cubic feet, Provided = 1,834.40 cubic feet

Based on the soil evaluation provided in the Geotech, the depth to groundwater is elevation 1 FT, which the bottom of the proposed system is 3 FT, meeting the requirement for separation of groundwater of 2 FT.

STANDARD 4: WATER QUALITY

The subsurface infiltration system is equipped with an isolator row on each side which shall be designed with material that will meet 80% removal efficiency requirement for all onsite drainage. The Total Suspended Solid (TSS) removal calculations are included in *Appendix E. The water quality treatment calculations are outlined below. The water quality depth of 0.5 inch is used because this site is note located within a Zone II or Interim Wellhead Protection Area, to or near another critical area, runoff from a LUHPPL, or exfiltration to soils with infiltration rate greater than 2.4 inches/hour or greater.* Provided volume calculations are provided in **Appendix D**.

V_{WQ} = **(D_{WQ}/12 inches/foot) * (A_{IMP} * 43,560 square feet/acre)**

V_{WQ} = **(*0.5 inches*/12 inches/foot) * (*0.63* * 43,560 square feet/acre)**

V_{WQ} = **1,137 cubic feet, Provided = 1,834.40 cubic feet**

STANDARD 5: LAND USES WITH HIGHER POTENTIAL POLLUTANT LOADS

This standard is not applicable for this project. This site does not contain any higher potential pollutant loads.

STANDARD 6: CRITICAL AREAS

This standard is not applicable for this project. The site doesn't discharge within Zone II, Wellhead Protection Areas or near or to other Critical Areas,: Shellfish Growing Areas, Bathing Beaches, Outstanding Resource Waters, Special Resource Waters, and Cold-Water Fisheries.

STANDARD 7: REDEVELOPMENT

This standard is not applicable for this project. This project is not considered a redevelopment.

STANDARD 8: CONSTRUCTION PERIOD CONTROLS

Soil Erosion and Sediment Control Plan has been provided. Appropriate control measures as well as the area to be disturbed has been provided.

STANDARD 9: OPERATION AND MAINTENANCE PLAN

Operation and Maintenance Plan will be submitted for approval to the City of New Bedford prior to the start of construction. Any required easements or covenants associated with the stormwater improvements will be recorded prior to the start of construction.

STANDARD 10: ILLICIT DISCHARGES TO DRAINAGE SYSTEM

This standard is not applicable for this project. The subsurface infiltration system does not have any illicit discharges.

7.0 Conclusions

The proposed project complies with all applicable stormwater management regulations and standards. As such, the project is not anticipated to have any adverse impacts or neighboring properties, downstream watercourses, or conveyance systems within the watershed.

APPENDIX A
PROJECT FIGURES

INVENTORY

USGS LOCATION MAP

TAX MAP

AERIAL MAP

FEMA MAP

AERIAL MAP

100' 0' 100' 200'

GRAPHIC SCALE IN FEET
1" = 100'

SOURCE: GOOGLE EARTH PRO, DATED: JUNE, 2021

ALRIG USA DEVELOPMENT, LLC

PROPOSED STARBUCKS WITH DRIVE-THRU

BLOCK 93 LOTS 168, 169, & 275
0 & 8 MITCHELL STREET & 171 COGGESHALL STREET
CITY OF NEW BEDFORD, BRISTOL COUNTY, MASSACHUSETTS

DRAWN BY:	FWN
CHECKED BY:	DM
DATE:	06/29/2021
SCALE:	1" = 100'
PROJECT ID:	BOS-200026

STONEFIELD
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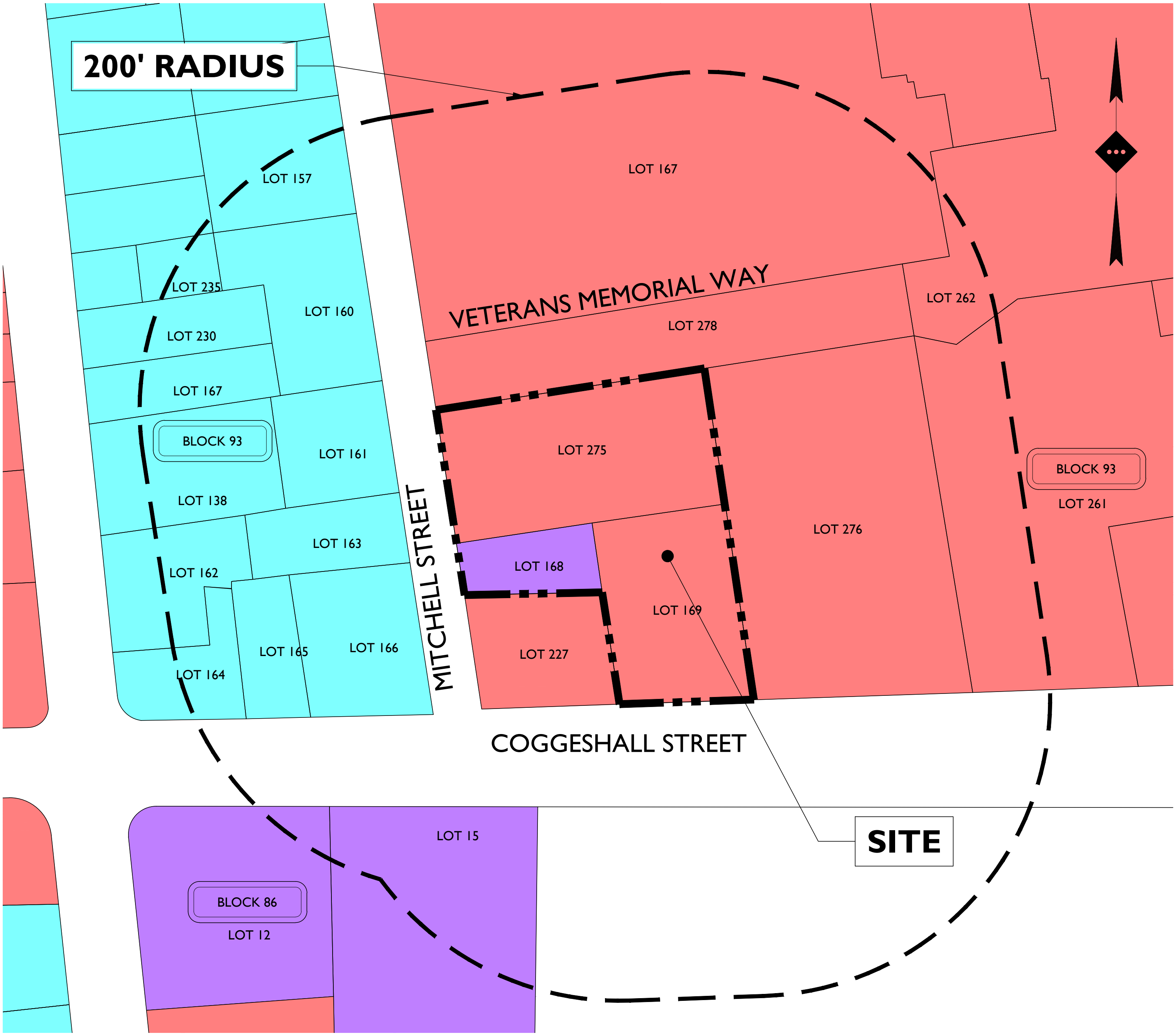

ZONING LEGEND

MUB (MIXED USE BUSINESS)

IA (INDUSTRIAL A)

IB (INDUSTRIAL B)

TAX AND ZONING MAP

100' 0' 100' 200'

GRAPHIC SCALE IN FEET

1" = 100'

SOURCE: CITY OF NEW BEDFORD ZONING MAP DATED: 2015, ARCGIS PARCEL MAP

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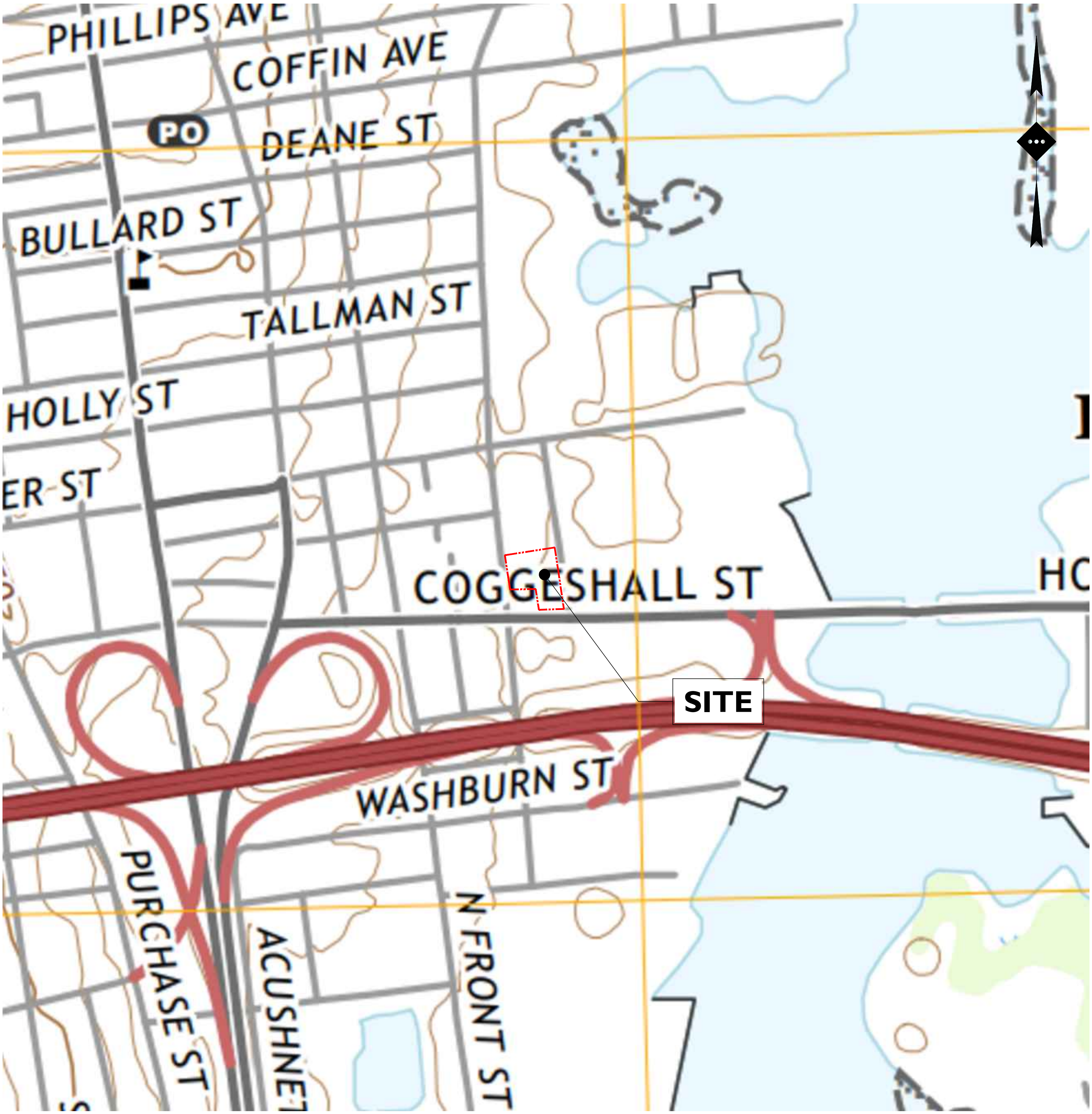

USGS QUADRANGLE MAP

500' 0' 500' 1000'

GRAPHIC SCALE IN FEET

1"= 500'

SOURCE: UNITED STATES GEOLOGICAL SURVEY, DATED: 2021

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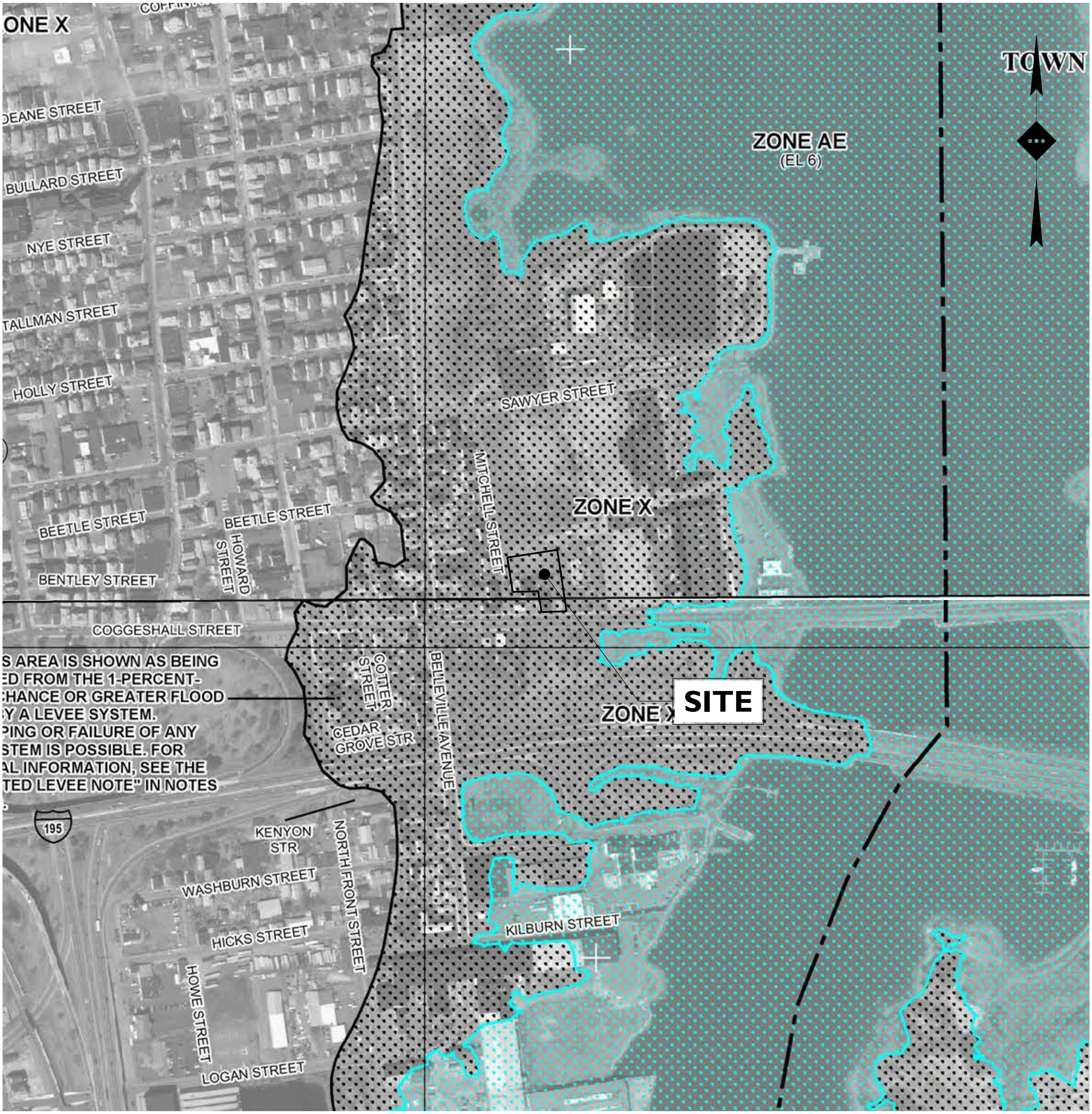

EFFECTIVE FEMA FLOOD INSURANCE RATE MAP

500' 0' 500' 1000'

GRAPHIC SCALE IN FEET

1"= 500'

SOURCE: FLOOD INSURANCE RATE MAP BRISTOL COUNTY, MA PANEL: 391 & 393 OF 550
DATED: JULY 16, 2014

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APPENDIX B
NRCS COUNTY SOIL SURVEY

United States Department of Agriculture

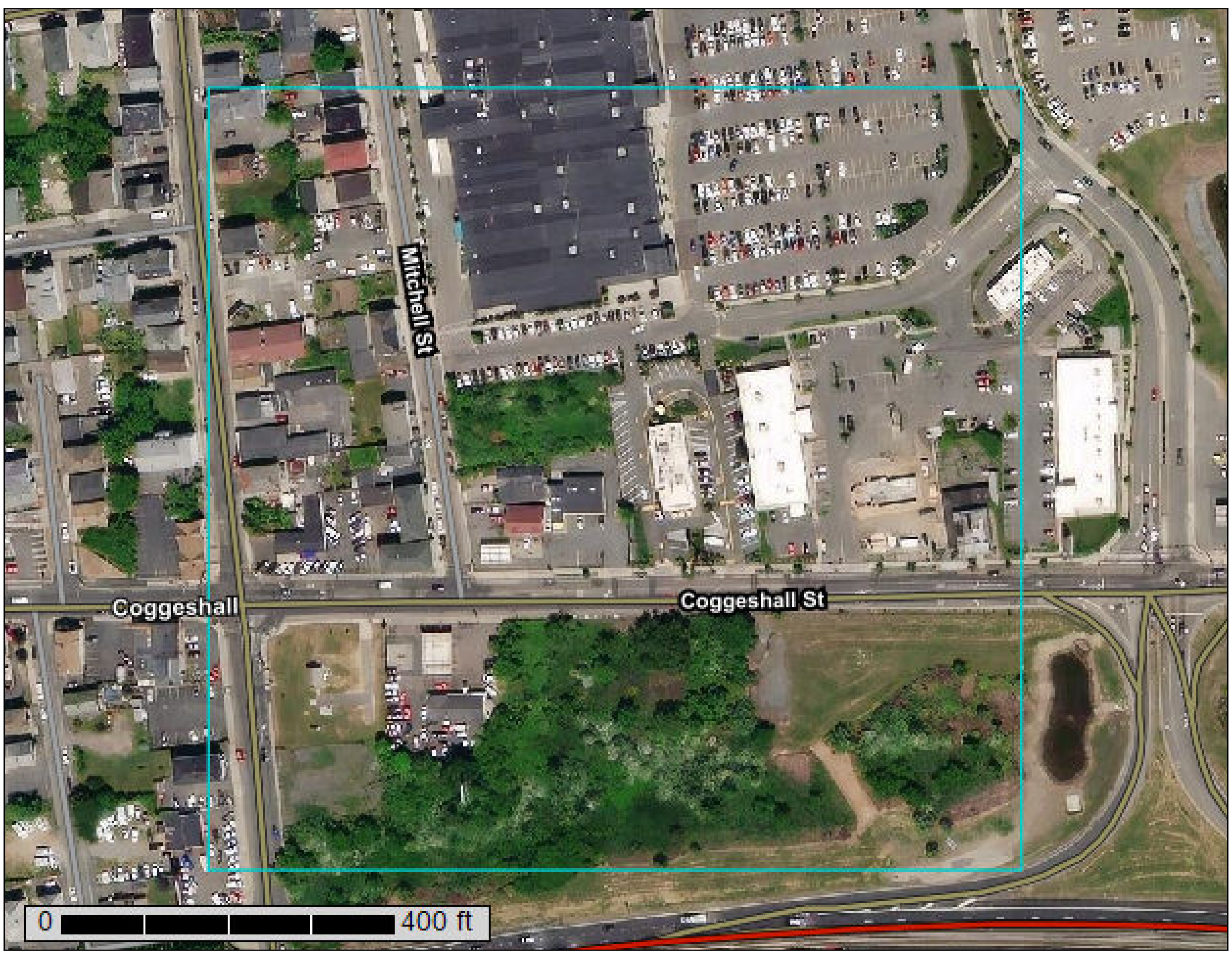
NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

Bristol County, Massachusetts, Southern Part



June 21, 2021

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map

Map Scale: 1:2,420 if printed on A landscape (11" x 8.5") sheet.

Meters: 0, 35, 70, 140, 210

Feet: 0, 100, 200, 400, 600

N

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	21.1	100.0%
Totals for Area of Interest		**21.1**	**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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APPENDIX C
GEOTECHNICAL ENGINEERING REPORT

Geotechnical Engineering Report

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8 Mitchell Street & Coggeshall Street Development
New Bedford, Massachusetts
May 27, 2021
Terracon Project No. J1215043A

Prepared for:
Alrig USA Development, LLC
Bingham Falls, Michigan

Prepared by:
Terracon Consultants, Inc.
Manchester, New Hampshire

May 27, 2021

Alrig USA Development, LLC
30200 Telegraph Road, Suite 205
Bingham Falls, MI 48025

Attn: Mr. Jordan Chapman
P: (248) 646 9999
E: jordan@alrigusa.com

Re: Geotechnical Engineering Report
8 Mitchell Street & Coggeshall Street Development
8 Mitchell Street
New Bedford, Massachusetts
Terracon Project No. J1215043A

Dear Mr Chapman:

We have completed the Geotechnical Engineering services for the above referenced project. This study was performed in general accordance with Terracon Proposal No. PJ1217033 dated March 15, 2021. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations, floor slabs, and pavements for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

Carl W. Thunberg, P.E.
Geotechnical Department Manager

Joseph Robichaud, Jr., P.E.(NY)
Authorized Project Reviewer

REPORT TOPICS

Note: This report was originally delivered in a web-based format. **Orange Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the ***GeoReport*** logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

Note: Refer to each individual Attachment for a listing of contents.

Geotechnical Engineering Report

8 Mitchell Street & Coggeshall Street Development
8 Mitchell Street
New Bedford, Massachusetts
Terracon Project No. J1215043A
May 27, 2021

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed retail development to be located at 8 Mitchell Street and Coggeshall Street in New Bedford, Massachusetts. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions
- Site preparation and earthwork
- Demolition considerations
- Excavation considerations
- Dewatering considerations
- Foundation design and construction
- Floor slab design and construction
- Seismic site classification per MSBC, 8th Ed.
- Lateral earth pressures
- Pavement design and construction
- Frost considerations

The geotechnical exploration Scope of Services for this project included the advancement of six test borings to depths ranging from approximately 12 to 22 feet below existing site grades. Three groundwater monitoring wells were installed in the boreholes at select locations as part of our companion Limited Site Investigation to be submitted under separate cover.

Maps showing the site and boring locations are shown in the **Site Location** and **Exploration Plan** sections, respectively. The boring logs are shown in the **Exploration Results** section. Soil laboratory tests are in progress and are not yet available and will be included in our final geotechnical engineering report.

SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Parcel Information	The site development area consists of a 0.8 acre parcel located on the northeast corner of the intersection of Mitchell Street and Coggeshall Streets in New Bedford, Massachusetts. The approximate coordinates are latitude 41.6566, longitude -70.9224 See **Site Location**.
Existing Improvements	The site is currently occupied by an auto body shop and a former car wash and Subway sandwich shop. The former car wash and Subway are located in the same building fronting on Coggeshall Street. The auto body shop fronts on Mitchell Street and is still in business. There is also a gasoline station at the intersection of Mitchell and Coggeshall Streets that is outside the project limits. Based on our site reconnaissance during our companion Limited Site Investigation, the existing buildings do not contain basements. The proposed building footprint area is currently vacant.
Current Ground Cover	Partially paved or occupied by existing buildings. The proposed building footprint area is vegetated with grasses.
Existing Topography	Based on Google Earth™ imagery, site grades vary from Elevation +4 feet to +9 feet. The majority of the site is relatively level at about Elevation +8.
Geology	Given the site development history, existing fill is expected reflecting fill and backfill for the existing buildings and site utilities. NRCS SSURGO mapping indicates the naturally deposited soils consist of coarse grained glacial stratified deposits overlying glacial till. USGS bedrock maps indicate bedrock consists of the Avalon formation, which is a granite. The subsurface conditions encountered in the borings were generally consistent with the expected subsurface conditions, except we did not core bedrock to confirm its composition.

We also collected photographs at the time of our field exploration program. Representative photos are provided in our **Photography Log**.

PROJECT DESCRIPTION

Our initial understanding of the project was provided in our proposal and was discussed during project planning. Our final understanding of the project conditions is as follows:

Item	Description
Information Provided	Conceptual Plans entitled Concept F, Sheets F-1 through F-3, prepared by Stonefield Engineering & Design, dated March 2, 2021.
Project Description	The project includes demolition of two existing buildings, followed by construction of a 2,289 square foot restaurant with drive-through. The plans show 27 parking spaces and access/egress drives off Coggeshall and Mitchell Streets.
Building Construction	Not provided, but anticipated to be conventional steel or wood framed construction supported on shallow spread and strip footings with concrete floor slab on grade (i.e. no basement).
Finished Floor Elevation	Not provided, but presumed be slightly above existing site grades at about Elevation +9 feet.
Maximum Loads	Unknown at this time, but the following loads are assumed: ■ Columns: 30 to 60 kips ■ Walls: 1 to 3 kips per linear foot (klf) ■ Slabs: 100 to 250 pounds per square foot (psf)
Grading/Slopes	Cuts and fills on the order of 2 to 3 feet or less are anticipated to reach site grades.
Below-Grade Structures	The restaurant is expected to have a grease pit
Free-Standing Retaining Walls	No retaining walls are anticipated.
Pavements	We assume access drives and parking will consist of flexible (asphalt) pavement sections and rigid (concrete) pavement will be required at the trash enclosure pad. For design purposes, we assume NAPA Class II Equivalent Single Axle Loads (ESALs) will be suitable for all pavements. Pavement designs are based on the following parameters: ■ Standard Duty Parking and Drive Lanes ■ Pavement design life of 20 years

GEOTECHNICAL CHARACTERIZATION

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, geologic setting and our understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical calculations and evaluation of site preparation and foundation options. Conditions encountered at each exploration point are indicated on the individual logs. The individual logs can be found in the **Exploration Results** section and the GeoModel can be found in the **Figures** section of this report.

As part of our analyses, we identified the following model layers within the subsurface profile. For a more detailed view of the model layer depths at each boring location, refer to the GeoModel.

Model Layer	Layer Name	General Description
1	**Fill**	Fill - Silty Sand, trace gravel, glass, and plastic, brown and black, very loose to dense
2	**Sands**	Silty Sand (SM) and Poorly Graded Sand (SP), trace gravel and oxidation, light brown and brownish gray, very loose to very dense

Groundwater Conditions

Groundwater measurements are summarized in the following table and are noted on the boring logs in the **Exploration Results** section. The groundwater levels were measured at the completion of drilling and may not represent stabilized levels.

Boring No.	Approximate Ground Surface Elevation (feet) [1]	Approximate Groundwater Depth (feet)	Approximate Groundwater Elevation (feet) [1]
B-1	+8	7	+1
B-2	+8	8	0
B-3 MW	+8	7	+1
B-4	+8	8	0
B-5 MW	+6	7	-1
B-6 MW	+7	7	0

1. Elevations were estimated based on available electronic imagery, due to a lack of site-specific topographic plans.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project. Refer to the Geotechnical Overview for implications of groundwater depths and elevations.

Infiltration Testing

Terracon performed *in-situ* soil hydraulic conductivity testing within the boreholes using the falling head infiltration testing techniques. Testing was performed by installing 2-inch diameter PVC well pipe to the bottom of the test hole. Granular filter media, i.e., coarse sand, was placed at the bottom of the pipe to prevent scouring and silting. The pipes were then filled with water to the top of pipe and allowed to presoak. Following the presoak period, infiltration testing was performed in general accordance with ASTM D5126-90 (2004), which is listed an acceptable method in Chapter 1 Volume 3, Stage 3, letter a. of the *Massachusetts Stormwater Management Standards*.

Infiltration Test No.	Surface Elevation (feet)	Test Depth (feet)	Test Elevation (feet)	Saturated Hydraulic Conductivity (Ksat) (in/hr)
B-1	+8	5	+3	2.07
B-2	+8	5	+3	2.05
B-3 MW	+8	5	+3	2.15
B-4	+8	7.5	+0.5	0.89
B-5 MW	+6	6	0	1.14
B-6 MW	+7	5	+2	2.01

GEOTECHNICAL OVERVIEW

The naturally deposited subsurface conditions encountered in the borings consist of sandy soils with varying amounts of silt and gravel exhibiting loose to very dense relative density. Existing fill was encountered in the borings ranging from 2 to 7 feet in thickness. The maximum depth of fill was encountered in boring B-4, which was drilled in the proposed access/egress drive from Mitchell Street. Glass and plastic were embedded within the fill, which suggests the fill is an uncontrolled fill. It should be stressed that the borings were widely spaced, and additional fill or abandoned structures may potentially be encountered in areas between the borings, reflecting previous earthwork performed during the site development history.

Groundwater was encountered at depths varying from 7 to 8 feet while drilling. Groundwater may potentially impact excavation excavations for utilities and foundations, especially if construction proceeds during seasonally wet conditions or during spring thaw.

Existing fill and abandoned structures should be excavated their full depth from the proposed building footprint and replaced with compacted structural fill. Portions of the existing fill may be potentially re-used as general fill, provided it is free of weak, compressible materials or foreign matter, and can be adequately compacted.

There are two buildings that will need to be demolished to construct the new restaurant building. The **Earthwork** section provides recommendations for demolition and its effect on future development, as well as the potential for existing fill in the area of the existing buildings

The near surface, silty sand could become unstable with typical earthwork and construction traffic, especially after precipitation events. The effective site drainage should be completed early in the construction sequence and maintained after construction to avoid weather-related disturbance. If possible, the grading should be performed during the warmer and drier times of the year (typically May to October). If grading is performed during the winter months (typically November to April), an increased risk for possible undercutting and replacement of unstable subgrade will persist. Additional site preparation recommendations, including subgrade improvement and fill placement, are provided in the **Earthwork** section.

The **Shallow Foundations** section addresses support of the foundations bearing on proofrolled undisturbed native sandy soils or compacted structural fill. The **Floor Slabs** section addresses slab-on-grade support on a minimum 6 inches of Floor Slab Base Course over proofrolled native sandy soils or compacted structural fill.

Flexible and rigid pavement systems are recommended for this site. The **Pavements** section addresses the design of pavement systems.

Support of pavements on or above existing fill materials is discussed in this report. However, even with the recommended construction procedures, there is inherent risk for the owner that compressible fill or unsuitable material, within or buried by the fill, will not be discovered. This risk of unforeseen conditions cannot be eliminated without completely removing the existing fill but can be reduced by following the recommendations contained in this report. To take advantage of the cost benefit of not removing the entire amount of undocumented fill, the owner must be willing to accept the risk associated with building over the undocumented fills following the recommended reworking of the material.

The **General Comments** section provides an understanding of the report limitations.

EARTHWORK

Earthwork is anticipated to include demolition of two existing buildings and pavements, clearing and grubbing, excavations, and fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria, as necessary, to render the site in the state considered in our geotechnical engineering evaluation for foundations, floor slabs, and pavements.

Demolition

The proposed building footprint appears to be outside of the existing buildings scheduled for demolition. If encountered, existing footings, slabs, utilities, or abandoned structures should be removed within the proposed building area and the foundation bearing zone, which is defined as the volume below 2/3 horizontal (H) to 1 vertical (V) lines extending outward and downward from the lower edges of the footing. The resulting excavation should be filled with compacted layers of imported structural fill.

For areas outside the proposed building footprint and foundation bearing zone, existing footings, floor slabs, and utilities need only be removed where they conflict with proposed utilities and pavements. In such cases, existing footings, floor slabs, and utilities should be removed to a depth of 2 feet below the affected utility or underside of pavement section. Areas disturbed during demolition of the existing structures and the removal of foundation elements should be evaluated by the Geotechnical Engineer prior to placement of fill. Disturbed soils should be undercut prior to placement of fill.

Site Preparation

Prior to placing fill, existing pavements, demolition debris, vegetation, and root mat should be removed. Complete stripping of surface materials should be performed in the proposed building and parking/driveway areas.

Following stripping, the exposed subgrade should be proofrolled with an adequately loaded vehicle such as a fully-loaded tandem-axle dump truck or vibratory drum compactor with minimum static weight of 10 tons. The proofrolling should be performed under the direction of the Geotechnical Engineer. Areas excessively deflecting under the proofroll should be delineated and subsequently addressed by the Geotechnical Engineer. Such areas should be replaced with Structural Fill. Excessively wet or dry material should either be removed or moisture conditioned and recompacted.

Existing Fill

As noted in **Geotechnical Characterization**, the borings encountered uncontrolled fill ranging from 2 to 7 feet in thickness. The maximum depth of fill was encountered in boring B-4, which was drilled in the proposed access/egress drive from Mitchell Street. Glass and plastic were embedded within the fill, which suggests the fill is an uncontrolled fill. It should be stressed that the borings were widely spaced, and additional fill or abandoned structures may potentially be encountered in areas between the borings, reflecting previous earthwork performed during the site development history.

Existing fill and abandoned structures should be excavated their full depth from the proposed building footprint and replaced with compacted structural fill. Portions of the existing fill may be potentially re-used as general fill, provided it is free of weak, compressible materials or foreign matter, and can be adequately compacted.

If the owner elects to construct pavements on the existing fill, the following protocol should be followed. Once the planned subgrade elevation has been reached the entire pavement area should be proofrolled with at least six passes in each perpendicular direction using a minimum 10-ton vibratory compactor. Areas of soft or otherwise unsuitable material should be undercut and replaced with either new General Fill or suitable, existing on site materials.

Fill Material Types

Fill required to achieve design grade should be classified as Structural Fill and General Fill. Structural Fill is material used below, or within 10 feet of structures, pavements or constructed slopes. General Fill is material used to achieve grade outside of these areas. Earthen materials used for Structural and General Fill should meet the following material property requirements:

Fill Type [1]	Massachusetts Department of Transportation (MassDOT) Item	Acceptable Location for Placement
General Fill [1, 2]	M1.02.0 Special Borrow	General raise in grade fill. General Fill should not be placed within the building footprint or within the foundation bearing zone of settlement sensitive structures.
Structural Fill	M1.03.0 Gravel Borrow Type C	Beneath foundations and floor slabs.
Crushed Stone	M2.01.4 Crushed Stone	Backfill of underdrains and over wet subgrades as needed.
Non-Frost Susceptible Fill [3]	M1.03.1 Processed Gravel for Subbase or M2.01.4 Crushed Stone	Exterior slabs, sidewalks.
Floor Slab/Pavement Base Course	M2.01.7 Dense Graded Crushed Stone for Sub-base	Below floor slabs or pavements as aggregate base course.

1. Fill to be placed on site should consist of approved materials that are free of organic matter and debris. Frozen material should not be used. Fill should not be placed on frozen subgrade.
2. General Fill should have a maximum particle size of 6 inches and no more than 25 percent by weight passing the No. 200 sieve.
3. Non-Frost Susceptible (NFS) Fill should contain less than 5 percent material passing No. 200 sieve size.

Fill Compaction Requirements

Structural and General Fill should meet the following compaction requirements.

Item	Description
Maximum Lift Thickness	12 inches or less in loose thickness 4 to 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used
Minimum Compaction Requirements [1, 2]	At least 95% of the material's maximum Modified Proctor dry density (ASTM D1557) for Structural Fill At least 92% of the material's maximum Modified Proctor dry density (ASTM D1557) for General Fill
Water Content Range [1]	±3% for granular material

1. Maximum density and optimum water content as determined by the Modified Proctor test (ASTM D1557, Method C).
2. We recommend testing fill for moisture content and compaction during placement. If the results of in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested, as required, until the specified moisture and compaction requirements are achieved.

Utility Trench Backfill

Trench excavations should be made with sufficient working space to permit construction including backfill placement and compaction. Trenches should be backfilled with material that approximately matches the permeability characteristics of the surrounding soil. Fill placed as backfill for utilities located below the slab should consist of compacted Structural Fill or suitable bedding material.

Grading and Drainage

All grades must provide effective drainage away from the building during and after construction and should be maintained throughout the life of the structure. Water retained next to the building can result in soil movements greater than those discussed in this report. Greater movements can result in unacceptable differential floor slab and/or foundation movements, cracked slabs and walls, and roof leaks. The roof should have gutters/drains with downspouts that discharge into the site drainage system.

Exposed ground should be sloped and maintained at a minimum 5% away from the building for at least 10 feet beyond the perimeter of the building. Locally, flatter grades may be necessary to transition ADA access requirements for flatwork. After building construction and landscaping have been completed, final grades should be verified to document effective drainage has been achieved. Grades around the structure should also be periodically inspected and adjusted, as necessary, as part of the structure's maintenance program. Where paving or flatwork abuts the structure, a maintenance program should be established to effectively seal and maintain joints and prevent surface water infiltration.

Earthwork Construction Considerations

Shallow excavations for the proposed structure are anticipated to be accomplished with conventional construction equipment. Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to construction of floor slabs. Construction traffic over the completed subgrades should be avoided. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Water collecting over or adjacent to construction areas should be removed. If the subgrade freezes, desiccates, saturates, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted prior to floor slab construction.

The groundwater table could affect overexcavation efforts, especially if construction proceeds during seasonally wet conditions for removal of demolition debris or installation of deep utilities. A temporary dewatering system consisting of sumps with pumps could be necessary to achieve the recommended depth of over-excavation. The Contractor should select whatever means and methods are familiar to him to facilitate excavation in a dry, undisturbed state. No fill should be placed in standing water.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, "Excavations" and its appendices, and in accordance with any applicable local, and/or state regulations.

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming responsibility for construction site safety, or the contractor's activities; such responsibility shall neither be implied nor inferred.

Construction Observation and Testing

The earthwork efforts should be monitored under the direction of the Geotechnical Engineer. Monitoring should include documentation of adequate removal of vegetation and topsoil, proofrolling, and mitigation of areas delineated by the proofroll to require mitigation.

Each lift of compacted fill should be tested, evaluated, and reworked, as necessary, until approved by the Geotechnical Engineer prior to placement of additional lifts. Each lift of fill should be tested for density and water content at a frequency of at least one test for every 2,500 square feet of compacted fill in the building areas and 5,000 square feet in pavement areas. One density and water content test should be performed for every 50 linear feet of compacted utility trench backfill.

In areas of foundation excavations, the bearing subgrade should be evaluated under the direction of the Geotechnical Engineer. If unanticipated conditions are encountered, the Geotechnical Engineer should prescribe mitigation options.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer's evaluation of subsurface conditions, including assessing variations and associated design changes.

SHALLOW FOUNDATIONS

If the site has been prepared in accordance with the requirements noted in the **Earthwork** section, the following design parameters are applicable for shallow foundations.

Design Parameters – Compressive Loads

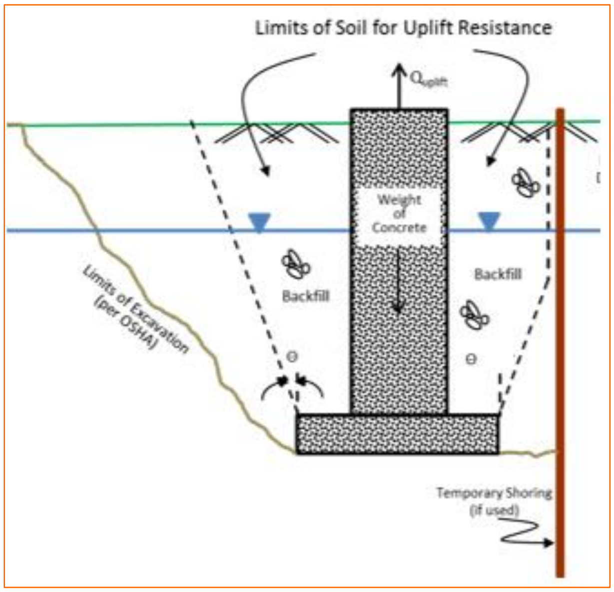
Item	Description
Maximum Net Allowable Bearing Pressure [1, 2]	3,000 psf
Required Bearing Stratum [3]	Undisturbed native soils prepared in accordance with the Earthwork section, or compacted structural fill over undisturbed native soils following uncontrolled fill removal.
Minimum Foundation Dimensions	Columns: 30 inches Continuous: 18 inches
Ultimate Passive Resistance [4] **(Equivalent Fluid Pressures)**	390 pcf (granular backfill)
Ultimate Coefficient of Sliding Friction [5]	0.45 (granular material)
Minimum Embedment below Finished Grade [6]	Exterior footings in unheated areas: 48 inches Interior footings in heated areas: 18 inches
Estimated Total Settlement from Structural Loads [2]	Less than about 1 inch
Estimated Differential Settlement [2, 7]	About 1/2 of total settlement

Item	Description

1. The maximum net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. An appropriate factor of safety has been applied. Values assume that exterior grades are no steeper than 20% within 10 feet of structure.
2. Values provided are for maximum loads noted in the **Project Description** section.
3. Unsuitable or soft soils should be over-excavated and replaced per the recommendations presented in the **Earthwork** section.
4. Use of passive earth pressures require the sides of the excavation for the spread footing foundation to be nearly vertical and the concrete placed neat against these vertical faces or that the footing forms be removed and compacted Structural Fill be placed against the vertical footing face.
5. Can be used to compute sliding resistance where foundations are placed on suitable soil/materials. Should be neglected for foundations subject to net uplift conditions.
6. Embedment necessary to minimize the effects of frost and/or seasonal water content variations. For sloping ground, maintain depth below the lowest adjacent exterior grade within 5 horizontal feet of the structure. Interior footing depth in heated areas should be as local codes allow.
7. Differential settlements are as measured over a span of 50 feet.

Design Parameters - Uplift Loads

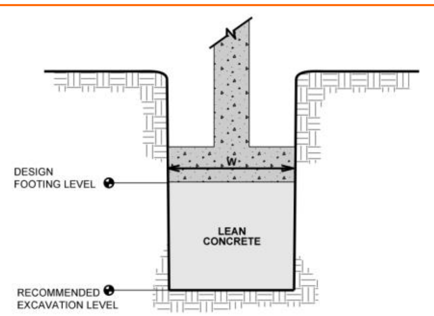
Uplift resistance of spread footings can be developed from the effective weight of the footing and the overlying soils. As illustrated on the subsequent figure, the effective weight of the soil prism defined by diagonal planes extending up from the top of the perimeter of the foundation to the ground surface at an angle, θ, of 20 degrees from the vertical can be included in uplift resistance. The maximum allowable uplift capacity should be taken as a sum of the effective weight of soil plus the dead weight of the foundation, divided by an appropriate factor of safety. A maximum total unit weight of 100 pcf should be used for the backfill. This unit weight should be reduced to 40 pcf for portions of the backfill or natural soils below the groundwater elevation.



Foundation Construction Considerations

As noted in the **Earthwork** section the footing excavations should be evaluated under the direction of the Geotechnical Engineer. The base of all foundation excavations should be free of water and loose soil, prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Care should be taken to prevent wetting or drying of the bearing materials during construction. Excessively wet or dry material or any loose/disturbed material in the bottom of the footing excavations should be removed/reconditioned before foundation concrete is placed.

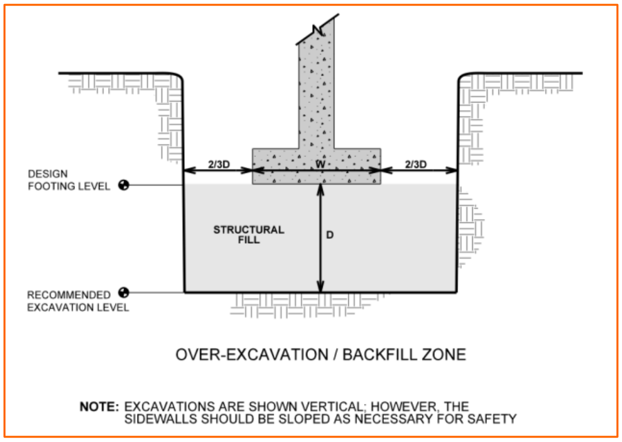
If unsuitable bearing soils are encountered at the base of the planned footing excavation, the excavation should be extended deeper to suitable soils, and the footings could bear directly on these soils at the lower level or on lean concrete backfill placed in the excavations. This is illustrated on the sketch below.



LEAN CONCRETE BACKFILL

NOTE: EXCAVATIONS ARE SHOWN VERTICAL; HOWEVER, THE SIDEWALLS SHOULD BE SLOPED AS NECESSARY FOR SAFETY

As an alternative to lowering the foundation or replacing over-excavated material with lean concrete, over-excavation and replacement with Structural Fill below footings may be considered and conducted as shown below. The over-excavation should be backfilled up to the footing base elevation, with structural fill placed, as recommended in the **Earthwork** section.



SEISMIC CONSIDERATIONS

The seismic design requirements for buildings and other structures are based on Seismic Design Category. Site Classification is required to determine the Seismic Design Category for a structure. The Site Classification is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or undrained shear strength in accordance with Section 20.4 of ASCE 7 and the Massachusetts State Building Code, 8th Edition which references the International Building Code (IBC). Based on the soil properties encountered at the site and as described on the exploration logs and results, it is our professional opinion that the Seismic Site Classification is D. Subsurface explorations at this site were extended to a maximum depth of 22 feet. The site properties below the boring depth to 100 feet were estimated based on our experience and knowledge of geologic conditions of the general area. Additional deeper borings or geophysical testing may be performed to confirm the conditions below the current boring depth.

LIQUEFACTION

Based on the relative density and groundwater levels encountered in the borings, we have evaluated liquefaction susceptibility per the requirements of Figure 1804.6b of the Massachusetts State Building Code, 9th Edition. It is our professional opinion that soils beneath site are not susceptible to liquefaction in the event of a seismic disturbance.

FLOOR SLABS

Design parameters for floor slabs assume the requirements in the **Earthwork** section have been followed. Specific attention should be given to positive drainage away from the structure and positive drainage of the aggregate base beneath the floor slab.

Floor Slab Design Parameters

Item	Description
Floor Slab Support [1, 2]	Minimum 6 inches of M2.01.7 Dense Graded Crushed Stone for Sub-base compacted to at least 95% of ASTM D1557 over structural fill or proofrolled native sand
Estimated Modulus of Subgrade Reaction [3]	150 pounds per square inch per inch (psi/in) for point loads
Modulus Correction Factor, K_c [3]	$K_c = k\left(\frac{b+1}{2b}\right)^2$

1. Floor slabs should be structurally independent of building footings or walls to reduce the possibility of floor slab cracking caused by differential movements between the slab and foundation.
2. Free-draining granular material should have less than 5% fines (material passing the No. 200 sieve). Other design considerations such as cold temperatures and condensation development could warrant more extensive design provisions.
3. Modulus of subgrade reaction is an estimated value based upon our experience with the subgrade condition, the requirements noted in the **Earthwork** section, and the floor slab support as noted in this table. It is provided for point loads. It is common to reduce the k-value to account for dimensional effects of large loaded areas using the modulus correction factor provided, where K_c is the corrected or design modulus value and b is the mat width (short dimension) or tributary loaded area. The native soil at subgrade is expected to develop a subgrade modulus value of 150 psi/in when combined with the stone base. Soft or unstable subgrade will be remediated by scarifying and re-compacting or by over-excavation and replacement.

Saw-cut control joints should be placed in the slab to help control the location and extent of cracking. For additional recommendations refer to the ACI Design Manual. Joints or cracks should be sealed with a water-proof, non-extruding compressible compound specifically recommended for heavy duty concrete pavement and wet environments.

Where floor slabs are tied to perimeter walls or turn-down slabs to meet structural or other construction objectives, our experience indicates differential movement between the walls and slabs will likely be observed in adjacent slab expansion joints or floor slab cracks beyond the length of the structural dowels. The Structural Engineer should account for potential differential settlement through use of sufficient control joints, appropriate reinforcing or other means.

Floor Slab Construction Considerations

Finished subgrade, within and for at least 10 feet beyond the floor slab, should be protected from traffic, rutting, or other disturbance and maintained in a relatively moist condition until floor slabs are constructed. If the subgrade should become damaged or desiccated prior to construction of floor slabs, the affected material should be removed and Structural Fill should be added to replace the resulting excavation. Final conditioning of the finished subgrade should be performed immediately prior to placement of the floor slab support course.

The Geotechnical Engineer should approve the condition of the floor slab subgrades immediately prior to placement of the floor slab support course, reinforcing steel, and concrete. Attention should be paid to high traffic areas that were rutted and disturbed earlier, and to areas where backfilled trenches are located.

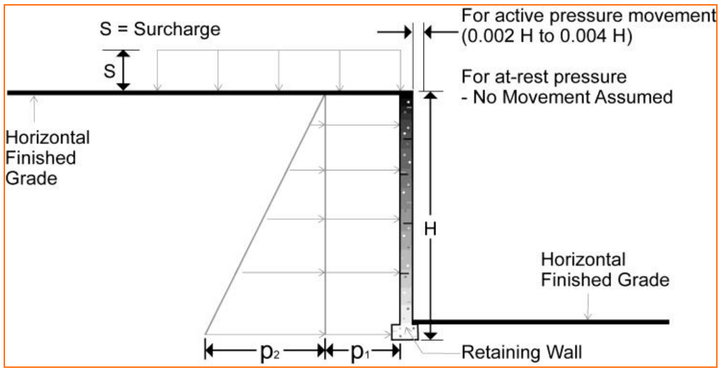
BELOW-GRADE STRUCTURES

Below grade structures associated with restaurants include grease pits. Grease pits should be designed to resist lateral earth pressures, and should be designed to resist buoyancy due to hydrostatic pressure. The maximum groundwater elevation encountered in the borings was Elevation (El) +1 feet. For buoyancy calculations, recommend a design groundwater elevation of El +3 feet to account for seasonal fluctuations.

LATERAL EARTH PRESSURES

Design Parameters

Structures with unbalanced backfill levels on opposite sides should be designed for earth pressures at least equal to values indicated in the following table. Earth pressures will be influenced by structural design of the walls, conditions of wall restraint, methods of construction and/or compaction and the strength of the materials being restrained. Two wall restraint conditions are shown in the diagram below. Active earth pressure is commonly used for design of free-standing cantilever retaining walls and assumes wall movement. The “at-rest” condition assumes no wall movement and is commonly used for basement walls, loading dock walls, or other walls restrained at the top. The recommended design lateral earth pressures do not include a factor of safety and do not provide for possible hydrostatic pressure on the walls (unless stated).



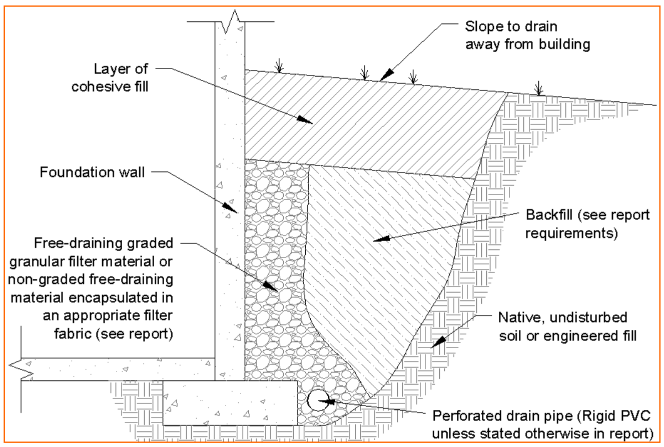
Lateral Earth Pressure Design Parameters				
Earth Pressure Condition [1]	Coefficient for Backfill Type [2]	Surcharge Pressure [3, 4, 5] p_1 (psf)	Effective Fluid Pressures (psf) [2, 4, 5]	
			Unsaturated [6]	Submerged [6]
Active (Ka)	Granular - 0.31	(0.31)S	(40)H	(80)H
At-Rest (Ko)	Granular - 0.47	(0.47)S	(55)H	(90)H
Passive (Kp)	Granular - 3.25	---	(390)H	(250)H

1. For active earth pressure, wall must rotate about base, with top lateral movements 0.002 H to 0.004 H, where H is wall height. For passive earth pressure, wall must move horizontally to mobilize resistance.
2. Uniform, horizontal backfill, compacted to at least 95% of the ASTM D 1557 maximum dry density, rendering a maximum unit weight of 120 pcf.
3. Uniform surcharge, where S is surcharge pressure.
4. Loading from heavy compaction equipment is not included.
5. No safety factor is included in these values.
6. To achieve “Unsaturated” conditions, follow guidelines in **Subsurface Drainage for Below-Grade Walls** below. “Submerged” conditions are recommended when drainage behind walls is not incorporated into the design.

Backfill placed against structures should consist of free-draining granular soils. For the granular values to be valid, the granular backfill must extend out and up from the base of the wall at an angle of at least 45 and 60 degrees from vertical for the active and passive cases, respectively.

Subsurface Drainage for Below-Grade Walls

Below grade walls such as grease traps should be designed to resist hydrostatic pressure and buoyancy. A perforated rigid plastic drain line installed behind the base of other below grade walls such as retaining walls and extends below adjacent grade are recommended to prevent hydrostatic loading on the walls. The invert of a drain line around a below-grade building area or exterior retaining wall should be placed near foundation bearing level. The drain line should be sloped to provide positive gravity drainage to daylight or to a sump pit and pump. The drain line should be surrounded by clean, free-draining granular material having less than 5% passing the No. 200 sieve, such as Crushed Stone. The free-draining aggregate should be encapsulated in a filter fabric. The granular fill should extend to within 2 feet of final grade, where it should be capped with pavement, or compacted cohesive fill to reduce infiltration of surface water into the drain system.



As an alternative to free-draining granular fill, a pre-fabricated drainage structure may be used. A pre-fabricated drainage structure is a plastic drainage core or mesh which is covered with filter fabric to prevent soil intrusion, and is fastened to the wall prior to placing backfill.

PAVEMENTS

General Pavement Comments

Design of Asphaltic Concrete (AC) pavements are based on the procedures outlined in the National Asphalt Pavement Association (NAPA) Information Series 109 (IS-109). Design of Portland Cement Concrete (PCC) pavements are based upon American Concrete Institute (ACI) 330; Guide for Design and Construction of Concrete Parking Lots. The thickness of each course is a function of subgrade strength, traffic, design life, and frost susceptibility. The design of pavement thickness was based on NAPA Class II Equivalent Single Axle Loads (ESALs) for Standard Duty pavements.

- Standard Duty Parking and Drive Lanes: Class II - 27,000 ESALs
- Soil characterization of “medium”, based on the encountered subsurface conditions
- Pavement design life of 20 years

The following tables provide options for Asphaltic Concrete and for Portland Cement Sections:

Asphaltic Concrete Design	
Layer	**Minimum Thickness (inches)**
	Standard Duty [1]
Asphalt Top Course [2]	2
Asphalt Binder Course [2]	2
Aggregate Base Course [2]	8
Total Thickness	12

1. See the **Project Description** section for more specifics regarding pavements.
2. All materials should meet the current Massachusetts Department of Transportation (MassDOT) Standard Specifications for Highways and Bridges.
   - Asphalt Top Course – MassDOT Top Course, M3.11.03 Table A
   - Asphalt Binder Course – MassDOT Binder Course, M3.11.03 Table A
   - Aggregate Base Course – MassDOT Dense Graded Crushed Stone for Sub-base, M2.01.7

We recommend rigid concrete pavement at the dumpster locations where refuse trucks will park. For dumpster pads, at a minimum, the concrete pavement area should be large enough to support the container and tipping axle of the refuse truck. The outer edges of concrete pavement are susceptible to damage as trucks move from the concrete to the adjacent bituminous concrete. Therefore, the concrete thickness of the outer 2 feet of the concrete pavement should be increased to 12 inches. Dowels should be placed across slab expansion joints to limit differential settlements. Welded wire mesh (¼ inch, minimum) should be incorporated into the rigid concrete pavement design to provide tensile strength and increase serviceability. The below sections represent minimum thicknesses and, as such, periodic maintenance should be anticipated.

Portland Cement Concrete Design	
Layer [1]	**Thickness (inches)**
Portland Cement Concrete	5.0
Aggregate Base	6.0
Total Thickness	11.0

1. All materials should meet the current Massachusetts Department of Transportation (MassDOT) Standard Specifications for Highways and Bridges.
   - Type II Portland Cement Concrete (Reinforced Concrete) fc' = 5,000 pounds per square inch (psi)
   - Aggregate Base Course – MassDOT Dense-graded Crushed Stone for Sub-base, M2.01.7

Pavement Drainage

Pavements should be sloped to provide rapid drainage of surface water. Water allowed to pond on or adjacent to the pavements could saturate the subgrade and contribute to premature pavement deterioration. In addition, the pavement subgrade should be graded to provide positive drainage within the granular base section. We recommend pavement subgrades be crowned at least 2% to promote the flow of water towards the pavement shoulder to reduce the potential for ponding of water on the subgrade.

Pavement Maintenance

The pavement sections represent minimum recommended thicknesses and, as such, periodic maintenance should be anticipated. Therefore, preventive maintenance should be planned and provided for through an on-going pavement management program. Maintenance activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment. Maintenance consists of both localized maintenance (e.g., crack and joint sealing and patching) and global maintenance (e.g., surface sealing). Preventive maintenance is usually the priority when implementing a pavement maintenance program. Additional engineering observation is recommended to determine the type and extent of a cost-effective program. Even with periodic maintenance, some movements and related cracking may still occur and repairs may be required.

Pavement performance is affected by its surroundings. In addition to providing preventive maintenance, the civil engineer should consider the following recommendations in the design and layout of pavements:

- Final grade adjacent to paved areas should slope down from the edges at a minimum 2%.
- Subgrade and pavement surfaces should have a minimum 2% slope to promote proper surface drainage.
- Install pavement drainage systems surrounding areas anticipated for frequent wetting.

- Install joint sealant and seal cracks immediately.
- Seal all landscaped areas in or adjacent to pavements to reduce moisture migration to subgrade soils.
- Place compacted, low permeability backfill against the exterior side of curb and gutter.

FROST CONSIDERATIONS

The soils on this site are frost susceptible, and small amounts of water can affect the performance of the sidewalks and exterior slabs. Exterior slabs should be anticipated to heave during winter months. If frost action needs to be eliminated in critical areas, we recommend the use of Non-Frost Susceptible (NFS) Fill (for instance, structural stoops in front of building doors). Placement of NFS Fill in large areas may not be feasible; however, the following recommendations are provided to help reduce potential frost heave:

- Provide surface drainage away from the building and slabs, and toward the site storm drainage system.
- Install drains below exterior slabs and connect them to the site storm drainage system.
- Grade subgrades, so groundwater potentially perched in overlying more permeable subgrades, such as sand or aggregate base, slope toward a site drainage system.
- Place a minimum thickness of 2 feet of NFS Fill as backfill beneath sidewalks and exterior slabs, critical to the project.
- Place a 3 horizontal to 1 vertical (3H:1V) transition zone between NFS Fill and other soils.

GENERAL COMMENTS

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

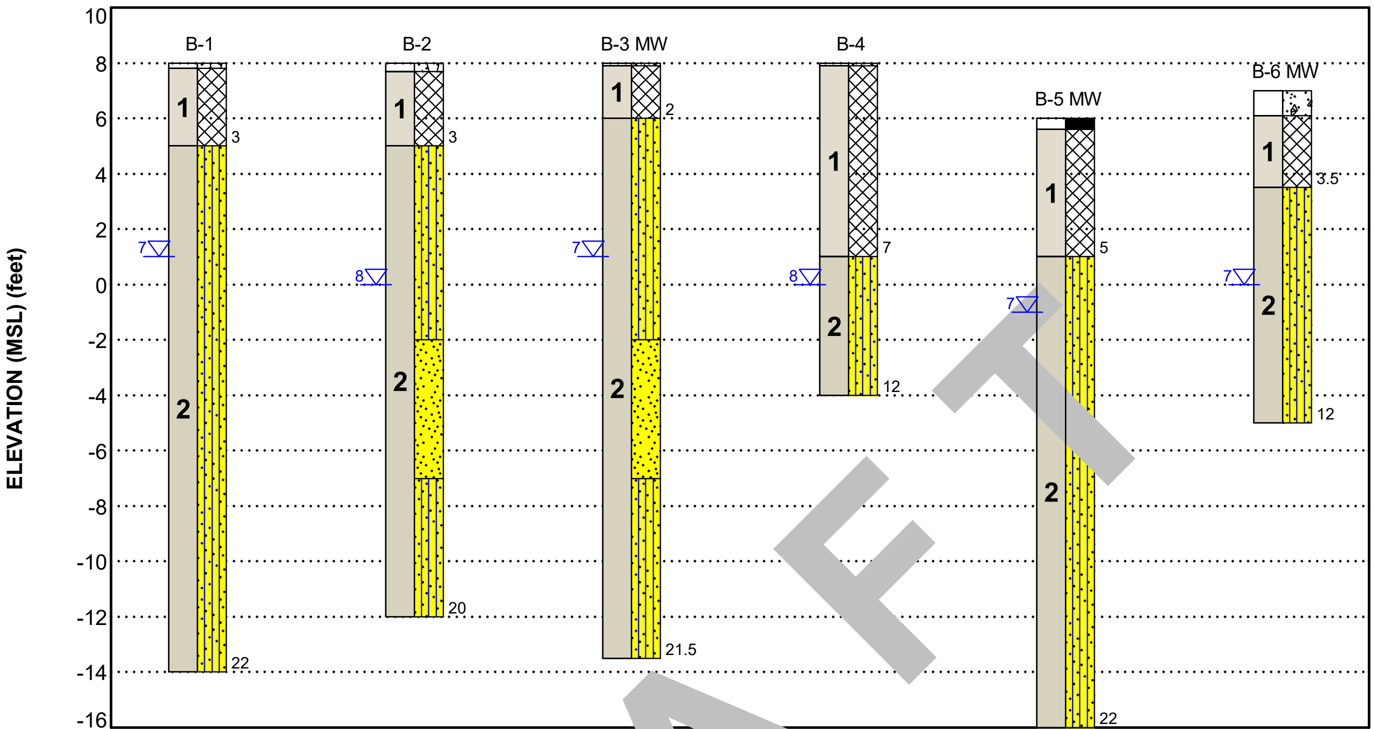
FIGURES

Contents:

GEOMODEL

8 Mitchell Street & Coggeshall Street Development ■ New Bedford, Massachusetts
Terracon Project No. J1215043A

Terracon GeoReport



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	Fill	Fill - Silty Sand, trace gravel, glass, and plastic, brown and black, very loose to dense
2	Sands	Silty Sand (SM) and Poorly Graded Sand (SP), trace gravel and oxidation, light brown and brownish gray, very loose to very dense

LEGEND

- Topsoil
- Fill
- Silty Sand
- Poorly-graded Sand
- Asphalt
- Concrete

▽ First Water Observation

Groundwater levels are temporal. The levels shown are representative of the date and time of our exploration. Significant changes are possible over time.
Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project.
Numbers adjacent to soil column indicate depth below ground surface.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Number of Borings	Boring Depth (feet)	Location
3	20 to 22l	Building Footprint
3	12 to 22	Pavement Areas

Boring Layout and Elevations: Unless otherwise noted, Terracon personnel provided the boring layout. Coordinates were obtained with a handheld GPS unit (estimated horizontal accuracy of about ±10 feet) and approximate elevations were obtained by Google Earh™ imagery because no site-specific survey information was available. If more precise elevations and locations are desired, we recommend borings be surveyed following completion of fieldwork.

Subsurface Exploration Procedures: We retained a drilling subcontractor to advance the borings with a truck-mounted, rotary drill rig using continuous flight hollow stem augers.. Four samples were obtained in the upper 10 feet of each boring and at intervals of 5 feet thereafter. In the split-barrel sampling procedure, a standard 2-inch outer diameter split-barrel sampling spoon was driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration was recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths.. We observed and recorded groundwater levels during drilling and sampling. For safety purposes, all borings were backfilled with auger cuttings after their completion. Pavements were patched with cold-mix asphalt and/or pre-mixed concrete, as appropriate.

The sampling depths, penetration distances, and other sampling information was recorded on the field boring logs. The samples were placed in appropriate containers and taken to our soil laboratory for testing and classification by a Geotechnical Engineer. Our exploration team prepared field boring logs as part of the drilling operations. These field logs included visual classifications of the materials encountered during drilling and our interpretation of the subsurface conditions between samples. Final boring logs were prepared from the field logs. The final boring logs represent the Geotechnical Engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

Laboratory Testing

The project engineer reviewed the field data and assigned laboratory tests to understand the engineering properties of the various soil strata, as necessary, for this project. As of the date of this DRAFT report, the soil laboratory results were not yet available, and will be included with our final report. Procedural standards noted below are for reference to methodology in general. In some cases, variations to methods were applied because of local practice or professional judgment. Standards noted below include reference to other, related standards. Such references are not necessarily applicable to describe the specific test performed.

- ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- ASTM D422 Standard Test Method for Particle-Size Analysis of Soils

The laboratory testing program included examination of soil samples by an engineer. Based on the material's texture and plasticity, we described and classified the soil samples in accordance with the Unified Soil Classification System.

PHOTOGRAPHY LOG

Photo No. 1 – Proposed Building Area – Gasoline Station and Car Wash/Subway Building in Background.

Photo No. 2 – Proposed Building Footprint Area – Facing Mitchell Street

Photo No. 3 - Car Wash/Subway Building to be Demolished – Proposed Coggeshall Street Access/Egress Drive

Photo No. 4 – Auto Body Shop to be Demolished – Proposed Parking

SITE LOCATION AND EXPLORATION PLANS

Contents:

Note: All attachments are one page unless noted above.

SITE LOCATION

8 Mitchell Street & Coggeshall Street Development ■ New Bedford, Massachusetts
May 27, 2021 ■ Terracon Project No. J1215043A

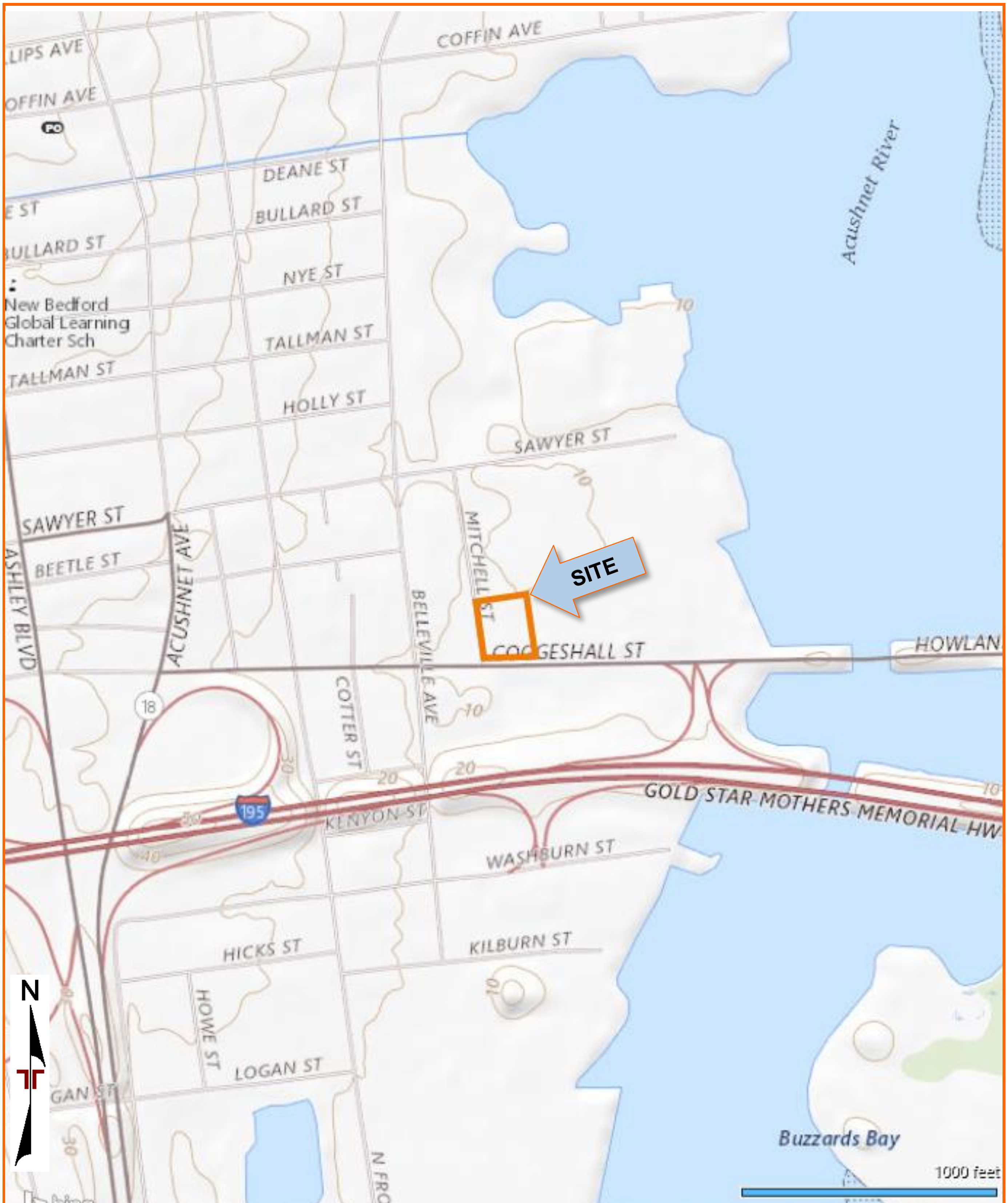


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP COURTESY OF THE U.S. GEOLOGICAL SURVEY

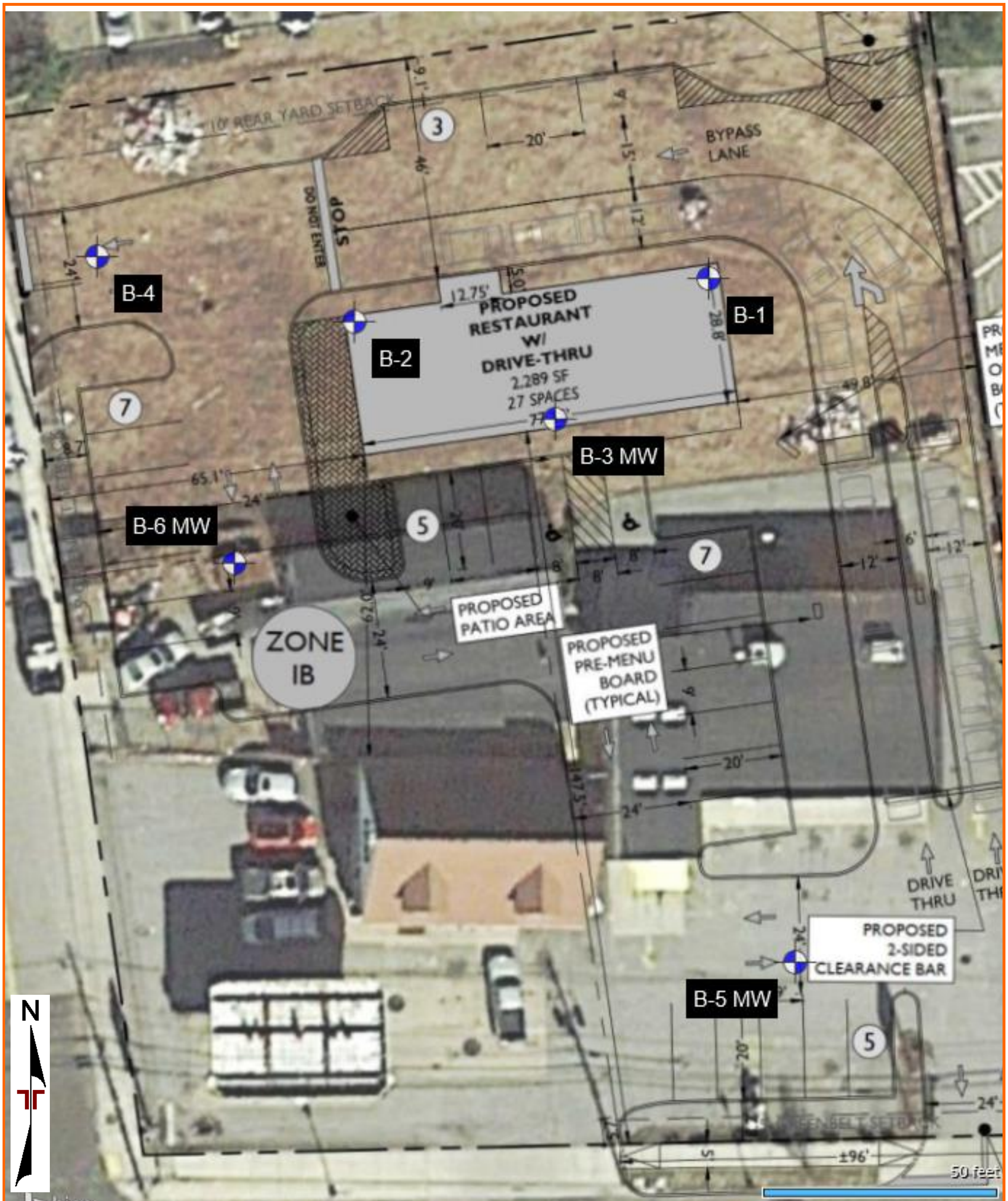


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION RESULTS

Contents:

Boring Logs (B-1, B-2, B-3 MW, B-4, B-5 MW, B-6 MW)

Note: All attachments are one page unless noted above.

BORING LOG NO. B-1

PROJECT: 8 Mitchell Street & Coggeshall Street Development

CLIENT: Alrig USA Development LLC
Bingham Farms, MI

SITE: 8 Mitchell Street & Coggeshall Street
New Bedford, Massachusetts

LOCATION See Exploration Plan

Latitude: 41.6566° Longitude: -70.9222°

Approximate Surface Elev.: 8 (Ft.) +/-

MODEL LAYER	DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS
	0.2	2-inches of topsoil with roots	8+/-					
1		**FILL - SILTY SAND**, trace gravel, black, loose				X	12	1-4-4-7 N=8
	3.0		5+/-			X	21	11-20-10-10 N=30
2		**SILTY SAND (SM)**, trace gravel, brown to brownish gray, loose to dense		5		X	19	2-2-2-3 N=4
		Similar, trace oxidation			▽	X	16	3-2-2-2 N=4
				10		X	15	7-9-10-8 N=19
		Similar, trace gravel		15		X	5	1-3-10-10 N=13
	22.0	Similar, trace oxidation	-14+/-	20		X	10	14-12-12-18 N=24

Boring Terminated at 22 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.
Samples obtained using a 2" O.D. split spoon sampler

Hammer Type: Automatic

Advancement Method:
4-1/4-inch I.D. hollow stem augers

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *7 feet while drilling*

Terracon
77 Sundial Ave, Ste 401W
Manchester, NH

Boring Started: 05-14-2021	Boring Completed: 05-14-2021
Drill Rig: CME-55	Driller: Geosearch / Rodney
Project No.: J1215043A	

BORING LOG NO. B-2

PROJECT: 8 Mitchell Street & Coggeshall Street Development

CLIENT: Alrig USA Development LLC
Bingham Farms, MI

SITE: 8 Mitchell Street & Coggeshall Street
New Bedford, Massachusetts

LOCATION See Exploration Plan

Latitude: 41.6566° Longitude: -70.9225°

Approximate Surface Elev.: 8 (Ft.) +/-

MODEL LAYER	DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS
	0.3	3-inches of topsoil with roots	7.5+/-					
1		**FILL - SILTY SAND**, trace glass, brownish black, loose				X	10	1-2-2-3 N=4
	3.0		5+/-					
2		**SILTY SAND (SM)**, trace gravel, light brown, very loose to loose				X	15	2-2-5-5 N=7
				5		X	20	2-2-2-2 N=4
		Similar, trace oxidation			▽	X	17	2-1-1-1 N=2
	10.0		-2+/-	10				
		POORLY GRADED SAND (SP), trace silt and oxidation, light brown, dense				X	16	4-16-22-23 N=38
	15.0		-7+/-	15				
		SILTY SAND (SM), trace gravel and oxidation, light brownish gray, medium dense to very dense				X	10	6-6-10-22 N=16
	20.0		-12+/-	20			0	25/0"
		Auger Refusal on probable bedrock at 20 Feet						

Stratification lines are approximate. In-situ, the transition may be gradual.
Samples obtained using a 2" O.D. split spoon sampler

Hammer Type: Automatic

Advancement Method:
4-1/4-inch I.D. hollow stem augers

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *8 feet while drilling*

Terracon
77 Sundial Ave, Ste 401W
Manchester, NH

Boring Started: 05-14-2021	Boring Completed: 05-14-2021
Drill Rig: CME-55	Driller: Geosearch / Rodney
Project No.: J1215043A	

BORING LOG NO. B-3 MW

PROJECT: 8 Mitchell Street & Coggeshall Street Development

CLIENT: Alrig USA Development LLC, Bingham Farms, MI

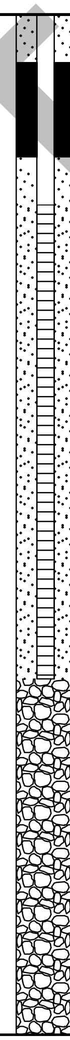
SITE: 8 Mitchell Street & Coggeshall Street, New Bedford, Massachusetts

LOCATION See Exploration Plan

Latitude: 41.6566° Longitude: -70.9223°

Approximate Surface Elev.: 8 (Ft.) +/-

MODEL LAYER	DEPTH	DESCRIPTION	ELEVATION (Ft.)	INSTALLATION DETAILS
1	0.1	1-inch of topsoil	8+/-	
1	2.0	**FILL - SILTY SAND**, trace glass, black, loose	6+/-	Bentonite Seal
2	10.0	**SILTY SAND (SM)**, light brown, very loose to medium dense Similar, trace oxidation Similar, trace gravel	-2+/-	2-inch PVC Screen with Filter Sand
2	15.0	**POORLY GRADED SAND (SP)**, light brown, medium dense	-7+/-	
2	21.5	**SILTY SAND (SM)**, brownish gray, medium dense to very dense	-13.5+/-	Native Backfill
		Auger Refusal on probable bedrock at 21.5 Feet		



Sample depth (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS
0-2		X	16	1-2-5-11 N=7
2-4		X	20	6-6-7-8 N=13
5-7	▽ (7 ft)	X	14	1-1-2-3 N=3
7-9		X	15	4-4-9-12 N=13
10-12		X	12	4-8-13-12 N=21
15-17		X	14	9-10-10-16 N=20
20-21.3		X	13	10-11-50/4"

Stratification lines are approximate. In-situ, the transition may be gradual.
Samples obtained using a 2" O.D. split spoon sampler

Hammer Type: Automatic

Advancement Method:
4-1/4-inch I.D. hollow stem augers

Abandonment Method:
Monitoring well installed upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *7 feet while drilling*

Terracon
77 Sundial Ave, Ste 401W
Manchester, NH

Boring Started: 05-14-2021	Boring Completed: 05-14-2021
Drill Rig: CME-55	Driller: Geosearch / Rodney
Project No.: J1215043A	

BORING LOG NO. B-4

PROJECT: 8 Mitchell Street & Coggeshall Street Development

CLIENT: Alrig USA Development LLC Bingham Farms, MI

SITE: 8 Mitchell Street & Coggeshall Street New Bedford, Massachusetts

LOCATION See Exploration Plan

Latitude: 41.6566° Longitude: -70.9227°

Approximate Surface Elev.: 8 (Ft.) +/-

MODEL LAYER	DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS
1	0.1	1-inch of topsoil with roots	8+/-					
		FILL - SILTY SAND, trace plastic, black, very loose to loose				X	6	1-1-1-3 N=2
		Similar, change to light brown				X	18	2-4-5-5 N=9
				5		X	18	1-2-1-1 N=3
	7.0	Similar, change to black at 6.5 feet	1+/-					
2		**SILTY SAND (SM)**, light brown, loose to dense			▽	X	12	1-2-2-1 N=4
		Similar, trace gravel		10		X	13	5-13-19-16 N=32
	12.0		-4+/-					

Boring Terminated at 12 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Samples obtained using a 2" O.D. split spoon sampler

Hammer Type: Automatic

Advancement Method:
4-1/4-inch I.D. hollow stem augers

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *8 feet while drilling*

Terracon
77 Sundial Ave, Ste 401W
Manchester, NH

Boring Started: 05-14-2021	Boring Completed: 05-14-2021
Drill Rig: CME-55	Driller: Geosearch / Rodney
Project No.: J1215043A	

BORING LOG NO. B-5 MW

PROJECT: 8 Mitchell Street & Coggeshall Street Development

CLIENT: Alrig USA Development LLC, Bingham Farms, MI

SITE: 8 Mitchell Street & Coggeshall Street, New Bedford, Massachusetts

LOCATION See Exploration Plan

Latitude: 41.6562° Longitude: -70.9221°

Approximate Surface Elev.: 6 (Ft.) +/-

MODEL LAYER	DEPTH	ELEVATION (Ft.)	Description	INSTALLATION DETAILS
	0.4	5.5+/-	4-inches of asphalt	
1	5.0	1+/-	**FILL - SILTY SAND**, trace gravel, brown, medium dense to dense	Native Backfill; Bentonite Seal
2	22.0	-16+/-	**SILTY SAND (SM)**, light brown, very loose to medium dense	2-inch PVC Screen with Filter Sand; Native Backfill

Boring Terminated at 22 Feet

Sample	RECOVERY (In.)	FIELD TEST RESULTS
1	18	6-19-15-10 N=34
2	18	6-5-10-11 N=15
3	12	2-1-2-3 N=3
4	14	8-8-9-10 N=17
5	24	1-2-4-5 N=6
6	14	1-1-1-3 N=2
7	12	4-4-5-4 N=9

Water level observation (▽) at approximately 7 feet.

Stratification lines are approximate. In-situ, the transition may be gradual.

Samples obtained using a 2" O.D. split spoon sampler

Hammer Type: Automatic

Advancement Method:
4-1/4-inch I.D. hollow stem augers

Abandonment Method:
Monitoring well installed upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *7 feet while drilling*

Terracon
77 Sundial Ave, Ste 401W
Manchester, NH

Boring Started: 05-17-2021	Boring Completed: 05-17-2021
Drill Rig: CME-55	Driller: Geosearch / Rodney
Project No.: J1215043A	

BORING LOG NO. B-6 MW

PROJECT: 8 Mitchell Street & Coggeshall Street Development

CLIENT: Alrig USA Development LLC Bingham Farms, MI

SITE: 8 Mitchell Street & Coggeshall Street New Bedford, Massachusetts

LOCATION See Exploration Plan

Latitude: 41.6565° Longitude: -70.9226°

Approximate Surface Elev.: 7 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	Description	ELEVATION (Ft.)	INSTALLATION DETAILS	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS
		0.9	10-inches of concrete	6+/-	Native Backfill			X	14	2-3-3-4 N=6
1		3.5	**FILL - SILTY SAND**, trace gravel, black, loose	3.5+/-	Bentonite Seal			X	16	3-2-2-3 N=4
2			**SILTY SAND (SM)**, trace gravel, orangish brown to brownish gray, loose to very dense Similar, oxidized		2-inch PVC Screen with Filter Sand	5	▽	X	12	1-4-20-50/4" N=24
		12.0		-5+/-		10		X	14	18-24-37-43 N=61

Boring Terminated at 12 Feet

DRAFT

Stratification lines are approximate. In-situ, the transition may be gradual.
Samples obtained using a 2" O.D. split spoon sampler

Hammer Type: Automatic

Advancement Method:
4-1/4-inch I.D. hollow stem augers

Abandonment Method:
Monitoring well installed upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *7 feet while drilling*

Terracon
77 Sundial Ave, Ste 401W
Manchester, NH

Boring Started: 05-14-2021	Boring Completed: 05-14-2021
Drill Rig: CME-55	Driller: Geosearch / Rodney
Project No.: J1215043A	

SUPPORTING INFORMATION

Contents:

Note: All attachments are one page unless noted above.

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

8 Mitchell Street & Coggeshall Street Development ■ New Bedford, Massachusetts

Terracon Project No. J1215043A

SAMPLING	WATER LEVEL		FIELD TESTS	
☒ Standard Penetration Test	▽	Water Initially Encountered	N	Standard Penetration Test Resistance (Blows/Ft.)
	▽	Water Level After a Specified Period of Time	(HP)	Hand Penetrometer
	▼	Water Level After a Specified Period of Time	(T)	Torvane
		Cave In Encountered	(DCP)	Dynamic Cone Penetrometer
	Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.		UC	Unconfined Compressive Strength
			(PID)	Photo-Ionization Detector
			(OVA)	Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

LOCATION AND ELEVATION NOTES

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength Qu, (tsf)**	**Standard Penetration or N-Value Blows/Ft.**
Very Loose	0 - 3	Very Soft	less than 0.25	0 - 1
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4
Medium Dense	10 - 29	Medium Stiff	0.50 to 1.00	4 - 8
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30
		Hard	> 4.00	> 30

RELEVANCE OF SOIL BORING LOG

The soil boring logs contained within this document are intended for application to the project as described in this document. Use of these soil boring logs for any other purpose may not be appropriate.

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification: Group Symbol	Soil Classification: Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	Cu ≥ 4 and 1 ≤ Cc ≤ 3 [E]	GW	Well-graded gravel [F]
			Cu < 4 and/or [Cc<1 or Cc>3.0] [E]	GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH	GM	Silty gravel [F, G, H]
			Fines classify as CL or CH	GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	Cu ≥ 6 and 1 ≤ Cc ≤ 3 [E]	SW	Well-graded sand [I]
			Cu < 6 and/or [Cc<1 or Cc>3.0] [E]	SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH	SM	Silty sand [G, H, I]
			Fines classify as CL or CH	SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above “A” line [J]	CL	Lean clay [K, L, M]
			PI < 4 or plots below “A” line [J]	ML	Silt [K, L, M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OL	Organic clay [K, L, M, N]
					Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above “A” line	CH	Fat clay [K, L, M]
			PI plots below “A” line	MH	Elastic Silt [K, L, M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OH	Organic clay [K, L, M, P]
					Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve.

[B] If field sample contained cobbles or boulders, or both, add “with cobbles or boulders, or both” to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add “with sand” to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add “with organic fines” to group name.

[I] If soil contains ≥ 15% gravel, add “with gravel” to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add “with sand” or “with gravel,” whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add “sandy” to group name.

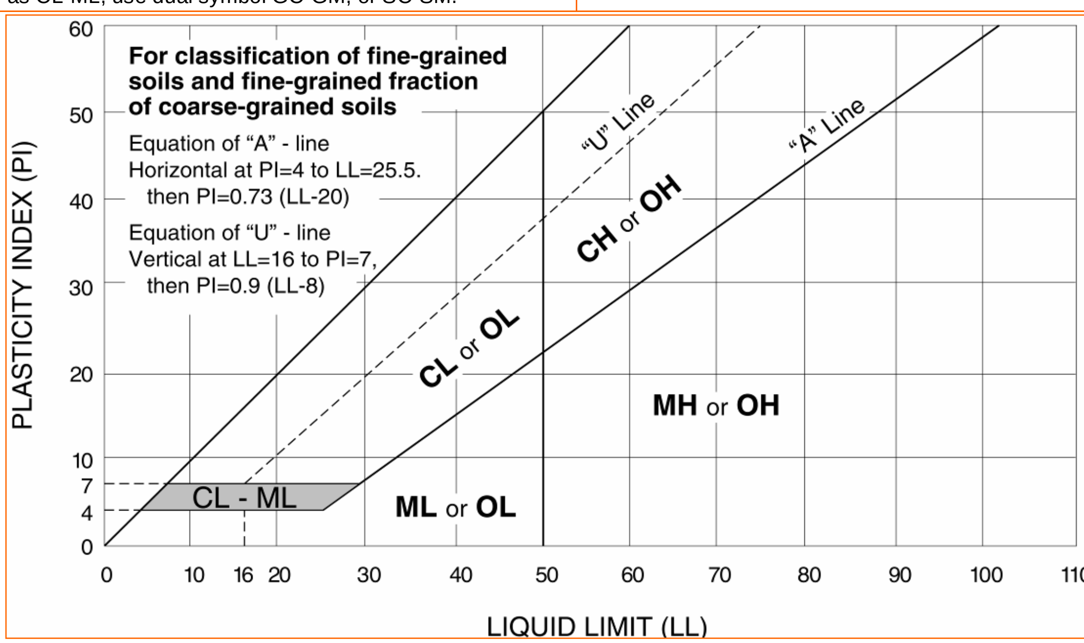
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add “gravelly” to group name.

[N] PI ≥ 4 and plots on or above “A” line.

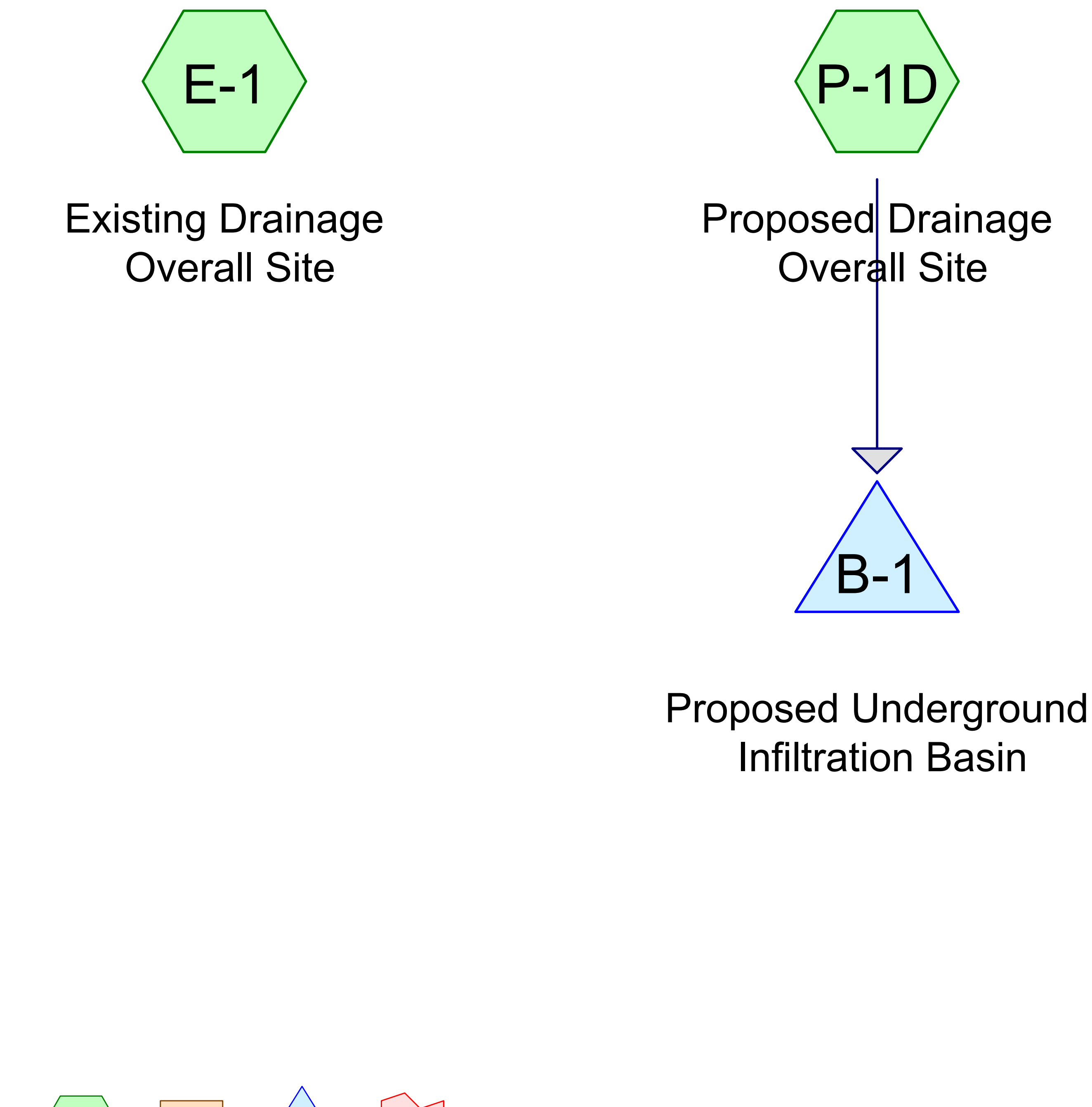
[O] PI < 4 or plots below “A” line.

[P] PI plots on or above “A” line.

[Q] PI plots below “A” line.



APPENDIX D
DESIGN CALCULATIONS & DIAGRAMS



Routing Diagram for 2021-06-30_New Bedford
Prepared by Stonefield Engineering and Design , Printed 6/30/2021
HydroCAD® 10.00-26 s/n 10626 © 2020 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
27,301	61	>75% Grass cover, Good, HSG B (E-1, P-1D)
15,841	98	Paved parking, HSG B (E-1)
27,283	98	Paved parking, HSG D (P-1D)
70,425	**84**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
43,142	HSG B	E-1, P-1D
0	HSG C	
27,283	HSG D	P-1D
0	Other	
70,425		**TOTAL AREA**

Ground Covers (all 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	Sub Num
0	27,301	0	0	0	27,301	>75% Grass cover, Good	
0	15,841	0	27,283	0	43,124	Paved parking	
0	**43,142**	**0**	**27,283**	**0**	**70,425**	**TOTAL AREA**	

Pipe Listing (all 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	B-1	3.50	2.99	102.0	0.0050	0.011	15.0	0.0	0.0

Time span=0.00-72.00 hrs, dt=0.02 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment E-1: Existing Drainage Runoff Area=35,212 sf 44.99% Impervious Runoff Depth=1.65"
Tc=6.0 min CN=61/98 Runoff=1.42 cfs 4,833 cf

Subcatchment P-1D: Proposed Drainage Runoff Area=35,213 sf 77.48% Impervious Runoff Depth=2.49"
Tc=6.0 min CN=61/98 Runoff=2.18 cfs 7,294 cf

Pond B-1: Proposed Underground Infiltration Peak Elev=4.84' Storage=2,263 cf Inflow=2.18 cfs 7,294 cf
Discarded=0.09 cfs 5,447 cf Primary=1.16 cfs 1,847 cf Outflow=1.25 cfs 7,294 cf

Total Runoff Area = 70,425 sf Runoff Volume = 12,127 cf Average Runoff Depth = 2.07"
38.77% Pervious = 27,301 sf 61.23% Impervious = 43,124 sf

Summary for Subcatchment E-1: Existing Drainage Overall Site

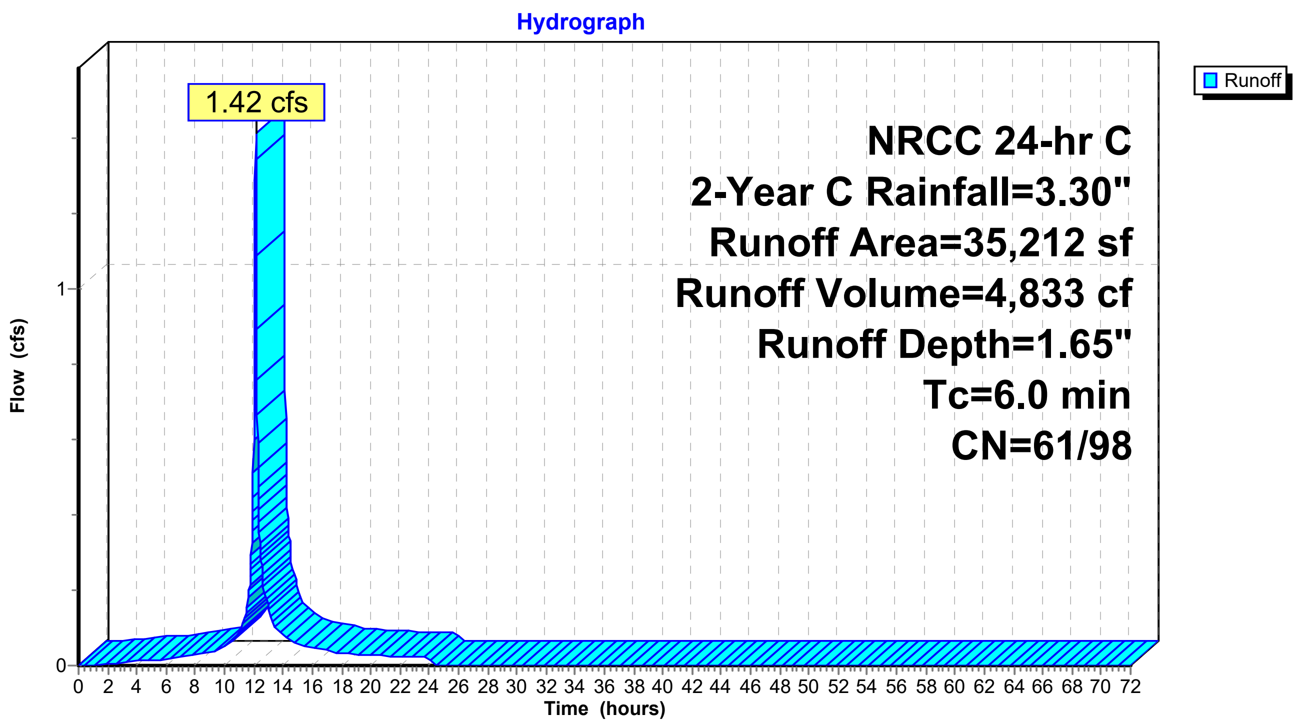
Runoff = 1.42 cfs @ 12.13 hrs, Volume= 4,833 cf, Depth= 1.65"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
NRCC 24-hr C 2-Year C Rainfall=3.30"

Area (sf)	CN	Description
19,371	61	>75% Grass cover, Good, HSG B
15,841	98	Paved parking, HSG B
35,212	78	Weighted Average
19,371	61	55.01% Pervious Area
15,841	98	44.99% Impervious Area

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

Subcatchment E-1: Existing Drainage Overall Site



Summary for Subcatchment P-1D: Proposed Drainage Overall Site

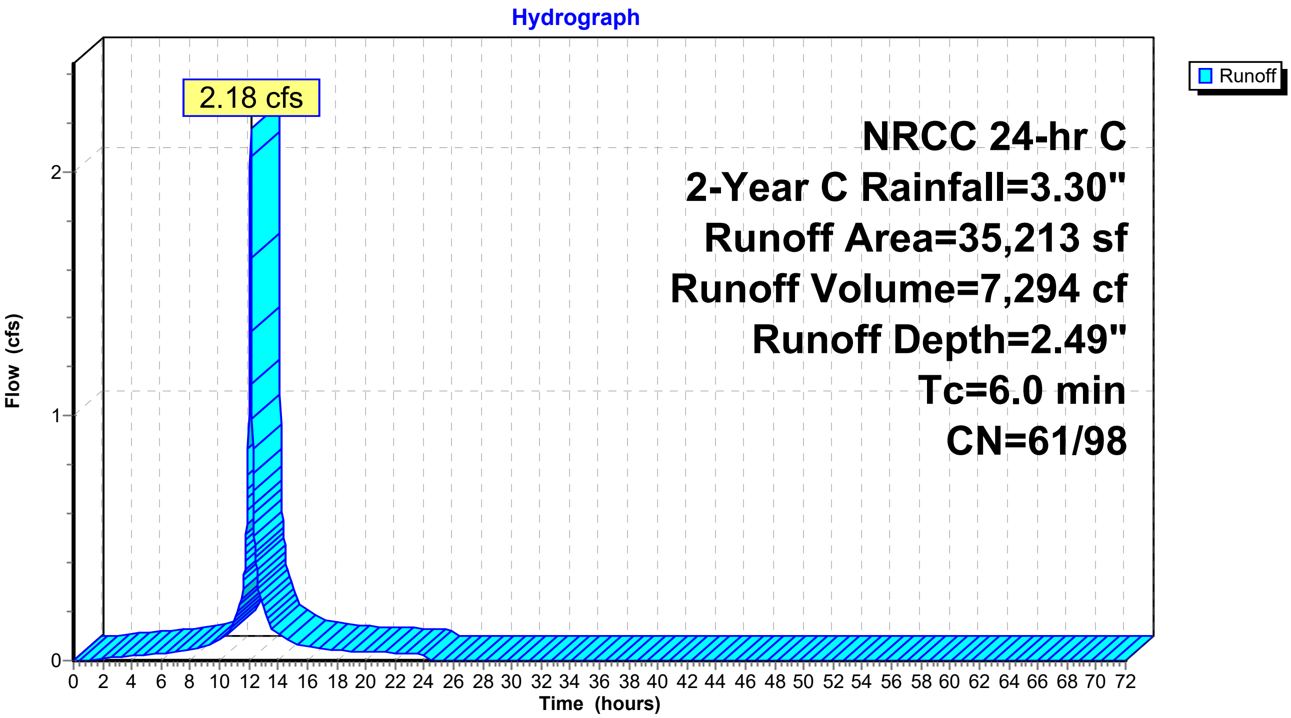
Runoff = 2.18 cfs @ 12.13 hrs, Volume= 7,294 cf, Depth= 2.49"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
NRCC 24-hr C 2-Year C Rainfall=3.30"

Area (sf)	CN	Description
27,283	98	Paved parking, HSG D
7,930	61	>75% Grass cover, Good, HSG B
35,213	90	Weighted Average
7,930	61	22.52% Pervious Area
27,283	98	77.48% Impervious Area

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

Subcatchment P-1D: Proposed Drainage Overall Site



Summary for Pond B-1: Proposed Underground Infiltration Basin

Inflow Area = 35,213 sf, 77.48% Impervious, Inflow Depth = 2.49" for 2-Year C event
Inflow = 2.18 cfs @ 12.13 hrs, Volume= 7,294 cf
Outflow = 1.25 cfs @ 12.21 hrs, Volume= 7,294 cf, Atten= 42%, Lag= 4.8 min
Discarded = 0.09 cfs @ 12.21 hrs, Volume= 5,447 cf
Primary = 1.16 cfs @ 12.21 hrs, Volume= 1,847 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Peak Elev= 4.84' @ 12.21 hrs Surf.Area= 1,817 sf Storage= 2,263 cf

Plug-Flow detention time= 163.6 min calculated for 7,292 cf (100% of inflow)
Center-of-Mass det. time= 163.7 min (928.9 - 765.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	3.00'	1,662 cf	**30.00'W x 60.58'L x 3.50'H Field A** 6,361 cf Overall - 2,205 cf Embedded = 4,155 cf x 40.0% Voids
#2A	3.50'	2,205 cf	**ADS_StormTech SC-740 +Cap** x 48 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 48 Chambers in 6 Rows
		3,867 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	3.50'	**15.0" Round Culvert** L= 102.0' Ke= 0.500 Inlet / Outlet Invert= 3.50' / 2.99' S= 0.0050 '/' Cc= 0.900 n= 0.011, Flow Area= 1.23 sf
#2	Device 1	4.52'	**24.0" W x 4.0" H Vert. 24" x 4" Slot** C= 0.600
#3	Device 1	5.45'	**2.5" Vert. 2.5" Orifice** C= 0.600
#4	Device 1	6.00'	**2.0' long x 0.5' breadth 24" x 6" Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#5	Discarded	3.00'	**1.140 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 1.00' Phase-In= 0.01'

Discarded OutFlow Max=0.09 cfs @ 12.21 hrs HW=4.84' (Free Discharge)
└─**5=Exfiltration** (Controls 0.09 cfs)

Primary OutFlow Max=1.15 cfs @ 12.21 hrs HW=4.84' (Free Discharge)
└─**1=Culvert** (Passes 1.15 cfs of 4.65 cfs potential flow)
  ├─**2=24" x 4" Slot** (Orifice Controls 1.15 cfs @ 1.81 fps)
  ├─**3=2.5" Orifice** (Controls 0.00 cfs)
  └─**4=24" x 6" Weir** (Controls 0.00 cfs)

Pond B-1: Proposed Underground Infiltration Basin - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

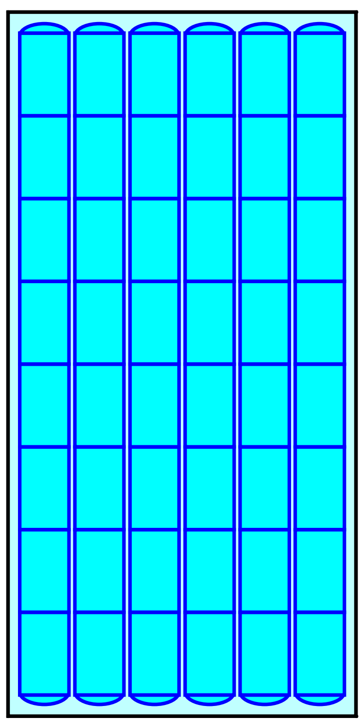
8 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 58.58' Row Length +12.0" End Stone x 2 = 60.58' Base Length
6 Rows x 51.0" Wide + 6.0" Spacing x 5 + 12.0" Side Stone x 2 = 30.00' Base Width
6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

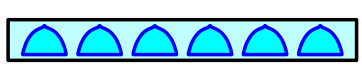
48 Chambers x 45.9 cf = 2,205.1 cf Chamber Storage

6,360.5 cf Field - 2,205.1 cf Chambers = 4,155.4 cf Stone x 40.0% Voids = 1,662.2 cf Stone Storage

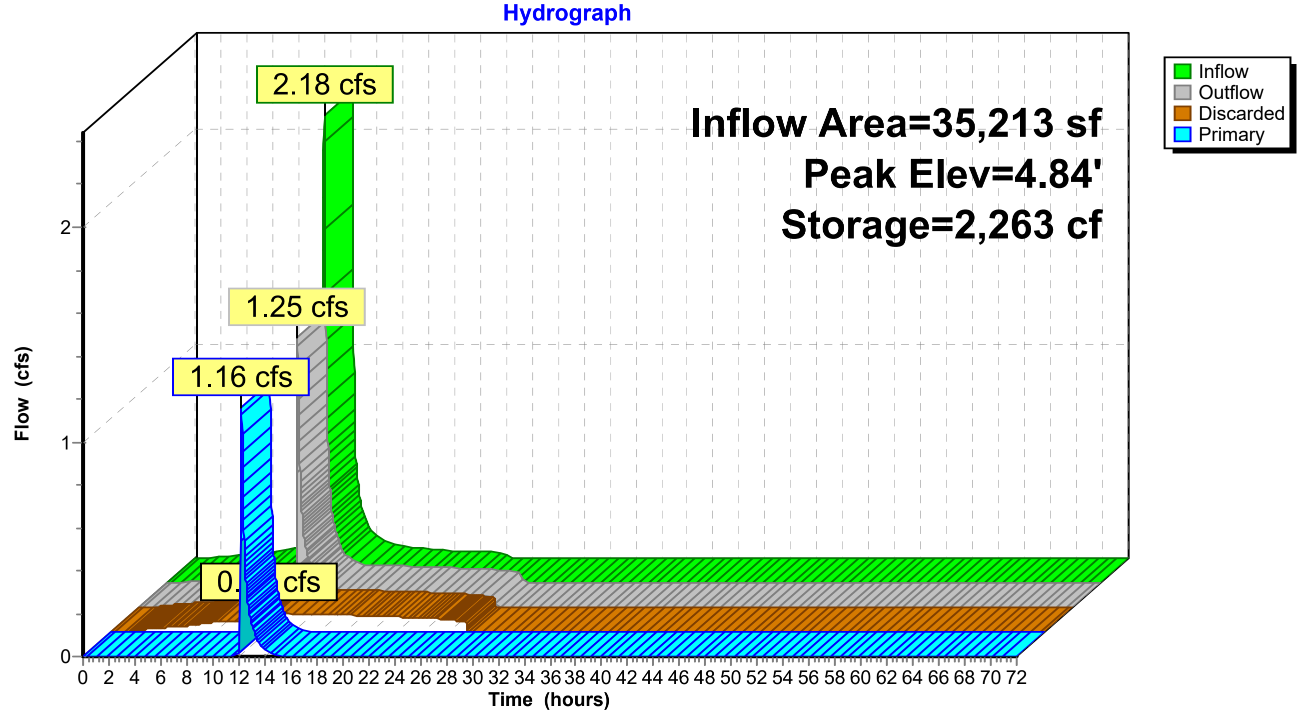
Chamber Storage + Stone Storage = 3,867.3 cf = 0.089 af
Overall Storage Efficiency = 60.8%
Overall System Size = 60.58' x 30.00' x 3.50'

48 Chambers
235.6 cy Field
153.9 cy Stone

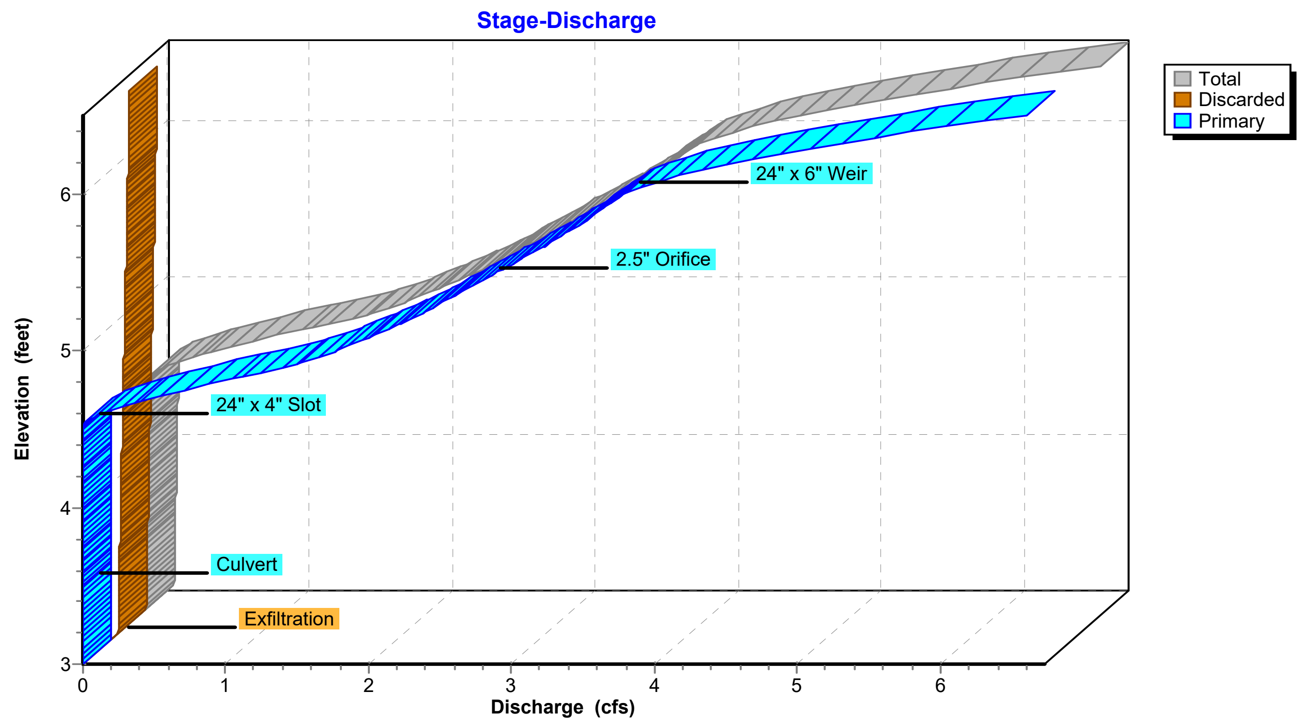




Pond B-1: Proposed Underground Infiltration Basin



Pond B-1: Proposed Underground Infiltration Basin



Hydrograph for Pond B-1: Proposed Underground Infiltration Basin

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)
0.00	0.00	0	3.00	0.00	0.00	0.00
2.00	0.01	1	3.00	0.01	0.01	0.00
4.00	0.02	3	3.00	0.02	0.02	0.00
6.00	0.03	4	3.01	0.03	0.03	0.00
8.00	0.05	7	3.01	0.05	0.05	0.00
10.00	0.09	104	3.14	0.05	0.05	0.00
12.00	**1.13**	**1,322**	**4.15**	**0.08**	**0.08**	**0.00**
14.00	**0.11**	**1,876**	**4.55**	**0.12**	**0.09**	**0.03**
16.00	0.06	1,778	4.48	0.08	0.08	0.00
18.00	0.04	1,562	4.32	0.08	0.08	0.00
20.00	0.04	1,282	4.13	0.07	0.07	0.00
22.00	0.03	999	3.93	0.07	0.07	0.00
24.00	0.03	715	3.74	0.07	0.07	0.00
26.00	0.00	278	3.38	0.06	0.06	0.00
28.00	0.00	0	3.00	0.00	0.00	0.00
30.00	0.00	0	3.00	0.00	0.00	0.00
32.00	0.00	0	3.00	0.00	0.00	0.00
34.00	0.00	0	3.00	0.00	0.00	0.00
36.00	0.00	0	3.00	0.00	0.00	0.00
38.00	0.00	0	3.00	0.00	0.00	0.00
40.00	0.00	0	3.00	0.00	0.00	0.00
42.00	0.00	0	3.00	0.00	0.00	0.00
44.00	0.00	0	3.00	0.00	0.00	0.00
46.00	0.00	0	3.00	0.00	0.00	0.00
48.00	0.00	0	3.00	0.00	0.00	0.00
50.00	0.00	0	3.00	0.00	0.00	0.00
52.00	0.00	0	3.00	0.00	0.00	0.00
54.00	0.00	0	3.00	0.00	0.00	0.00
56.00	0.00	0	3.00	0.00	0.00	0.00
58.00	0.00	0	3.00	0.00	0.00	0.00
60.00	0.00	0	3.00	0.00	0.00	0.00
62.00	0.00	0	3.00	0.00	0.00	0.00
64.00	0.00	0	3.00	0.00	0.00	0.00
66.00	0.00	0	3.00	0.00	0.00	0.00
68.00	0.00	0	3.00	0.00	0.00	0.00
70.00	0.00	0	3.00	0.00	0.00	0.00
72.00	0.00	0	3.00	0.00	0.00	0.00

Stage-Area-Storage for Pond B-1: Proposed Underground Infiltration Basin

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
3.00	**1,817**	0
3.05	1,817	36
3.10	1,817	73
3.15	1,817	109
3.20	1,817	145
3.25	1,817	182
3.30	1,817	218
3.35	1,817	254
3.40	1,817	291
3.45	1,817	327
3.50	1,817	363
3.55	1,817	438
3.60	1,817	512
3.65	1,817	587
3.70	1,817	661
3.75	1,817	735
3.80	1,817	808
3.85	1,817	882
3.90	1,817	955
3.95	1,817	1,028
4.00	1,817	1,100
4.05	1,817	1,173
4.10	1,817	1,245
4.15	1,817	1,316
4.20	1,817	1,388
4.25	1,817	1,459
4.30	1,817	1,529
4.35	1,817	1,599
4.40	1,817	1,669
4.45	1,817	1,738
4.50	1,817	1,807
4.55	1,817	1,876
4.60	1,817	1,944
4.65	1,817	2,011
4.70	1,817	2,078
4.75	1,817	2,145
4.80	1,817	2,211
4.85	1,817	2,276
4.90	1,817	2,341
4.95	1,817	2,405
5.00	1,817	2,468
5.05	1,817	2,531
5.10	1,817	2,593
5.15	1,817	2,655
5.20	1,817	2,715
5.25	1,817	2,775
5.30	1,817	2,833
5.35	1,817	2,891
5.40	1,817	2,948
5.45	1,817	3,003
5.50	1,817	3,058
5.55	1,817	3,111
5.60	1,817	3,163
5.65	1,817	3,213
5.70	1,817	3,261
5.75	1,817	3,306
5.80	1,817	3,349
5.85	1,817	3,390
5.90	1,817	3,429
5.95	1,817	3,467
6.00	1,817	3,504
6.05	1,817	3,540
6.10	1,817	3,577
6.15	1,817	3,613
6.20	1,817	3,649
6.25	1,817	3,686
6.30	1,817	3,722
6.35	1,817	3,758
6.40	1,817	3,795
6.45	1,817	3,831
6.50	1,817	**3,867**

Time span=0.00-72.00 hrs, dt=0.02 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment E-1: Existing Drainage Runoff Area=35,212 sf 44.99% Impervious Runoff Depth=2.80"
Tc=6.0 min CN=61/98 Runoff=2.50 cfs 8,224 cf

Subcatchment P-1D: Proposed Drainage Runoff Area=35,213 sf 77.48% Impervious Runoff Depth=3.89"
Tc=6.0 min CN=61/98 Runoff=3.41 cfs 11,415 cf

Pond B-1: Proposed Underground Infiltration Peak Elev=5.24' Storage=2,767 cf Inflow=3.41 cfs 11,415 cf
Discarded=0.10 cfs 6,574 cf Primary=2.39 cfs 4,841 cf Outflow=2.49 cfs 11,415 cf

Total Runoff Area = 70,425 sf Runoff Volume = 19,639 cf Average Runoff Depth = 3.35"
38.77% Pervious = 27,301 sf 61.23% Impervious = 43,124 sf

Summary for Subcatchment E-1: Existing Drainage Overall Site

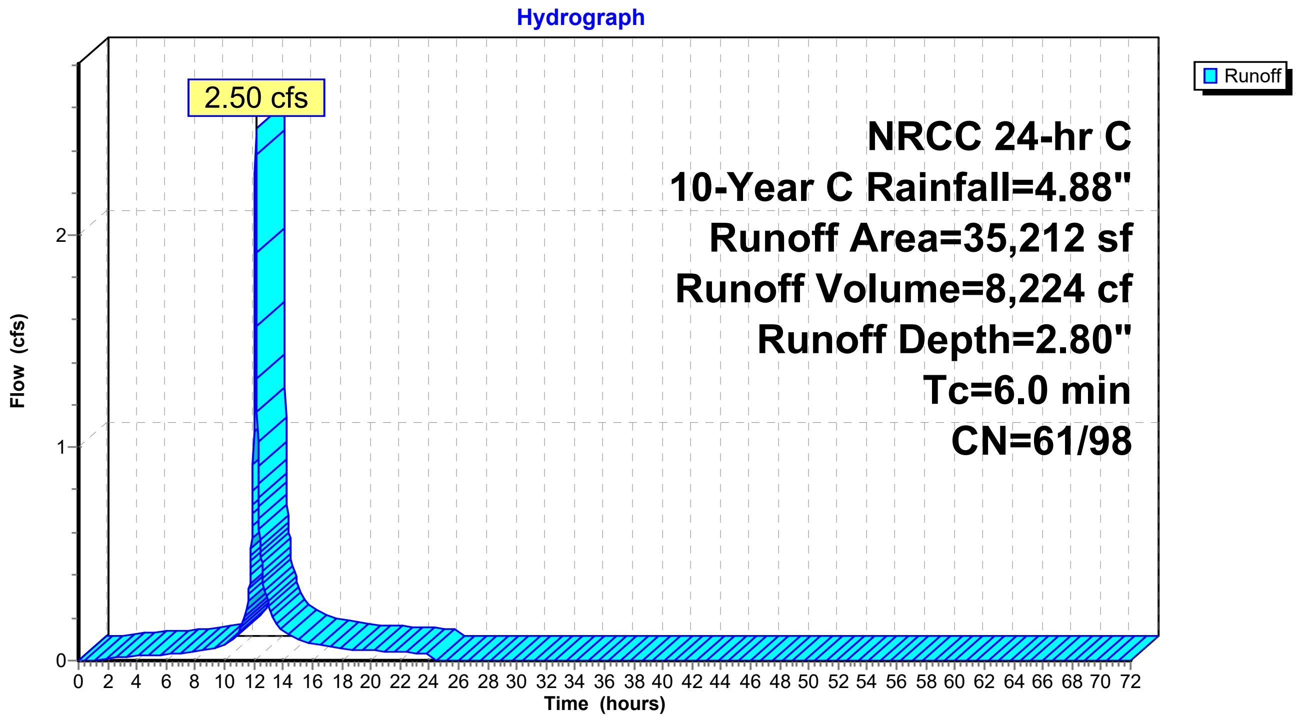
Runoff = 2.50 cfs @ 12.13 hrs, Volume= 8,224 cf, Depth= 2.80"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
NRCC 24-hr C 10-Year C Rainfall=4.88"

Area (sf)	CN	Description
19,371	61	>75% Grass cover, Good, HSG B
15,841	98	Paved parking, HSG B
35,212	78	Weighted Average
19,371	61	55.01% Pervious Area
15,841	98	44.99% Impervious Area

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

Subcatchment E-1: Existing Drainage Overall Site



Summary for Subcatchment P-1D: Proposed Drainage Overall Site

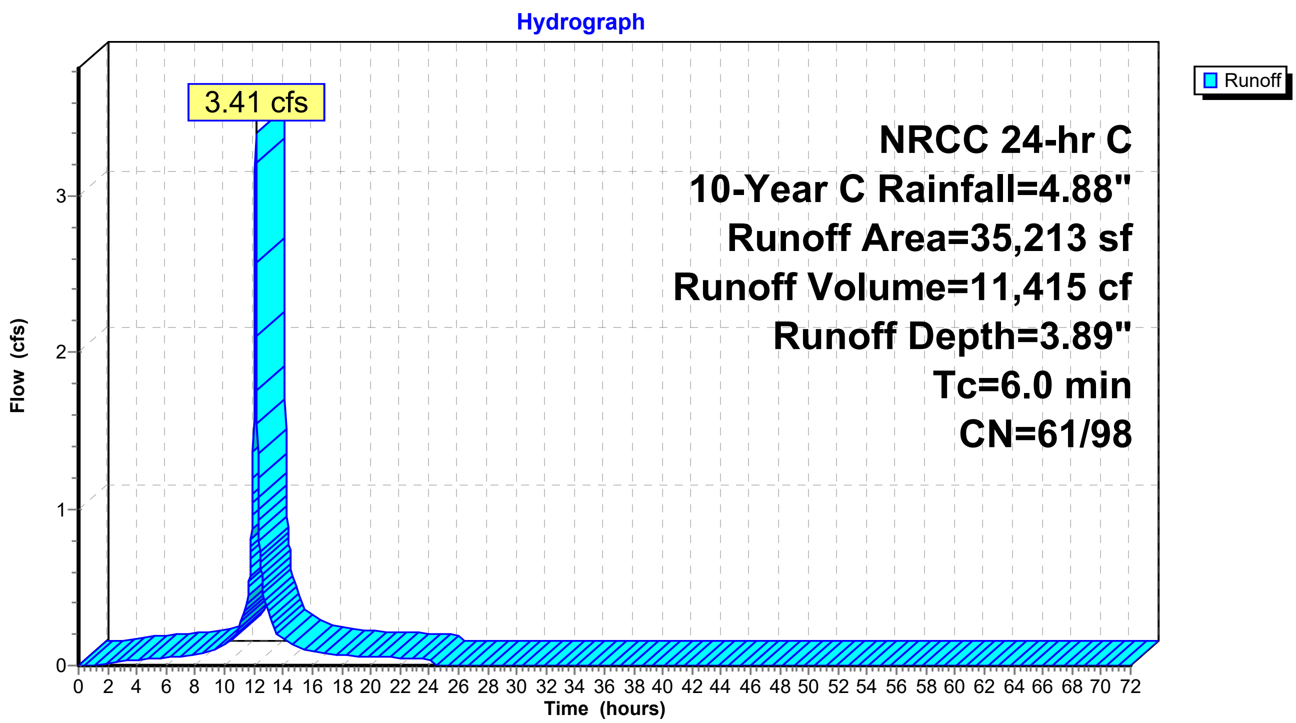
Runoff = 3.41 cfs @ 12.13 hrs, Volume= 11,415 cf, Depth= 3.89"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
NRCC 24-hr C 10-Year C Rainfall=4.88"

Area (sf)	CN	Description
27,283	98	Paved parking, HSG D
7,930	61	>75% Grass cover, Good, HSG B
35,213	90	Weighted Average
7,930	61	22.52% Pervious Area
27,283	98	77.48% Impervious Area

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

Subcatchment P-1D: Proposed Drainage Overall Site



Summary for Pond B-1: Proposed Underground Infiltration Basin

Inflow Area = 35,213 sf, 77.48% Impervious, Inflow Depth = 3.89" for 10-Year C event
Inflow = 3.41 cfs @ 12.13 hrs, Volume= 11,415 cf
Outflow = 2.49 cfs @ 12.18 hrs, Volume= 11,415 cf, Atten= 27%, Lag= 3.3 min
Discarded = 0.10 cfs @ 12.18 hrs, Volume= 6,574 cf
Primary = 2.39 cfs @ 12.18 hrs, Volume= 4,841 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Peak Elev= 5.24' @ 12.18 hrs Surf.Area= 1,817 sf Storage= 2,767 cf

Plug-Flow detention time= 138.0 min calculated for 11,411 cf (100% of inflow)
Center-of-Mass det. time= 138.1 min (898.2 - 760.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	3.00'	1,662 cf	**30.00'W x 60.58'L x 3.50'H Field A** 6,361 cf Overall - 2,205 cf Embedded = 4,155 cf x 40.0% Voids
#2A	3.50'	2,205 cf	**ADS_StormTech SC-740 +Cap** x 48 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 48 Chambers in 6 Rows
		3,867 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	3.50'	**15.0" Round Culvert** L= 102.0' Ke= 0.500 Inlet / Outlet Invert= 3.50' / 2.99' S= 0.0050 '/' Cc= 0.900 n= 0.011, Flow Area= 1.23 sf
#2	Device 1	4.52'	**24.0" W x 4.0" H Vert. 24" x 4" Slot** C= 0.600
#3	Device 1	5.45'	**2.5" Vert. 2.5" Orifice** C= 0.600
#4	Device 1	6.00'	**2.0' long x 0.5' breadth 24" x 6" Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#5	Discarded	3.00'	**1.140 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 1.00' Phase-In= 0.01'

Discarded OutFlow Max=0.10 cfs @ 12.18 hrs HW=5.24' (Free Discharge)
└─**5=Exfiltration** (Controls 0.10 cfs)

Primary OutFlow Max=2.38 cfs @ 12.18 hrs HW=5.24' (Free Discharge)
└─**1=Culvert** (Passes 2.38 cfs of 5.51 cfs potential flow)
  ├─**2=24" x 4" Slot** (Orifice Controls 2.38 cfs @ 3.57 fps)
  ├─**3=2.5" Orifice** (Controls 0.00 cfs)
  └─**4=24" x 6" Weir** (Controls 0.00 cfs)

Pond B-1: Proposed Underground Infiltration Basin - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

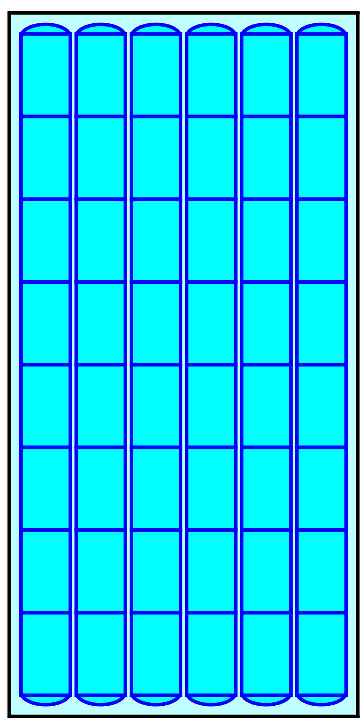
8 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 58.58' Row Length +12.0" End Stone x 2 = 60.58' Base Length
6 Rows x 51.0" Wide + 6.0" Spacing x 5 + 12.0" Side Stone x 2 = 30.00' Base Width
6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

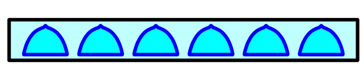
48 Chambers x 45.9 cf = 2,205.1 cf Chamber Storage

6,360.5 cf Field - 2,205.1 cf Chambers = 4,155.4 cf Stone x 40.0% Voids = 1,662.2 cf Stone Storage

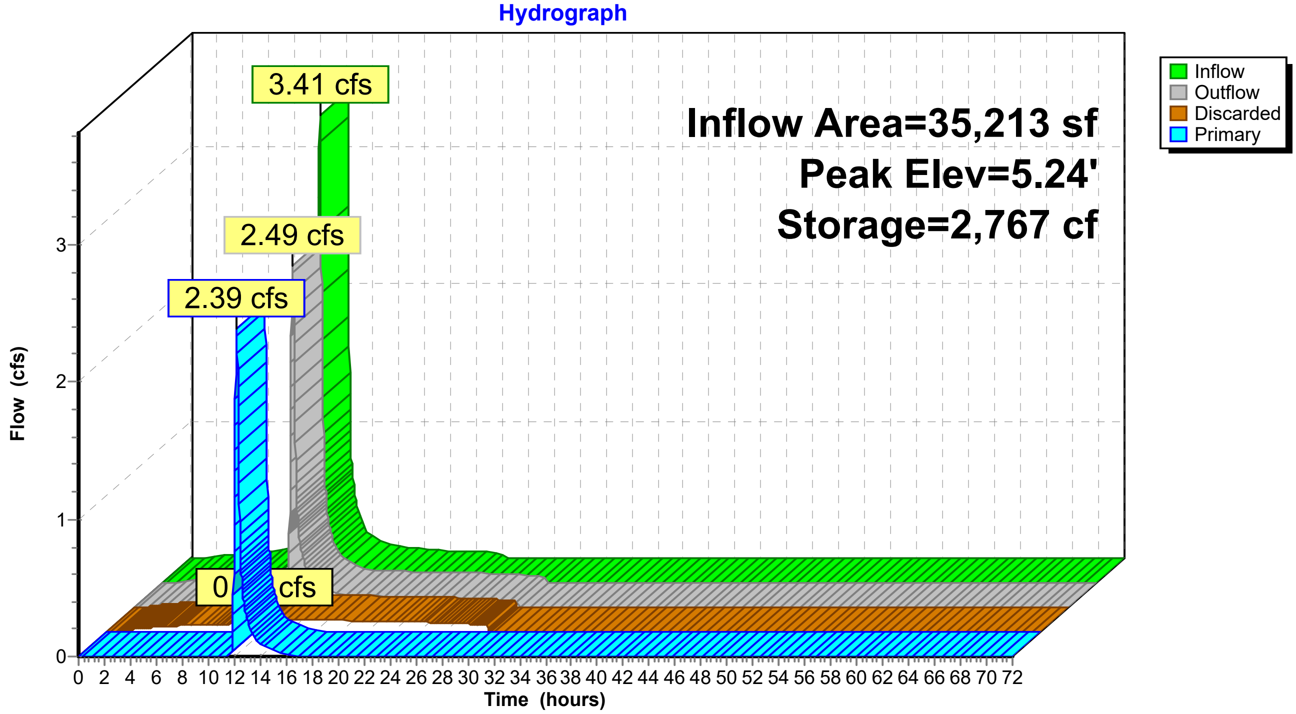
Chamber Storage + Stone Storage = 3,867.3 cf = 0.089 af
Overall Storage Efficiency = 60.8%
Overall System Size = 60.58' x 30.00' x 3.50'

48 Chambers
235.6 cy Field
153.9 cy Stone

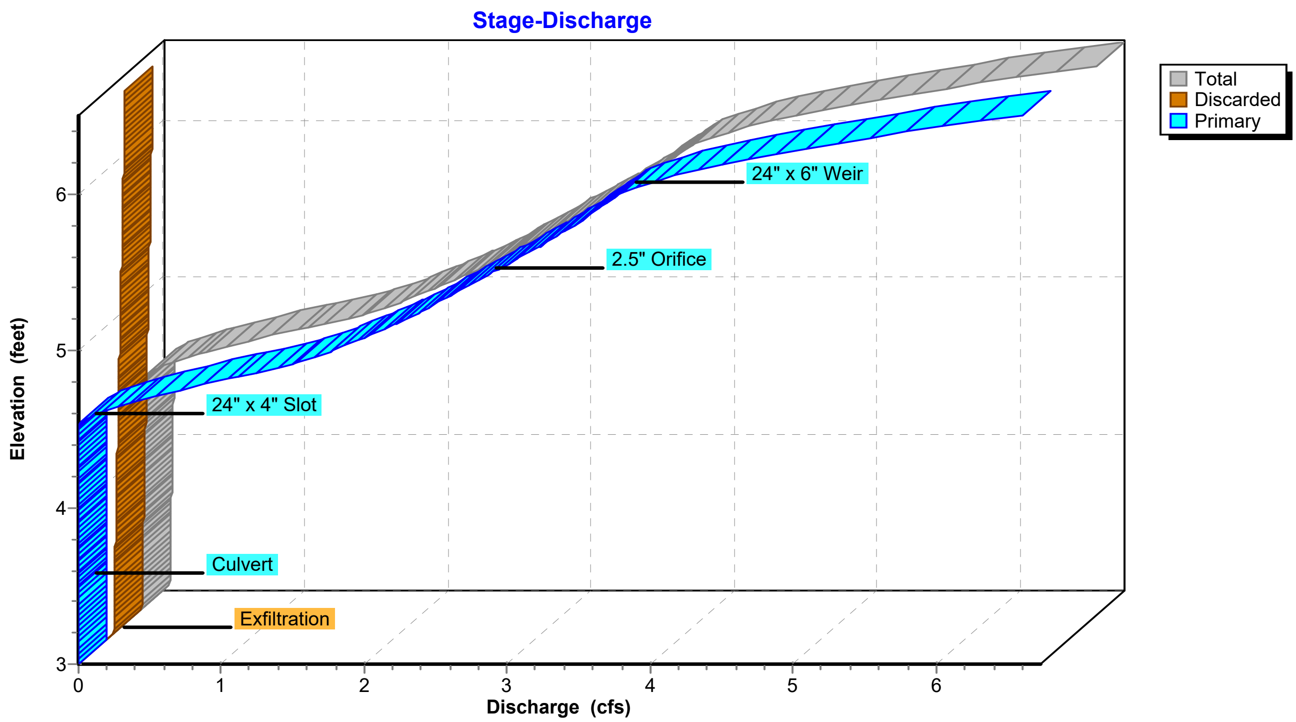




Pond B-1: Proposed Underground Infiltration Basin



Pond B-1: Proposed Underground Infiltration Basin



Hydrograph for Pond B-1: Proposed Underground Infiltration Basin

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)
0.00	0.00	0	3.00	0.00	0.00	0.00
2.00	0.02	3	3.00	0.02	0.02	0.00
4.00	0.04	5	3.01	0.04	0.04	0.00
6.00	0.05	7	3.01	0.05	0.05	0.00
8.00	0.07	91	3.12	0.05	0.05	0.00
10.00	0.13	390	3.52	0.06	0.06	0.00
12.00	**1.78**	**2,214**	**4.80**	**1.05**	**0.09**	**0.96**
14.00	**0.17**	**1,916**	**4.58**	**0.18**	**0.09**	**0.09**
16.00	0.10	1,859	4.54	0.10	0.08	0.01
18.00	0.06	1,798	4.49	0.08	0.08	0.00
20.00	0.06	1,632	4.37	0.08	0.08	0.00
22.00	0.05	1,434	4.23	0.08	0.08	0.00
24.00	0.04	1,206	4.07	0.07	0.07	0.00
26.00	0.00	718	3.74	0.07	0.07	0.00
28.00	0.00	273	3.38	0.06	0.06	0.00
30.00	0.00	0	3.00	0.00	0.00	0.00
32.00	0.00	0	3.00	0.00	0.00	0.00
34.00	0.00	0	3.00	0.00	0.00	0.00
36.00	0.00	0	3.00	0.00	0.00	0.00
38.00	0.00	0	3.00	0.00	0.00	0.00
40.00	0.00	0	3.00	0.00	0.00	0.00
42.00	0.00	0	3.00	0.00	0.00	0.00
44.00	0.00	0	3.00	0.00	0.00	0.00
46.00	0.00	0	3.00	0.00	0.00	0.00
48.00	0.00	0	3.00	0.00	0.00	0.00
50.00	0.00	0	3.00	0.00	0.00	0.00
52.00	0.00	0	3.00	0.00	0.00	0.00
54.00	0.00	0	3.00	0.00	0.00	0.00
56.00	0.00	0	3.00	0.00	0.00	0.00
58.00	0.00	0	3.00	0.00	0.00	0.00
60.00	0.00	0	3.00	0.00	0.00	0.00
62.00	0.00	0	3.00	0.00	0.00	0.00
64.00	0.00	0	3.00	0.00	0.00	0.00
66.00	0.00	0	3.00	0.00	0.00	0.00
68.00	0.00	0	3.00	0.00	0.00	0.00
70.00	0.00	0	3.00	0.00	0.00	0.00
72.00	0.00	0	3.00	0.00	0.00	0.00

Stage-Area-Storage for Pond B-1: Proposed Underground Infiltration Basin

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
3.00	**1,817**	0
3.05	1,817	36
3.10	1,817	73
3.15	1,817	109
3.20	1,817	145
3.25	1,817	182
3.30	1,817	218
3.35	1,817	254
3.40	1,817	291
3.45	1,817	327
3.50	1,817	363
3.55	1,817	438
3.60	1,817	512
3.65	1,817	587
3.70	1,817	661
3.75	1,817	735
3.80	1,817	808
3.85	1,817	882
3.90	1,817	955
3.95	1,817	1,028
4.00	1,817	1,100
4.05	1,817	1,173
4.10	1,817	1,245
4.15	1,817	1,316
4.20	1,817	1,388
4.25	1,817	1,459
4.30	1,817	1,529
4.35	1,817	1,599
4.40	1,817	1,669
4.45	1,817	1,738
4.50	1,817	1,807
4.55	1,817	1,876
4.60	1,817	1,944
4.65	1,817	2,011
4.70	1,817	2,078
4.75	1,817	2,145
4.80	1,817	2,211
4.85	1,817	2,276
4.90	1,817	2,341
4.95	1,817	2,405
5.00	1,817	2,468
5.05	1,817	2,531
5.10	1,817	2,593
5.15	1,817	2,655
5.20	1,817	2,715
5.25	1,817	2,775
5.30	1,817	2,833
5.35	1,817	2,891
5.40	1,817	2,948
5.45	1,817	3,003
5.50	1,817	3,058
5.55	1,817	3,111
5.60	1,817	3,163
5.65	1,817	3,213
5.70	1,817	3,261
5.75	1,817	3,306
5.80	1,817	3,349
5.85	1,817	3,390
5.90	1,817	3,429
5.95	1,817	3,467
6.00	1,817	3,504
6.05	1,817	3,540
6.10	1,817	3,577
6.15	1,817	3,613
6.20	1,817	3,649
6.25	1,817	3,686
6.30	1,817	3,722
6.35	1,817	3,758
6.40	1,817	3,795
6.45	1,817	3,831
6.50	1,817	**3,867**

Time span=0.00-72.00 hrs, dt=0.02 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment E-1: Existing Drainage Runoff Area=35,212 sf 44.99% Impervious Runoff Depth=5.88"
Tc=6.0 min CN=61/98 Runoff=5.39 cfs 17,241 cf

Subcatchment P-1D: Proposed Drainage Runoff Area=35,213 sf 77.48% Impervious Runoff Depth=7.32"
Tc=6.0 min CN=61/98 Runoff=6.40 cfs 21,478 cf

Pond B-1: Proposed Underground Infiltration Peak Elev=6.28' Storage=3,704 cf Inflow=6.40 cfs 21,478 cf
Discarded=0.13 cfs 8,046 cf Primary=5.01 cfs 13,432 cf Outflow=5.13 cfs 21,478 cf

Total Runoff Area = 70,425 sf Runoff Volume = 38,719 cf Average Runoff Depth = 6.60"
38.77% Pervious = 27,301 sf 61.23% Impervious = 43,124 sf

Summary for Subcatchment E-1: Existing Drainage Overall Site

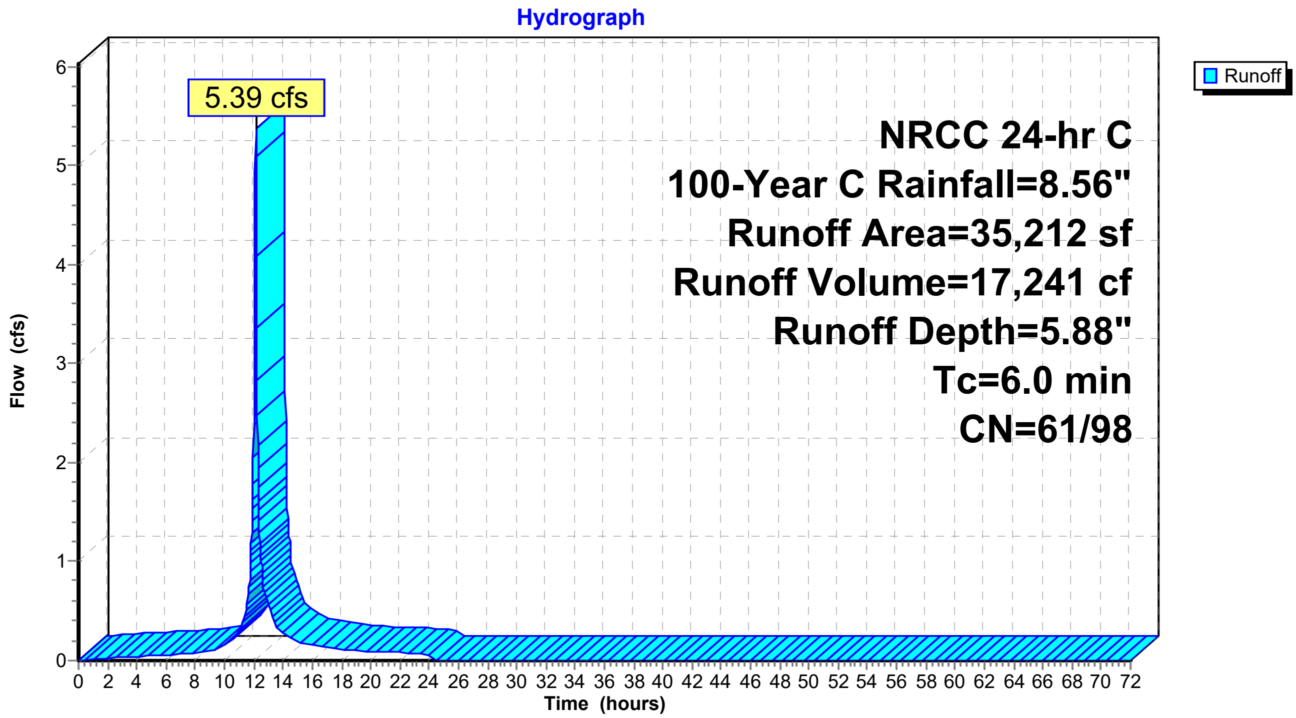
Runoff = 5.39 cfs @ 12.13 hrs, Volume= 17,241 cf, Depth= 5.88"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
NRCC 24-hr C 100-Year C Rainfall=8.56"

Area (sf)	CN	Description
19,371	61	>75% Grass cover, Good, HSG B
15,841	98	Paved parking, HSG B
35,212	78	Weighted Average
19,371	61	55.01% Pervious Area
15,841	98	44.99% Impervious Area

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

Subcatchment E-1: Existing Drainage Overall Site



Summary for Subcatchment P-1D: Proposed Drainage Overall Site

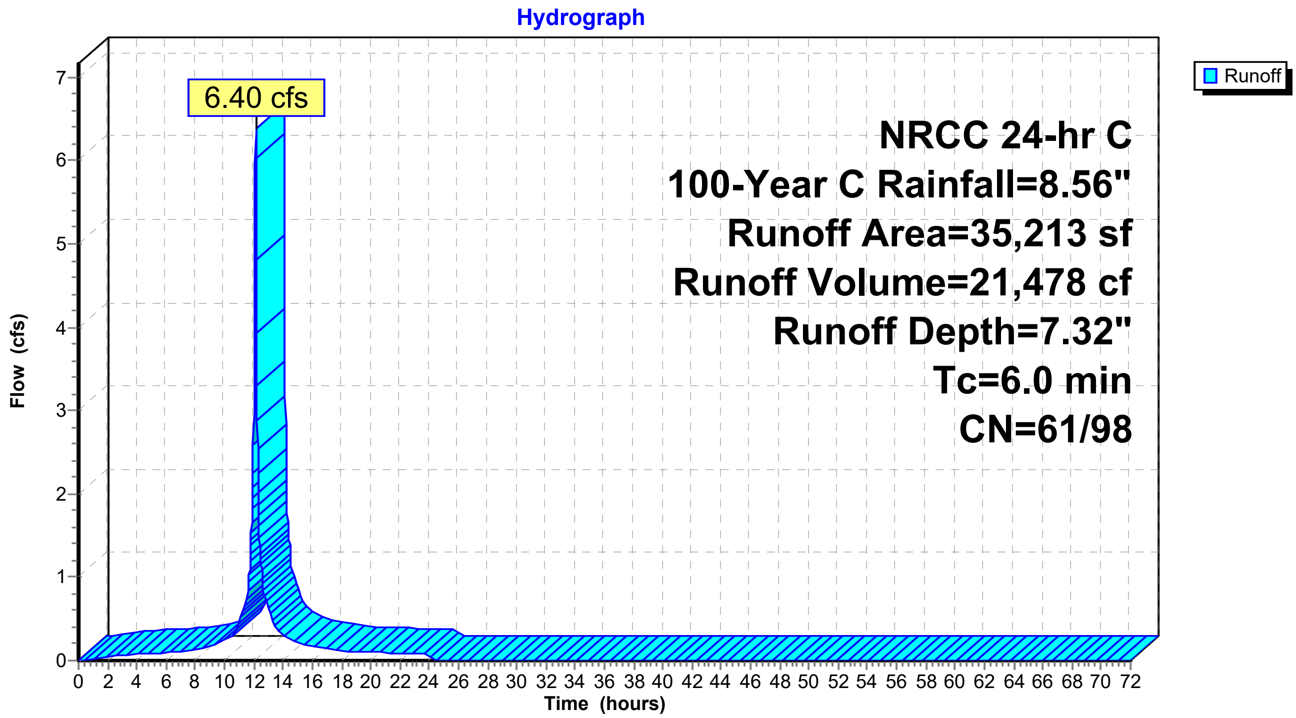
Runoff = 6.40 cfs @ 12.13 hrs, Volume= 21,478 cf, Depth= 7.32"

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
NRCC 24-hr C 100-Year C Rainfall=8.56"

Area (sf)	CN	Description
27,283	98	Paved parking, HSG D
7,930	61	>75% Grass cover, Good, HSG B
35,213	90	Weighted Average
7,930	61	22.52% Pervious Area
27,283	98	77.48% Impervious Area

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

Subcatchment P-1D: Proposed Drainage Overall Site



Summary for Pond B-1: Proposed Underground Infiltration Basin

Inflow Area = 35,213 sf, 77.48% Impervious, Inflow Depth = 7.32" for 100-Year C event
Inflow = 6.40 cfs @ 12.13 hrs, Volume= 21,478 cf
Outflow = 5.13 cfs @ 12.18 hrs, Volume= 21,478 cf, Atten= 20%, Lag= 2.8 min
Discarded = 0.13 cfs @ 12.18 hrs, Volume= 8,046 cf
Primary = 5.01 cfs @ 12.18 hrs, Volume= 13,432 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Peak Elev= 6.28' @ 12.18 hrs Surf.Area= 1,817 sf Storage= 3,704 cf

Plug-Flow detention time= 103.8 min calculated for 21,472 cf (100% of inflow)
Center-of-Mass det. time= 103.9 min (858.2 - 754.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	3.00'	1,662 cf	**30.00'W x 60.58'L x 3.50'H Field A** 6,361 cf Overall - 2,205 cf Embedded = 4,155 cf x 40.0% Voids
#2A	3.50'	2,205 cf	**ADS_StormTech SC-740 +Cap** x 48 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 48 Chambers in 6 Rows
		3,867 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	3.50'	**15.0" Round Culvert** L= 102.0' Ke= 0.500 Inlet / Outlet Invert= 3.50' / 2.99' S= 0.0050 '/' Cc= 0.900 n= 0.011, Flow Area= 1.23 sf
#2	Device 1	4.52'	**24.0" W x 4.0" H Vert. 24" x 4" Slot** C= 0.600
#3	Device 1	5.45'	**2.5" Vert. 2.5" Orifice** C= 0.600
#4	Device 1	6.00'	**2.0' long x 0.5' breadth 24" x 6" Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#5	Discarded	3.00'	**1.140 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 1.00' Phase-In= 0.01'

Discarded OutFlow Max=0.13 cfs @ 12.18 hrs HW=6.27' (Free Discharge)
└─**5=Exfiltration** (Controls 0.13 cfs)

Primary OutFlow Max=4.97 cfs @ 12.18 hrs HW=6.27' (Free Discharge)
└─**1=Culvert** (Passes 4.97 cfs of 7.84 cfs potential flow)
  ├─**2=24" x 4" Slot** (Orifice Controls 4.04 cfs @ 6.05 fps)
  ├─**3=2.5" Orifice** (Orifice Controls 0.14 cfs @ 4.07 fps)
  └─**4=24" x 6" Weir** (Weir Controls 0.79 cfs @ 1.47 fps)

Pond B-1: Proposed Underground Infiltration Basin - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

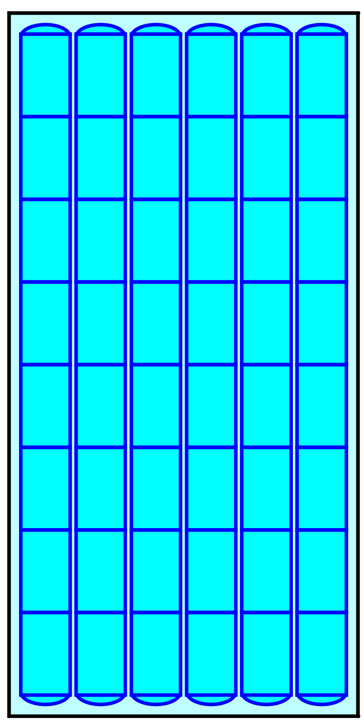
8 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 58.58' Row Length +12.0" End Stone x 2 = 60.58' Base Length
6 Rows x 51.0" Wide + 6.0" Spacing x 5 + 12.0" Side Stone x 2 = 30.00' Base Width
6.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.50' Field Height

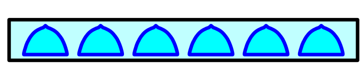
48 Chambers x 45.9 cf = 2,205.1 cf Chamber Storage

6,360.5 cf Field - 2,205.1 cf Chambers = 4,155.4 cf Stone x 40.0% Voids = 1,662.2 cf Stone Storage

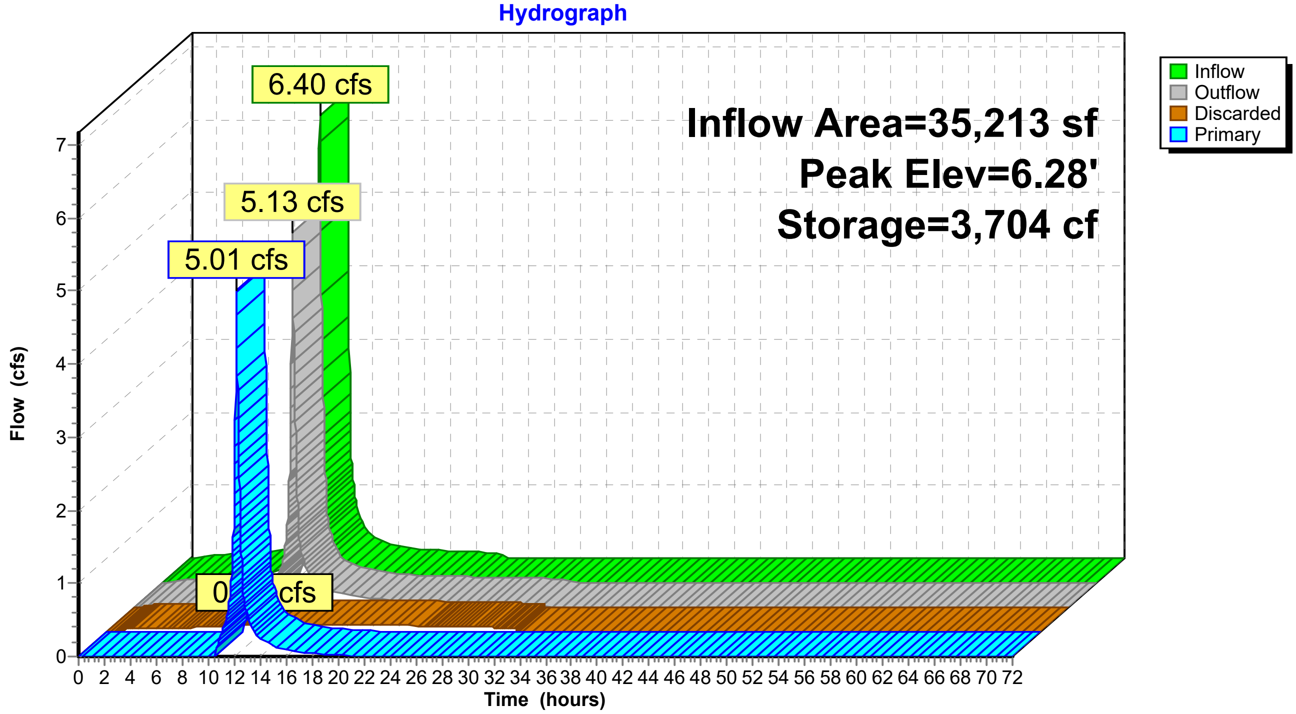
Chamber Storage + Stone Storage = 3,867.3 cf = 0.089 af
Overall Storage Efficiency = 60.8%
Overall System Size = 60.58' x 30.00' x 3.50'

48 Chambers
235.6 cy Field
153.9 cy Stone

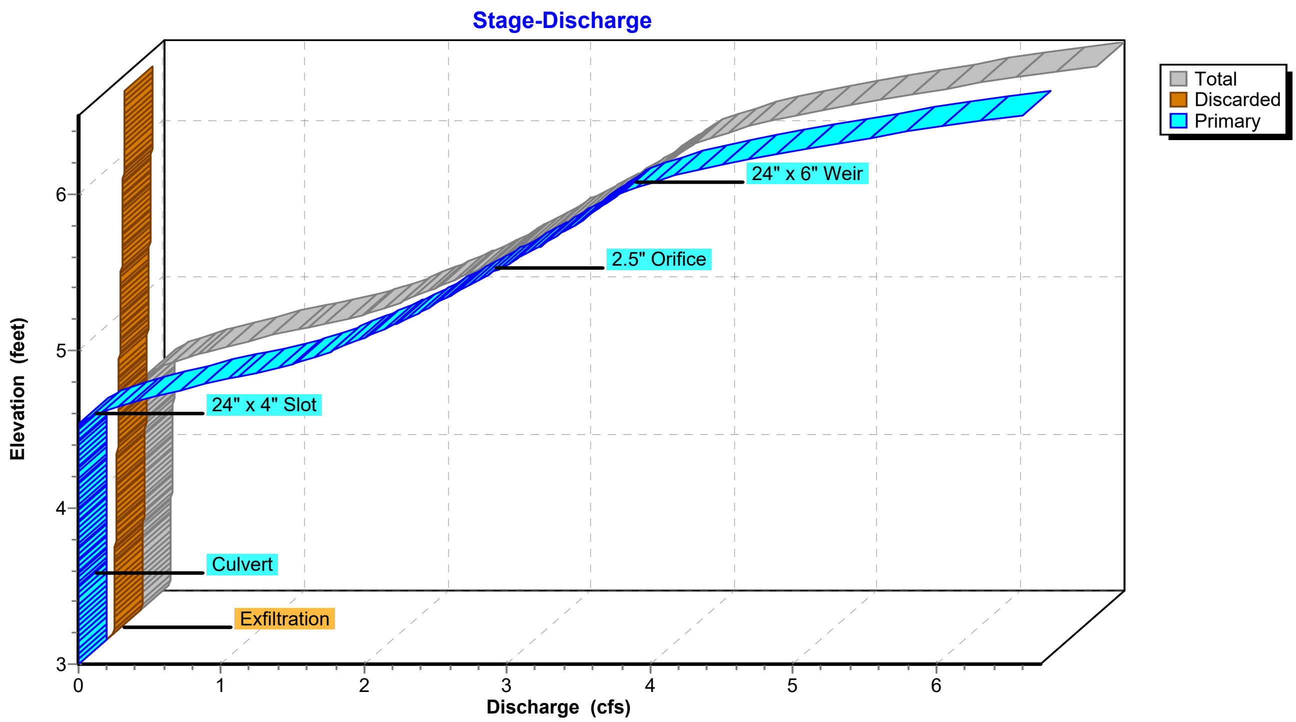




Pond B-1: Proposed Underground Infiltration Basin



Pond B-1: Proposed Underground Infiltration Basin



Hydrograph for Pond B-1: Proposed Underground Infiltration Basin

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)
0.00	0.00	0	3.00	0.00	0.00	0.00
2.00	0.05	7	3.01	0.05	0.05	0.00
4.00	0.07	99	3.14	0.05	0.05	0.00
6.00	0.09	296	3.41	0.06	0.06	0.00
8.00	0.14	666	3.70	0.06	0.06	0.00
10.00	0.25	1,432	4.23	0.08	0.08	0.00
12.00	**3.35**	**2,597**	**5.10**	**2.15**	**0.10**	**2.06**
14.00	**0.31**	**1,986**	**4.63**	**0.33**	**0.09**	**0.24**
16.00	0.18	1,917	4.58	0.18	0.09	0.09
18.00	0.12	1,881	4.55	0.13	0.09	0.04
20.00	0.10	1,863	4.54	0.10	0.08	0.02
22.00	0.09	1,848	4.53	0.09	0.08	0.01
24.00	0.07	1,812	4.50	0.08	0.08	0.00
26.00	0.00	1,265	4.11	0.07	0.07	0.00
28.00	0.00	759	3.77	0.07	0.07	0.00
30.00	0.00	308	3.42	0.06	0.06	0.00
32.00	0.00	0	3.00	0.00	0.00	0.00
34.00	0.00	0	3.00	0.00	0.00	0.00
36.00	0.00	0	3.00	0.00	0.00	0.00
38.00	0.00	0	3.00	0.00	0.00	0.00
40.00	0.00	0	3.00	0.00	0.00	0.00
42.00	0.00	0	3.00	0.00	0.00	0.00
44.00	0.00	0	3.00	0.00	0.00	0.00
46.00	0.00	0	3.00	0.00	0.00	0.00
48.00	0.00	0	3.00	0.00	0.00	0.00
50.00	0.00	0	3.00	0.00	0.00	0.00
52.00	0.00	0	3.00	0.00	0.00	0.00
54.00	0.00	0	3.00	0.00	0.00	0.00
56.00	0.00	0	3.00	0.00	0.00	0.00
58.00	0.00	0	3.00	0.00	0.00	0.00
60.00	0.00	0	3.00	0.00	0.00	0.00
62.00	0.00	0	3.00	0.00	0.00	0.00
64.00	0.00	0	3.00	0.00	0.00	0.00
66.00	0.00	0	3.00	0.00	0.00	0.00
68.00	0.00	0	3.00	0.00	0.00	0.00
70.00	0.00	0	3.00	0.00	0.00	0.00
72.00	0.00	0	3.00	0.00	0.00	0.00

Stage-Area-Storage for Pond B-1: Proposed Underground Infiltration Basin

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
3.00	**1,817**	0
3.05	1,817	36
3.10	1,817	73
3.15	1,817	109
3.20	1,817	145
3.25	1,817	182
3.30	1,817	218
3.35	1,817	254
3.40	1,817	291
3.45	1,817	327
3.50	1,817	363
3.55	1,817	438
3.60	1,817	512
3.65	1,817	587
3.70	1,817	661
3.75	1,817	735
3.80	1,817	808
3.85	1,817	882
3.90	1,817	955
3.95	1,817	1,028
4.00	1,817	1,100
4.05	1,817	1,173
4.10	1,817	1,245
4.15	1,817	1,316
4.20	1,817	1,388
4.25	1,817	1,459
4.30	1,817	1,529
4.35	1,817	1,599
4.40	1,817	1,669
4.45	1,817	1,738
4.50	1,817	1,807
4.55	1,817	1,876
4.60	1,817	1,944
4.65	1,817	2,011
4.70	1,817	2,078
4.75	1,817	2,145
4.80	1,817	2,211
4.85	1,817	2,276
4.90	1,817	2,341
4.95	1,817	2,405
5.00	1,817	2,468
5.05	1,817	2,531
5.10	1,817	2,593
5.15	1,817	2,655
5.20	1,817	2,715
5.25	1,817	2,775
5.30	1,817	2,833
5.35	1,817	2,891
5.40	1,817	2,948
5.45	1,817	3,003
5.50	1,817	3,058
5.55	1,817	3,111
5.60	1,817	3,163
5.65	1,817	3,213
5.70	1,817	3,261
5.75	1,817	3,306
5.80	1,817	3,349
5.85	1,817	3,390
5.90	1,817	3,429
5.95	1,817	3,467
6.00	1,817	3,504
6.05	1,817	3,540
6.10	1,817	3,577
6.15	1,817	3,613
6.20	1,817	3,649
6.25	1,817	3,686
6.30	1,817	3,722
6.35	1,817	3,758
6.40	1,817	3,795
6.45	1,817	3,831
6.50	1,817	**3,867**

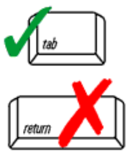
APPENDIX E
STORMWATER MANAGEMENT CHECKLIST

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.

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature

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 (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 (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 (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 (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 (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.

APPENDIX F
TSS REMOVAL CALCULATIONS

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

Version 1, Automated: Mar. 4, 2008

Location: New Bedford, MA

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Infiltration Basin	**0.80**	**1.00**	**0.80**	**0.20**
	0.00	**0.20**	**0.00**	**0.20**
	0.00	**0.20**	**0.00**	**0.20**
	0.00	**0.20**	**0.00**	**0.20**
	0.00	**0.20**	**0.00**	**0.20**

Total TSS Removal = 80%

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

Project: **0 & 8 Mitchell Street & 171 Coggeshall Street**
Prepared By: **Jake Modestow**
Date: **7/1/2021**

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

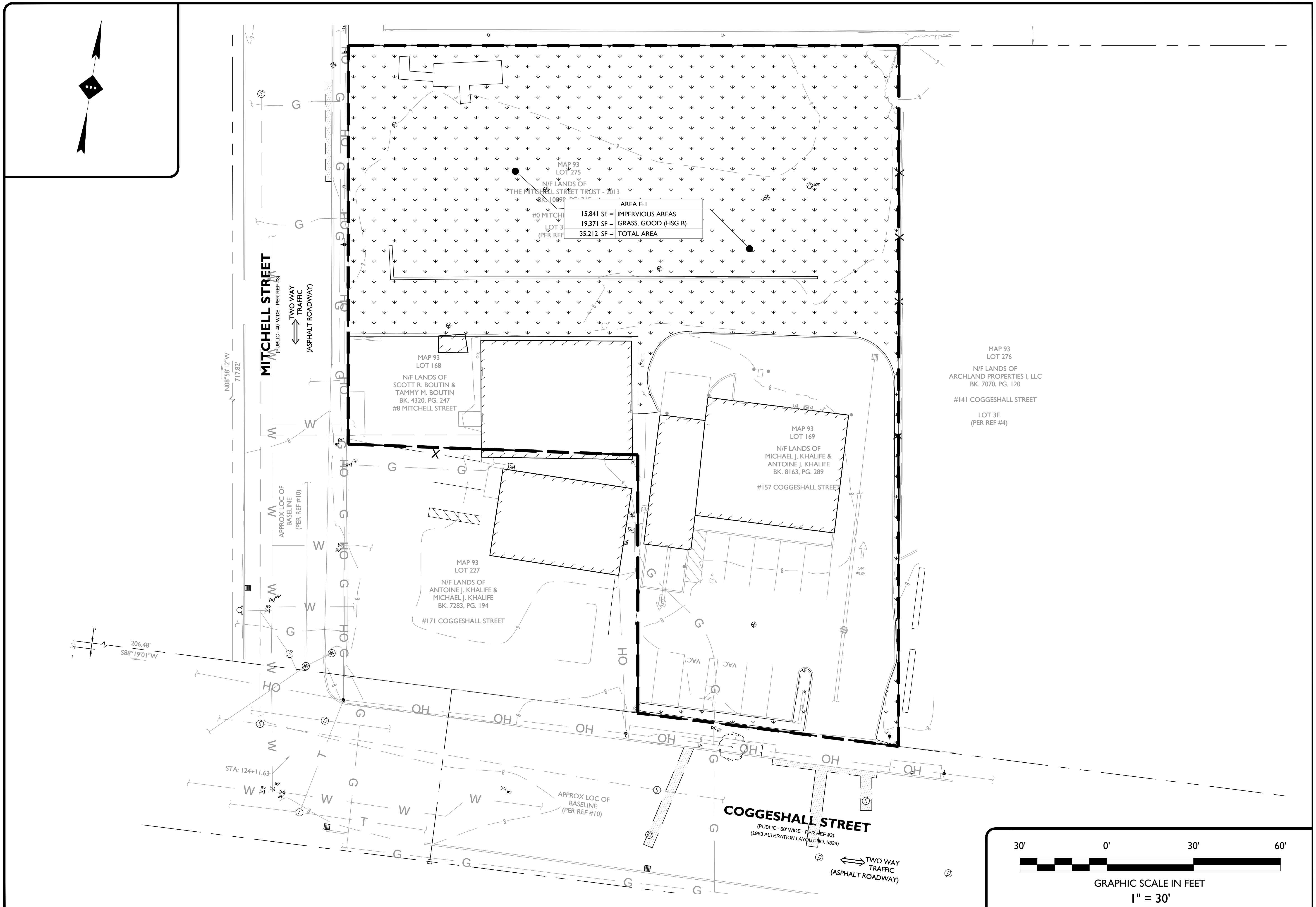
Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

APPENDIX G
DRAINAGE AREA MAPS

INVENTORY

EXISTING DRAINAGE AREA MAP

PROPOSED DRAINAGE AREA MAP



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OFFICE: 248.646.9999
FAX: 248.646.9998

DRAINAGE AREA MAPS

PROPOSED STARBUCKS WITH DRIVE-THRU FACILITIES

BLOCK 93, LOTS 168, 169, & 275
0 & 8 MITCHELL STREET & 171 COGGESHALL STREET
CITY OF NEW BEDFORD
BRISTOL COUNTY, MASSACHUSETTS

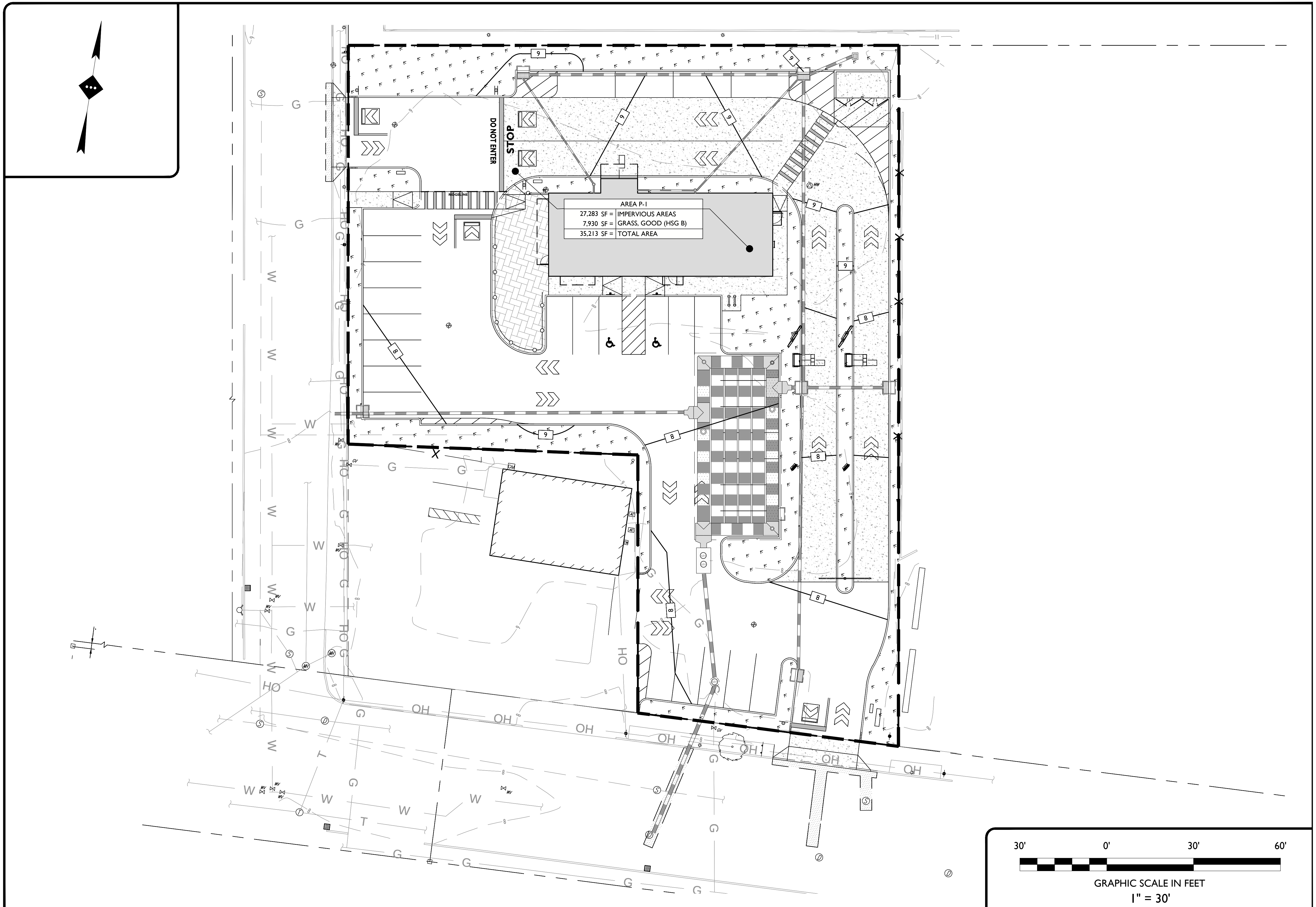
JAKE MODESTOW, P.E.
MASSACHUSETTS LICENSE No. 6201065336
LICENSED PROFESSIONAL ENGINEER

NOT APPROVED FOR CONSTRUCTION

DRAWN BY:	CMG
CHECKED BY:	DM
DATE:	06/22/2021
SCALE: (H)	1" = 30'
PROJECT ID:	BOS-200026

TITLE:
DRAINAGE AREA MAPS (EXISTING)

SHEET:
1 OF 2



Z:\Boston\BOS\2020\BOS-200026-Alrig-NEC Coggeshall Street & Mitchell Street, New Bedford, MA\CADD\Exhibits\2021-06-22 (HS) Drainage Area Maps.dwg

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DRAINAGE AREA MAPS

PROPOSED STARBUCKS WITH DRIVE-THRU FACILITIES

BLOCK 93, LOTS 168, 169, & 275
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DRAWN BY: CMG
CHECKED BY: DM
DATE: 06/22/2021
SCALE: (H) 1" = 30'
PROJECT ID: BOS-200026

TITLE:

DRAINAGE AREA MAPS (PROPOSED)

SHEET: