STORMWATER REPORT

Site Improvements for Buttonwood Community Center New Bedford, Massachusetts

Prepared for

TOWN OF NEW BEDFORD DEPARTMENT OF PUBLIC WORKS

June 17, 2021

Prepared by

GREEN INTERNATIONAL AFFILIATES, INC.
Civil and Structural Engineers

Building Strong Client Relationships Through Engineering Excellence

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EXECUTIVE SUMMARY

On behalf of The City of New Bedford (Applicant), Green International Affiliates, Inc. (Green) is submitting this Stormwater Management Report to accompany the Notice of Intent Application to the New Bedford Conservation Commission for parking lot and drainage improvements at the Buttonwood Community Center located at One Oneida Street in the City of New Bedford.

This project consists of a redesign of the Buttonwood Community Center to incorporate stormwater mitigation as well as sidewalk improvements and a new access pathway to Buttonwood Park Pond. The proposed improvements will result in an increase of impervious area. As this project is both redeveloping the existing parking area and adding new sidewalks, it is therefore categorized as a "Mix of New Development and Redevelopment" under the Massachusetts Stormwater Standards. The project will meet the stormwater management standards to the full extent.

This project provides an opportunity to improve existing drainage and improve the quality of stormwater runoff discharged to the pond through the installation of practical Best Management Practices (BMPs). The goal of the proposed stormwater improvements is to reduce erosion due to runoff into the pond and to improve the quality of discharged stormwater.

The following report was created in accordance with the "Massachusetts Stormwater Handbook" last revised in January 2008. The report is organized into sections that correspond to the categories listed in the "Massachusetts Stormwater Report Checklist". The checklist is included in *Appendix A* of this report. The following is a more detailed description of the existing and proposed drainage areas and the design methodology for this project.

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1.0 PROJECT DESCRIPTION

This Stormwater Report has been prepared for the proposed site improvements at the Buttonwood Community Center located at One Oneida Street in the City of New Bedford. The total site area is approximately 82,800 square feet (1.9 acres). The community center and surrounding Buttonwood Park are owned and maintained by the City of New Bedford.

The existing site features of the Buttonwood Community Center consist of lawn area, and Buttonwood Park Pond in the western portion of the site. The eastern portion of the site is lawn area that abuts a baseball field. The center of the site consists of Oneida Street which is a two-lane roadway with parking along portions of both sides. Oneida Street has parking the full length of the east side and approximately half of the west side of the lot. There are limited sidewalks within the site. The sidewalks are located at the community center and at the intersection of Oneida and Fuller Parkway. The existing site slopes from east to west and discharges to the Buttonwood Park Pond. There is only one catch basin on site, and it is fully clogged. The existing site mostly travels via sheet flow and overland flow. There are locations throughout the site that have eroded due to minimal drainage infrastructure.

This project will provide an updated layout to the current parking area, new sidewalks, improved storm water treatment, picnic areas and improved access to the pond area. Updates to the parking area will provide improved grading and drainage that will reduce erosion to the existing lawn areas on the west side of the site. These improvements will help minimize ice patches that currently form in the lot during the winter. New striping will improve handicap parking accommodations on site as well as provide a new crosswalk from the field area to the community center entrance. New sidewalks will be installed throughout the project allowing for safer pedestrian access from both Lake Street and Fuller Parkway. Water quality from stormwater runoff will be significantly improved with this project using stormwater Best Management Practices (BMPs). There will be two bioretention basins installed that will be pretreated by crushed stone diaphragms. The bioretention basins will be installed in the lawn area to the north and south of the community center. The project will treat and collect stormwater from the updated parking area, sidewalks, partial roof area, and fields to the east. This will provide improved water quality and peak rate attenuation into Buttonwood Park Pond. The implementation of BMP's will also help to improve the existing picnic areas around the Community Center by reducing erosion. Several new picnic tables and benches will be added including a handicap accessible table. All improvements will allow for the Community Center to meet the needs of all community members who use the facility. The improved Community Center site will provide a safer environment for all and serve as a welcoming entrance to the Buttonwood Pond area.

As this project is both redeveloping the existing parking areas and adding new sidewalks, it is therefore categorized as a "Mix of New Development and Redevelopment" under the Massachusetts Stormwater Standards.

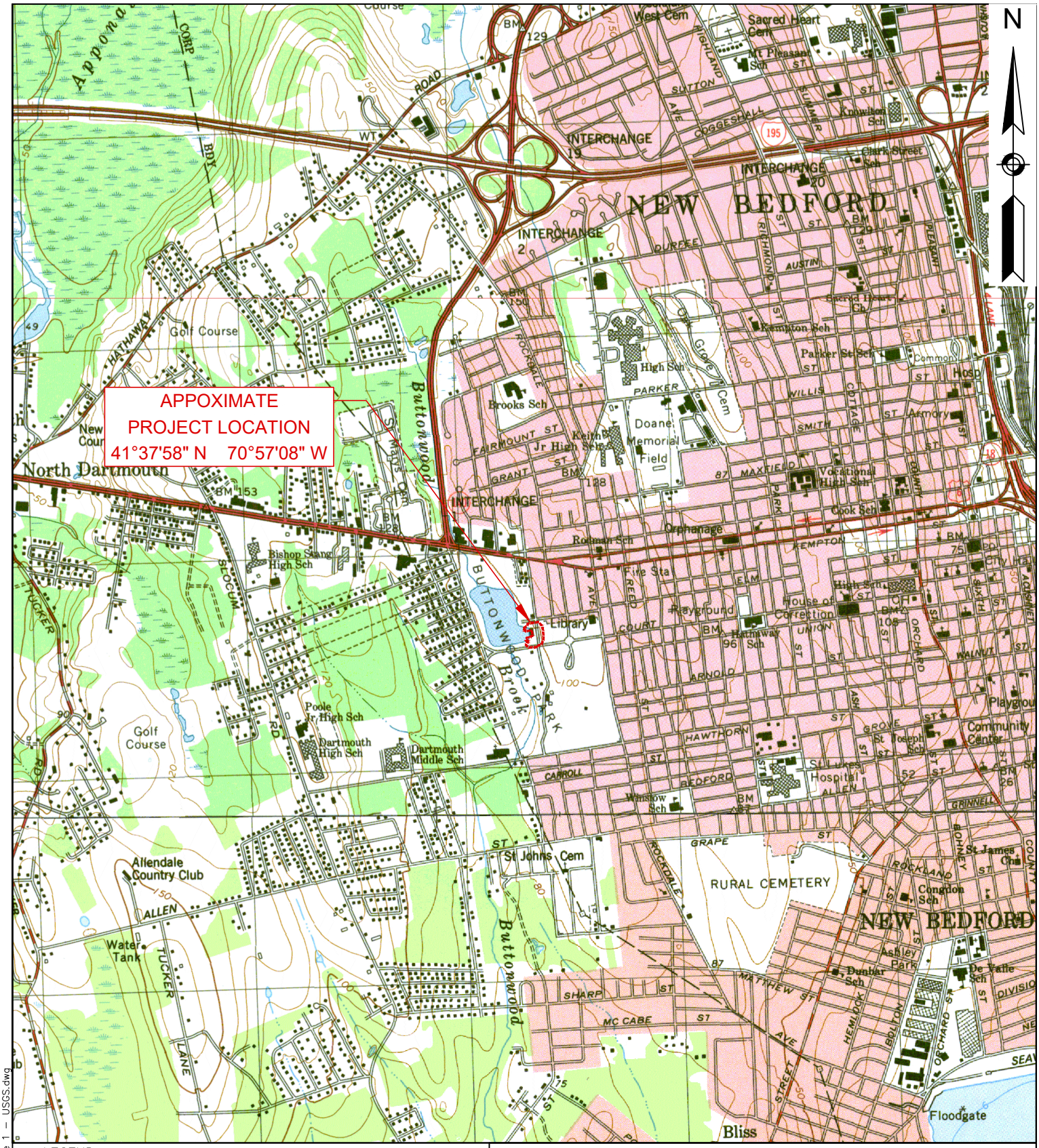
1.1 Topography, Geology and Soils

The general topography of the site slopes from the east to west towards Buttonwood Park Pond. The Natural Resources Conservation Service (NRCS) Soil Survey of Bristol County, Massachusetts defines the soils within the limit of work. Table 1.1 lists soil designations, soil names and the hydrological soil groups. See Figure 3 - Soils Map for location of soils within the site. Appendix D contains a soils report generated using the NRCS website containing soil definitions for the soils within the analyzed watershed.

Table 1.1 – NRCS Soil Classification

Map Designation State/Publ. Sym.	Soil Name	Hydrologic Soil Group
70A	Ridgebury fine sandy loam, 0 to 3 percent slopes	D
71A	Ridgebury fine sandy loam, 0 to 3 percent slopes, extremely stony	D
72A	Whitman fine sandy loam, 0 to 3 percent slopes	D
73A	Whitman fine sandy loam, 0 to 3 percent slopes, extremely stony	D
305B	Paxton fine sandy loam, 3 to 8 percent slopes	C
306B	Paxton fine sandy loam, 3 to 8 percent slopes, very stony	C
310B	Woodbridge fine sandy loam, 3 to 8 percent slopes	C/D
311B	Woodbridge fine sandy loam, 0 to 8 percent slopes, very stony	C/D
312B	Woodbridge fine sandy loam, 0 to 8 percent slopes, extremely stony	C/D
602	Urban Land	
1	Water	

Two test pits were excavated by the City of New Bedford Department of Public Works on 05/19/2021 and observed and analyzed by GEI Consultants. Both TP1 and TP2 did not encounter any groundwater although mottling was encountered in TP2 at a depth of approximately 4 feet (elevation 92.70').



LEGEND

APPROXIMATE PROJECT LOCATION

NOTE: DATA TAKEN FROM MASSGIS

SCALE IN FEET

1000 0 1000 2000

1" = 2000'

ELEVATIONS IN METERS

USGS LOCUS MAP

BUTTONWOOD PARK COMMUNITY CENTER
SITE IMPROVEMENTS
NEW BEDFORD, MASSACHUSETTS

PREPARED BY:
GREEN INTERNATIONAL AFFILIATES, INC.
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PREPARED FOR:
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133 WILLIAM STREET
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SCALE: AS NOTED	PROJECT NO. 21002
DATE: 5/26/2021	DRAWN BY: OF
REVISED:	CHECKED BY: OF

FIGURE 1

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LEGEND

APPROXIMATE PROJECT LOCATION

SCALE IN FEET

50 0 50 100

1" =100'

NOTE: DATA TAKEN FROM MASSGIS

AERIAL LOCUS MAP

BUTTONWOOD PARK COMMUNITY CENTER
SITE IMPROVEMENTS
NEW BEDFORD, MASSACHUSETTS

PREPARED BY:
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SCALE: AS NOTED | PROJECT NO. 21002

DATE: 5/26/2021 | DRAWN BY: OF
REVISED: | CHECKED BY: DS

FIGURE 2

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LEGEND

APPROXIMATE PROJECT LOCATION

NRCS SOIL SURVEY BOUNDARY

317C NRCS SOIL SURVEY SYMBOL

NOTE: MAP INFORMATION TAKEN FROM MASSGIS AND SOILS INFORMATION TAKEN FROM NRCS WEB SOIL SURVEY FOR BRISTOL COUNTY

SCALE IN FEET

50 0 50 100

1" =100'

SOILS MAP

STORMWATER MANAGEMENT AND SITE IMPROVEMENTS
BUTTONWOOD PARK SENIOR CENTER
NEW BEDFORD, MASSACHUSETTS

PREPARED BY:
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SCALE: AS NOTED | PROJECT NO. 21002

DATE: 5/26/2021 | DRAWN BY: OF

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FIGURE 5

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2.0 LOW IMPACT DEVELOPMENT MEASURES CONSIDERED

The Massachusetts Stormwater Management Regulations require that the project consider environmentally sensitive site design and Low Impact Development (LID) techniques to manage stormwater.

Key features of LID stormwater management systems include implementing practices that maintain a site's existing hydrology, using decentralized practices to manage stormwater close to the source of generation, and maximizing onsite infiltration to reduce runoff and landscape watering requirements.

The following are the LID site planning and design strategies that have been incorporated into the design.

- Minimize disturbance to existing trees and shrubs
- No disturbance to any Wetland Resource Area
- Bioretention Basins

3.0 STANDARD 1: NO NEW UNTREATED DISCHARGES

The Massachusetts Stormwater Handbook, Standard 1, requires that the project demonstrates that there are no new untreated discharges and that new discharges will not cause erosion or scour to downstream wetlands.

DP-1 under existing conditions discharges mostly via overland flow to Buttonwood Pond. There is one catch basin on-site in the parking area that discharges via a 12" pipe to Buttonwood Park; however, the catch basin is full of debris. DP-2 discharges to an existing combined sewer and drainage system on Fuller Parkway.

To improve existing conditions, a large portion of the site's stormwater runoff will be directed to two bioretention basins for treatment prior to discharging to Buttonwood Pond (DP-1). DP-2 will follow existing drainage patterns and discharge to a closed combined system within Fuller Parkway.

There are two new point source discharge points. Both point source discharges will be treated by bioretention basins prior to discharging to Buttonwood Pond.

There are no new untreated point source discharges created because of this project. Therefore, this standard is fully met.

4.0 STANDARD 2: PEAK RATE ATTENUATION

Standard 2 requires that the rates of flow be attenuated for the proposed development condition. The addition of new sidewalks throughout this project will result in a net increase in impervious area.

4.1 Existing Conditions

4.1.1 Existing Contributing Areas

The existing site can be analyzed as three (3) watershed areas that contribute runoff to two (2) discharge points. The existing drainage areas are delineated in Figure 6 – Existing Watershed Plan. For the purpose of this hydrologic analysis, the following assumptions were made:

- When the watershed boundary fell outside of the limit of work an arbitrary line was delineated as the watershed boundary.
- The total watershed area for the existing conditions is used as the comparison base for the watershed area in the proposed conditions.

Under existing conditions, the site mostly discharges to via overland flow or by a catch basin that outfalls to Buttonwood Pond. There are locations where the site discharges to combined sewer and drainage system in Fuller Parkway. These locations were analyzed as Discharge Points during the hydrologic analysis, as indicated on the Figure – 6 Existing Watershed Plan. Brief descriptions of each contributing area are below:

DRAINAGE AREA EDA-1A

This area mostly consists of lawn area including a portion of the field and the lawn area around the community center. It also includes the southern half of Oneida Street. Stormwater runoff travels via overland flow from east to west from the field to the parking lot. Stormwater runoff continues west, and sheets flows over the parking lot into the picnic area. Finally, stormwater travels via overland flow in the picnic area until discharging into Buttonwood Park Pond at DP-1 with little to no treatment. In addition, the runoff between the parking lot and the pond within the picnic area has caused significant erosion.

DRAINAGE AREA EDA-1B

This area mostly consists of lawn area including a portion of the field. It also includes the northern half of Oneida Street and southern half of Lake Street. Stormwater runoff travels via overland flow from east to west from the field to the parking lot. Stormwater runoff continues southwest via a combination of sheet and gutter flow to a catch basin that outfalls to Buttonwood Pond at DP-1. Field observations noted that this catch basin is clogged with debris, but has recently been cleaned; however, the condition of the existing outfall pipe is unknown. For this report this sub catchment was analyzed as it was intended to function.

DRAINAGE AREA EDA-2

This area mostly consists of impervious area from the high point in the parking entrance. Stormwater runoff travels via combination of sheet and gutter onto Fuller Parkway where it eventually enters a combined sewer and drainage system at DP-2.

4.1.2 Peak Discharge Runoff Rates & Volume

The existing peak flow rates, tributary to the design, were calculated for the 2-, 10-, and 100-year storm events. The results are presented in Table 4.3 – Peak Rates of Runoff.

4.2 Proposed Conditions

4.2.1 Proposed Contributing Areas

The proposed stormwater management analysis can be summarized as four (4) watershed areas that contribute runoff to two (2) discharge points. The watershed areas and discharge points are the same in the proposed condition as the existing condition. The proposed drainage areas are delineated in Figure 7 – Proposed Watershed Plan.

Proposed work for this project includes the realigning of the existing parking lot, new sidewalks, new picnic tables, and a new access path to Buttonwood Park Pond. The realigning of the parking lot and new sidewalks will result in a net increase in impervious area. The realigning of the parking lot will include new curbing which will help direct stormwater runoff towards two proposed bioretention basins. The basins will help improve peak rate attenuation and water quality. Runoff from PDA-2 and PDA-1C will all maintain historic drainage patterns. Area from PDA-1A and PDA-1B will now undergo stormwater treatment before discharging to DP-1.

The location was analyzed as a Discharge Point during the hydrologic analysis, as indicated on the Figure - 7 Proposed Watershed Plan. A brief description of the contributing area is below:

DRAINAGE AREA PDA-1A

This area mostly follows the same drainage patterns as EDA-1A. This area mostly consists of lawn area including a portion of the field. It also includes the southern half of Oneida Street. Stormwater runoff travels via overland flow from east to west from the field to the parking lot. Stormwater runoff continues west, and sheets flows over the parking lot into a bioretention basin that is pretreated by a crushed stone diaphragm. Finally, stormwater infiltrates into the ground or overflows via a spillway to Buttonwood Pond at DP-1.

DRAINAGE AREA PDA-1B

This area mostly follows the same drainage patterns as EDA-1B. This area mostly consists of lawn area including a portion of the field. It also includes the northern half of Oneida Street. Stormwater runoff travels via overland flow from east to west from the field to the parking lot. Stormwater runoff continues west, and sheets flows over the parking lot into a bioretention basin that is pretreated by a crushed stone diaphragm. Finally, stormwater infiltrates into the ground or overflows via a beehive grate that outfalls to Buttonwood Pond at DP-1. For larger storm events, the emergency spillway is also used as an overflow.

DRAINAGE AREA PDA-1C

This area mostly follows the same drainage pattern that existed within the lawn area surrounding the community center in EDA-1A. This area mostly consists of the lawn area but also includes portions of both the community center roof and the sidewalks. Stormwater runoff travels to the lawn area via sheet flow from the sidewalk areas and via downspouts on the roof area. All stormwater runoff on the lawn area travels from East to West via overland flow before eventually discharging into Buttonwood Pond at DP-1.

DRAINAGE AREA PDA-2

This area mostly follows the same drainage patterns as EDA-2. This area mostly consists of impervious area from the high point in the parking entrance. Stormwater runoff travels via combination of sheet and gutter onto Fuller Parkway where it eventually enters a combined sewer and drainage system at DP-2.

4.2.2 Peak Discharge Runoff Rates

The peak flow rates were calculated for the 2-, 10-, and 100-year storm events under proposed conditions and compared to the existing peak flow rates. The proposed parking lot realignment and new sidewalks will result in an overall increase of approximately 2,970 square feet of impervious area within the project limits. The increase in impervious area will be attenuated by the two bioretention basin and mitigates peak rates for the 2-, 10- and 100-year storms. Therefore, this standard is fully met.

The following Table 4.3 - Peak Rates of Runoff represents a comparison between existing and proposed conditions of the peak rates of runoff from the proposed development tributary to the discharge point.

Table 4.3 – Peak Rates of Runoff

DISCHARGE POINT		2-YEAR STORM (CFS)	10-YEAR STORM (CFS)	100-YEAR STORM (CFS)	100-YEAR STORM (af)	100-YR NET af increase
DP-1	Existing	6.32	11.96	25.76	2.411	-0.033
	Proposed	5.73	11.36	25.14	2.378	
DP-2	Existing	0.20	0.31	0.55	0.045	-0.009
	Proposed	0.16	0.25	0.45	0.036	

4.3 Methodology and Design Criteria

4.3.1 Hydrologic Model Description

The drainage analysis was performed using the Soil Conservation Service (SCS) TR-55 and TR-20 methodologies and the computer program HydroCAD 10.0 by HydroCAD Software Solutions, LLC.

4.3.2 Design Storms and Rainfall Depth

The analysis was performed on the 2-, 10-, and 100-year frequency rainfall events. Rainfall depths were taken from the NOAA Rainfall Frequency Atlas of the United States (Atlas-14). The events were based on the 24-Hour Type-III duration storm.

The following rainfall depths were used in the calculations:

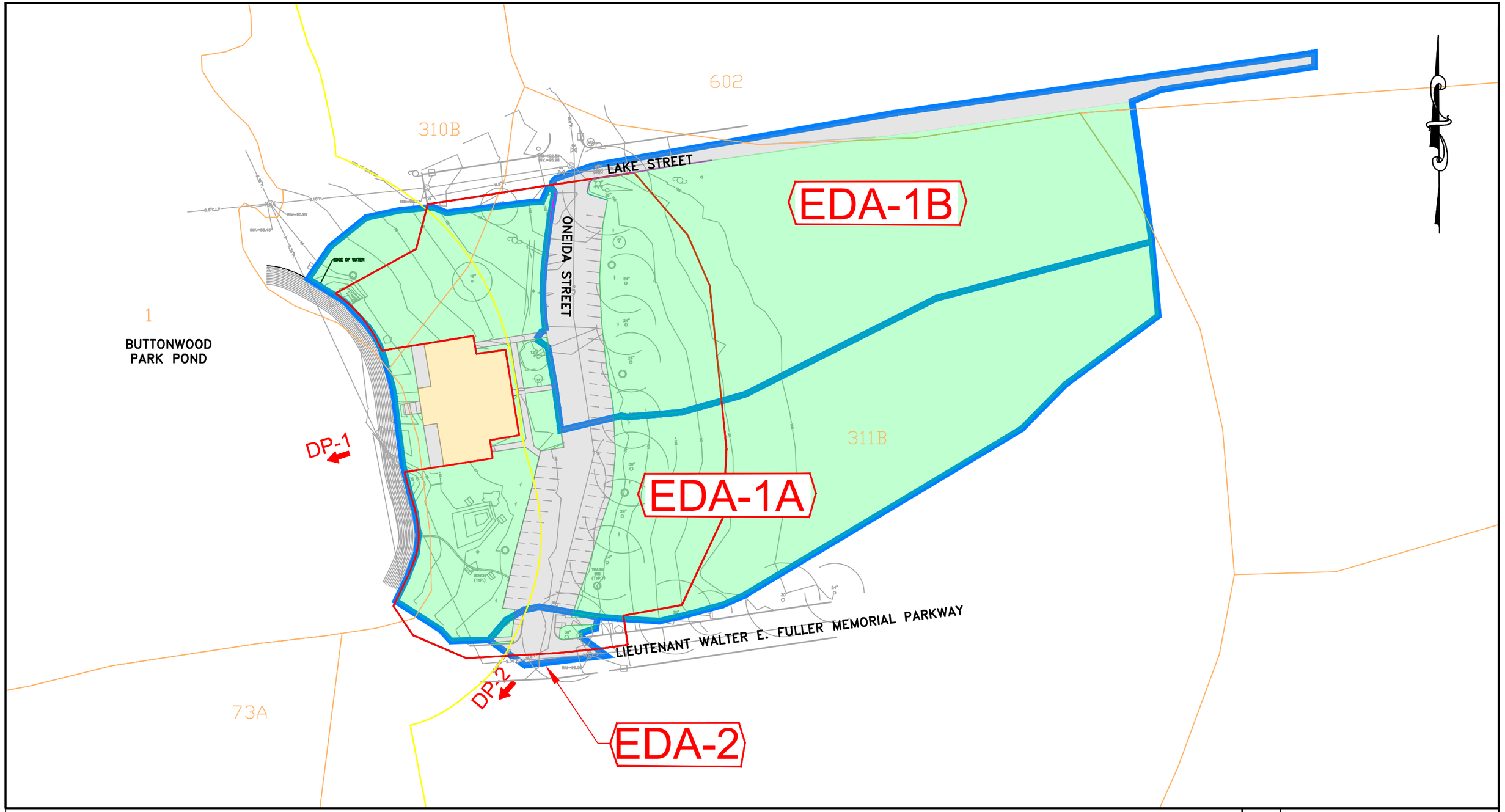
Storm Event	Rainfall Depth
2-Year	3.30 inches
10-Year	4.88 inches
100-Year	8.56 inches

4.3.3 Time of Concentration

The "time of concentration" (T_c) for each watershed was determined by finding the time necessary for runoff to travel from the hydraulically most distant point in the watershed to the point of concentration. The travel path was drawn based on the topography and the time was calculated using the TR-55 Method and HydroCAD. A minimum T_c of 6.0 minutes was used.

4.3.4 Curve Numbers

Curve numbers were developed for each of the different use categories and hydrologic soil group types within each watershed area. The curve numbers were based on the SCS TR-55 methodology and are included in the HydroCAD input and output found in Appendix B.



LEGEND

- LIMIT OF WORK
- 100-FT WETLAND BUFFER
- NRCS SOIL SURVEY BOUNDARY
- EXISTING WATERSHED BOUNDARY
- NRCS SOIL SURVEY SYMBOL — 73A
- EXISTING WATERSHED NUMBER — EDA-1
- DESIGN POINT — DP-1
- ROOF AREA
- IMPERVIOUS AREA
- PERVIOUS AREA

0' 75' 150' 300'

1" = 75 FEET

DATE	REVISIONS

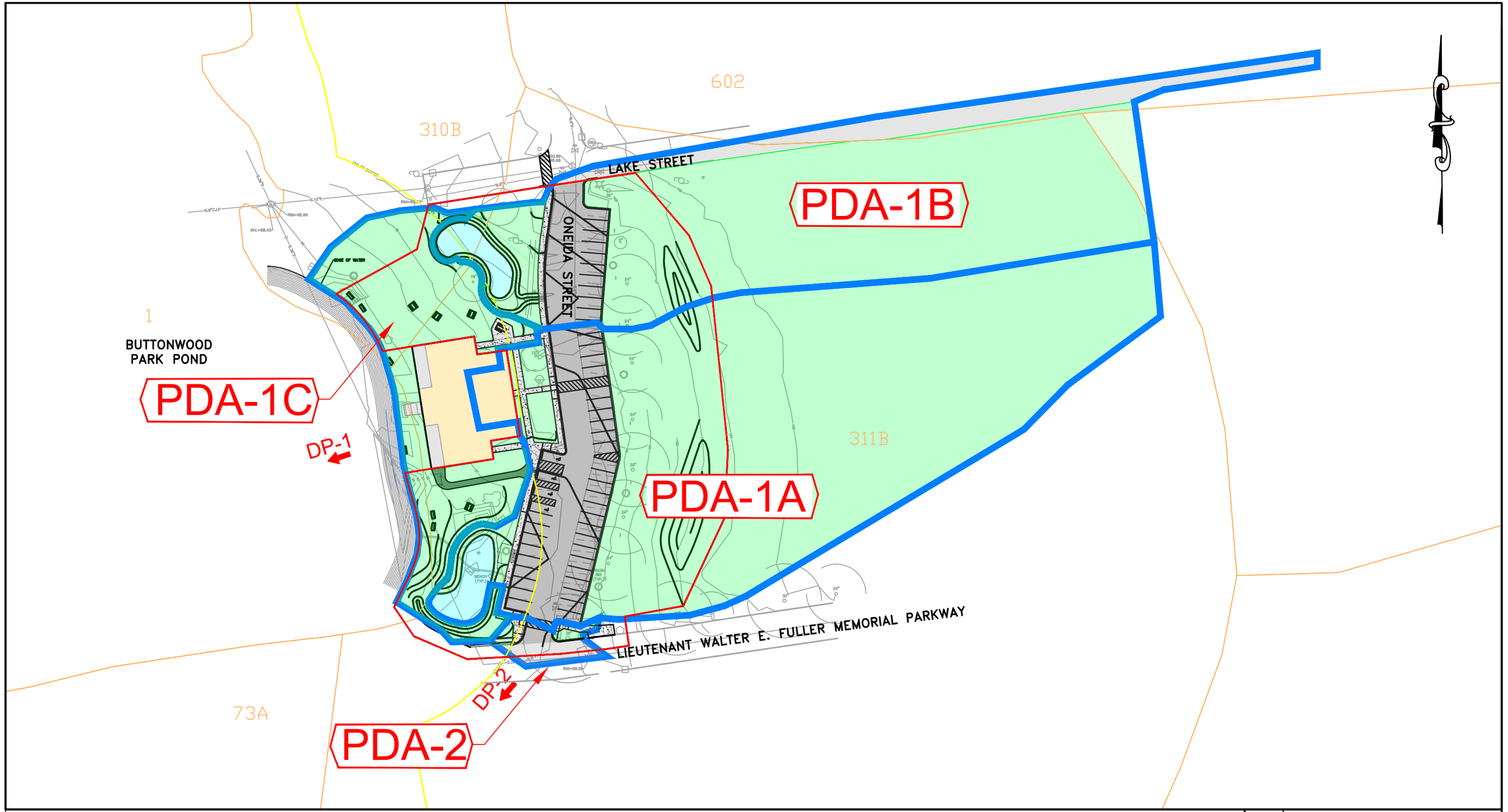
NEW BEDFORD, MASSACHUSETTS

BUTTONWOOD SENIOR CENTER
EXISTING WATERSHED PLAN

GREEN INTERNATIONAL AFFILIATES, INC.
CIVIL & STRUCTURAL ENGINEERS WESTFORD, MASSACHUSETTS

GREEN INTERNATIONAL AFFILIATES, INC.

SCALE 1" = 75'	DATE:6/15/2021	PROJECT NO. 21002
APPROVED: _____	DESIGNED BY: MW DRAWN BY: MW CHECKED BY: DS/JT	FIGURE NO. 6



LEGEND

- LIMIT OF WORK
- 100-FT WETLAND BUFFER
- NRCS SOIL SURVEY BOUNDARY
- PROPOSED WATERSHED BOUNDARY
- NRCS SOIL SURVEY SYMBOL — 73A
- PROPOSED WATERSHED NUMBER — PDA-1
- DESIGN POINT — DP-1

- ROOF AREA
- IMPERVIOUS AREA
- PERVIOUS AREA
- BIORETENTION MEDIA

0' 75' 150' 300'

1" = 75 FEET

GREEN INTERNATIONAL AFFILIATES, INC.

DATE	REVISIONS

NEW BEDFORD, MASSACHUSETTS

BUTTONWOOD SENIOR CENTER
PROPOSED WATERSHED PLAN

GREEN INTERNATIONAL AFFILIATES, INC.
CIVIL & STRUCTURAL ENGINEERS WESTFORD, MASSACHUSETTS

SCALE 1" = 75'	DATE:6/15/2021	PROJECT NO. 21002
APPROVED: _____	DESIGNED BY: MW DRAWN BY: MW CHECKED BY: DS/JT	FIGURE NO. 7

5.0 STANDARD 3: STORMWATER RECHARGE

Standard 3 requires that three computations or demonstrations be fulfilled to satisfy the stormwater recharge requirements. They are as follows:

- Impervious Area
- Required Recharge Volume
- Bottom Area Sizing for Bioretention Basins

As stated previously, the proposed improvements to the project site will result in an increase in impervious area by approximately 2,970 square feet. The required recharge volume for the total proposed impervious area is 621CF.

The project is proposing the implementation of two bioretention basins to help with stormwater treatment. The soil survey analysis is included in Section 1.1 of this report, Figure 3 Soils Map and Appendix D Soil Information. Based on the NRCS soil information, the BMP's are located within "C/D" soils. Based on the geotechnical report by GEI, the soils are a mixture of Silty Sand and Silty Sand with Gravel; therefore, a Hydrologic Soil Group of "C" was used. The recharge calculations can be found in appendix C.

For each BMP, the contributing impervious areas and their underlying Hydrologic Soil Groups were used to estimate the recharge volume lost by development, which was used as the required recharge volume for the given BMP. The combined storage provided by the proposed bioretention areas is 3,516 CF. Therefore, Standard 3 is fully met.

The BMP's were designed using the static method, so that the storage available below the first overflow is equivalent or larger than the required recharge volume. Drawdown calculations were performed to show that each BMP will drain within 72 hours. For this calculation, the RAWLs infiltration rates were used to estimate the recharge potential of each of the BMP. NRCS defined this area as "C" soils and the geotechnical test pits defined this area to be "B" soils. To be conservative the "C" soil infiltration rate of 0.27 in/hr was used to show these systems will fully drain within 72 hours. The drawdown calculations are in Appendix C.

Two test pits were excavated by the City of New Bedford Department of Public Works on 05/19/2021 and observed and analyzed by GEI Consultants. Both TP1 and TP2 did not encounter any groundwater although mottling was encountered in TP2 at a depth of approximately 4 feet (elevation 92.70'). Both bioretention basins will be able to provide a minimum of 2 feet of separation to the seasonal high ground water. Test pit results identified the subgrade soils to be B soils for both bioretention basins which are good for infiltration BMPs.

6.0 STANDARD 4: WATER QUALITY

Standard 4 requires that all stormwater management systems be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). The Massachusetts Stormwater Handbook states that this standard is met when:

- Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan, and thereafter are implemented and maintained.
- Structural stormwater best management practices are sized to capture the required water quality volume as determined in accordance with the Massachusetts Stormwater Handbook; and
- Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.

As stated previously, there are two (2) BMP's proposed as a part of this project. They have been designed to provide water quality treatment for the area of impervious surface that they capture. The treatment practices are:

- Bioretention Basin (2)

This standard is fully met.

6.1 Long-Term Pollution Prevention Plan

The long-term pollution prevention measures are combined with the Operation and Maintenance Plan for the City New Bedford's Department of Public Works which include limited sand use, street sweeping, and cleaning of bioretention basins.

6.2 Water Quality Treatment Volume

Massachusetts Stormwater Regulations require a "Water Quality Depth" of half (1/2) inch. One of the objectives of the proposed stormwater improvements is to improve upon the quality of discharged stormwater.

The proposed design aims to improve the water quality by installing two infiltration BMP's spread throughout the project. The required water quality volume for the total impervious area within the limit of work is 1,243 CF. The two (2) proposed bioretention basins exceed this water quality volume requirement by providing 3,516 CF of storage. The total project will exceed the required water quality volume. As a result, this standard will be fully met. See Appendix C for required water quality volume calculations.

6.3 TSS Removal Computations

Most of the runoff under existing conditions currently uses gutter flow and overland flow to Buttonwood Pond with no prior treatment. To meet 80% TSS removal, the project will include the installation of two (2) bioretention basins as well as crushed stone diaphragm for pretreatment.

The bioretention basins and pretreatment crushed stone diaphragm will be able to achieve 80% TSS removal.

This is a significant improvement over existing conditions where there is little to no treatment. These systems will be maintained on a regular basis per the City of New Bedford's Operation and Maintenance schedule.

The TSS calculations for all proposed BMP's are included in Appendix C.

7.0 STANDARD 5: LAND USES WITH HIGHER POTENTIAL POLLUTANT LOADS

The project site is not considered a Land Use with Higher Potential Pollutant Loads (LUHPPL); therefore, Standard 5 is not applicable to this project.

8.0 STANDARD 6: CRITICAL AREAS

The project is not located within a "critical" area as defined in the Massachusetts Stormwater Handbook. Therefore, Standard 6 is not applicable to the proposed project.

9.0 STANDARD 7: REDEVELOPMENT

The improvements to the Buttonwood Community Center site are considered a mix of Redevelopment and new development; therefore, Standard 7 is applicable to this project. Standard 7 requires a redevelopment project to meet Standards 2, 3 and the pretreatment and structural stormwater best management practice requirements of Standards 4, 5 and 6 only to the maximum extent practicable. A redevelopment project shall also comply with all other requirements of the Stormwater Management Standards and improve existing conditions.

This project provides an opportunity to improve the quality of stormwater runoff discharged to Buttonwood Pond. The proposed stormwater enhancements are summarized below:

- There are two BMP's proposed as part of this project. The proposed conditions have been designed to convey runoff to these BMP's for water quality treatment, and attenuation prior to discharge to the surrounding environment. The proposed BMPs consist of two bioretention basins.

- The implementation of the new BMP's will greatly reduce current problems will erosion at DP-1 into Buttonwood Park.

While the project is a mix of redevelopment and new development, the stormwater mitigation has been design to fully meet the ten Standards; therefore, a Redevelopment Stormwater Checklist is not included.

10.0 STANDARD 8: CONSTRUCTION PERIOD POLLUTION PREVENTION AND EROSION & SEDIMENTATION CONTROL

Construction period pollution prevention and erosion and sedimentation control measures will be implemented at the project site to control construction related impacts during construction and land disturbance activities. The General Contractor for the project will be responsible for implementation of the construction period controls.

The project will disturb more than one acre of land during the construction process and will require a NPDES Construction General Permit issued by the Environmental Protection Agency. As a result, the General Contractor will be required to prepare a Stormwater Pollution Prevention Plan (SWPPP). The SWPPP document will satisfy the requirements of the Construction General Permit and the construction period erosion, sedimentation and pollution prevention plan requirements outlined in Standard 8 of the Massachusetts Stormwater Handbook. A SWPPP has not been prepared for inclusion with this stormwater report; however, one will be prepared prior to any construction activities at the site by the General Contractor.

Without proper erosion and sediment control measures, grading, filling and installing the proposed work may cause erosion and sedimentation, resulting in temporarily increased turbidity and suspended solid loads. Runoff from construction sites may also transport sediment to downstream watercourses, where sediment deposition and accumulation will occur as flow velocities decrease.

Erosion and sedimentation controls will be employed to prevent the erosion and transport of sediment into resource areas during the earthwork and construction phases of the project. Erosion and sedimentation control measures will be installed prior to site excavation or disturbance and will be maintained throughout the construction period.

Below is a description of some of the erosion and sediment control measures that will be employed at the project and that will be included in the SWPPP.

10.1 Erosion and Sediment Control Measures

10.1.1 Minimize Disturbed Area and Protect Natural Features and Soil

The most important aspects of controlling erosion and sedimentation are limiting the extent of disturbance and limiting the size and length of the tributary drainage areas to the worksite and drainage structures. These fundamental principles will be the key factors in the Contractor's control of erosion on the project site. If appropriate, the Contractor will construct temporary diversion swales and settling basins or use a settling tank. If additional drainage or erosion control measures are needed, they will be located up-gradient from the compost filter tubes and sedimentation fences when possible.

The Contractor is responsible for the maintenance and repair of all on-site erosion control devices. All erosion control devices will be regularly inspected. At no time will silt-laden water be allowed to enter sensitive areas (wetlands, streams, and drainage systems). Any runoff from disturbed surfaces will be directed through a sedimentation process prior to being discharged to the existing on-site drainage system.

The contractor will establish a staging area(s) on areas to be disturbed for the overnight storage of equipment and stockpiling of materials.

In the staging area, the Contractor will have a stockpile of materials required to control erosion on-site to be used to supplement or repair erosion control devices. These materials will include, but are not limited to, compost filter tubes, sedimentation fence, erosion control matting and crushed stone. As mentioned previously, erosion and sedimentation controls will be employed to minimize the erosion and transport of sediment into resource areas during the earthwork and construction phases of the project. Erosion and sedimentation control measures will be installed prior to site excavation or disturbance and will be maintained throughout the construction period.

The Contractor is responsible for erosion control on the site and will utilize erosion control measures where needed, regardless of whether the measures are specified on the construction plans or in supplemental plans prepared for the Stormwater Pollution Prevention Plan (SWPPP).

Primary erosion control techniques proposed include compost filter tubes, sedimentation fence barriers, and a stabilized construction entrance. A detailed description of each technique is discussed below.

10.1.2 Best Management Practices (BMPs)

COMPOST FILTER TUBES

Erosion control barriers (compost filter tubes and/or sedimentation fence) will be installed where required prior to the start of construction. These barriers will remain in place until all tributary surfaces have been fully stabilized.

Compost filter tube barriers will be placed to trap sediment transported by runoff before it reaches the drainage system or leaves the construction site. In areas where high runoff velocities or high sediment loads are expected, sedimentation fencing may be installed adjacent to the compost filter tubes. This semi-permeable barrier made of a synthetic porous fabric will provide additional protection. The sedimentation fences and compost filter tube barrier will be replaced as determined by periodic field inspection. Compost filter tubes and sedimentation fences will be maintained and cleaned until the tributary area is fully stabilized.

DRAINAGE SYSTEM PROTECTION

Sediment filters (silt sacks) will be installed at all existing and proposed drainage structures and maintained and cleaned as required to maintain their effectiveness. Catch basins, and storm drainpipes will be cleaned of sediment and debris after the completion of construction. Sediment collected in structures will be disposed of properly and covered, if stored on-site. The following construction measures will be implemented to prevent the transport of sediment through the drainage system.

- Any proposed drainage system will be installed from the downstream end to the upstream end.
- Until tributary areas are stabilized, catch basin inlets will be filtered with a silt sack. If intense rainfall is predicted before all tributary areas are stabilized, erosion control measures will be reinforced for the duration of the storm. Downstream areas will be inspected, and any sediment removed at the end of the storm.
- Unfiltered water will not be allowed to enter pipes from unstabilized surfaces.

- Trench excavation will be limited to the minimum length required for daily pipe installation. All trenches will be backfilled as soon as possible. The ends of pipes will be closed nightly with plywood.

- Silt-laden waters will be intercepted prior to reaching catch basins during construction. Any gross depositions of materials on paved surfaces will be removed.

- Catch basins will be inspected monthly and cleaned in anticipation of the winter season in November.

UTILITY CONSTRUCTION

The Contractor will construct utility trenches in a manner that will not direct runoff toward wetlands resources or to drainage system structures.

10.1.3 Stabilization Activities

All disturbed surfaces will be stabilized a maximum of 14 days after construction on any portion of the project site that is completed or is temporarily halted, unless additional construction is intended to be initiated within 21 days. The Contractor will not disturb more area than can be stabilized within 14 days unless the area is to remain active. The Contractor will not disturb more area than can be stabilized within the same construction season.

SLOPE STABILIZATION

The smallest practicable area of land will be exposed at a time. Slopes greater than three-to-one (horizontal to vertical) will be stabilized with seed, organic mulch, jute fabric, or rip-rap, as appropriate, to prevent erosion during construction. After disturbed areas have been stabilized, the temporary erosion control measures will be removed, and accumulated sediment will be removed and disposed of in an appropriate location. Disturbed areas will be stabilized with appropriate ground cover as soon as possible. After the removal of temporary erosion control measures, disturbed areas will receive a layer of topsoil for stabilization.

STABILIZED CONSTRUCTION ENTRANCE

Temporary stabilized construction entrances may be installed at the project site. The purpose of the stabilized construction entrance is to remove sediment attached to vehicle tires and to minimize sediment transport and deposition onto public road surfaces. The construction entrances will be composed of beds of crushed stone which will be replenished as necessary to maintain their proper function.

10.2 Construction Period Pollution Prevention

10.2.1 Good Housekeeping BMPs

The following good housekeeping practices will be followed onsite during the construction project:

- An effort will be made to store only enough product required to do the job.

- All materials stored on-site will be stored in a neat, orderly manner in their appropriate containers and, if possible, under a roof or other enclosure.

- Products will be kept in their original containers with the original manufacturer's label.
- Substances will not be mixed with one another unless recommended by the manufacturer.
- Whenever possible, all of a product will be used up before disposing of the container.
- Manufacturer's recommendations for proper use and disposal will be followed.
- The site superintendent will inspect daily to ensure proper use and disposal of materials.
- The contractor will be required in the Contract documents to control dust.

10.2.2 Material Handling & Waste Management

HAZARDOUS PRODUCTS

These practices will be used to reduce the risks associated with hazardous materials. Material Safety Data Sheets (MSDSs) for each substance with hazardous properties that is used on the job site will be obtained and used for the proper management of potential wastes that may result from these products. An MSDS will be posted in the immediate area where such product is stored and/or used and another copy of each MSDS will be maintained in the SWPPP file at the job site construction office. Each employee who must handle a substance with hazardous properties will be instructed on the use of MSDS sheets and the specific information in the applicable MSDS for the product they are using, particularly regarding spill control techniques.

- Products will be kept in original containers unless they are not re-sealable.
- Original labels and material safety data will be retained, as they contain important product information.
- Manufacturer, local state, and/or federal recommended methods for proper disposal will be followed if surplus product must be disposed of.

HAZARDOUS WASTE

All hazardous waste material will be disposed of by the Contractor in the manner specified by local, state, and/or federal regulations and by the manufacturer of such products. Site personnel will be instructed in these practices by the job site superintendent, who will also be responsible for seeing that these practices are followed.

SOLID AND CONSTRUCTION WASTES

All waste materials will be collected and stored in accordance with state and federal law in an appropriately covered container and/or securely lidded metal dumpster.

All trash and construction debris from the site will be deposited in the dumpster. No construction waste materials will be buried on site. All personnel will be instructed regarding the correct procedures for waste disposal.

All waste dumpsters and roll-off containers will be located in an area where the likelihood of the containers contributing to storm water discharges is negligible. If required, additional BMPs must be implemented, such as sandbags around the base, to prevent wastes from contributing to storm water discharges.

SANITARY WASTES

All sanitary waste will be collected from the portable units as required to maintain proper operation and sanitary conditions of these units. All maintenance work on portable sanitation units shall be performed by a licensed portable facility provider in complete compliance with local and state regulations.

All sanitary waste units will be located in an area where the likelihood of the unit contributing to storm water discharges is negligible. If required, additional BMPs must be implemented, such as sandbags around the base, to prevent wastes from contributing to storm water discharges.

10.2.3 Spill Prevention & Control Plan

The Contractor will train all personnel in the proper handling and cleanup of spilled materials. No spilled hazardous materials or hazardous wastes will be allowed to come in contact with storm water discharges. If such contact occurs, the storm water discharge will be contained on site until appropriate measures in compliance with state and federal regulations are taken to dispose of such contaminated storm water. It shall be the responsibility of the job site superintendent to properly train all personnel in spill prevention and clean up procedures.

In order to minimize the potential for a spill of hazardous materials to come into contact with storm water, the following steps will be implemented:

- All materials with hazardous properties (such as pesticides, petroleum products, fertilizers, detergents, construction chemicals, acids, paints, paint solvents, cleaning solvents, additives for soil stabilization, concrete curing compounds and additives, etc.) will be stored in a secure location, with their lids on, preferably under cover, when not in use.

- During construction, liquid petroleum products and other hazardous materials with the potential to contaminate groundwater may not be stored or handled in areas of the site draining to an infiltration area. An “infiltration area” is any area of the site that by design or as a result of soils, topography and other relevant factors accumulates runoff that infiltrates into the soil. Dikes, berms, sumps, and other forms of secondary containment that prevent discharge to groundwater may be used to isolate portions of the site for the purposes of storage and handling of these materials.

- The minimum practical quantity of all such materials will be kept on the job site.

- A spill control and containment kit (containing, for example, absorbent materials, acid neutralizing powder, brooms, dust pans, mops, rags, gloves, goggles, plastic and metal trash containers, etc.) will be provided at the storage site.

- Manufacturers recommended methods for spill cleanup will be clearly posted and site personnel will be trained regarding these procedures and the location of the information and cleanup supplies.

In the event of a spill, the following procedures should be followed:

- All spills will be cleaned up immediately after discovery.
- The spill area will be kept well ventilated and personnel will wear appropriate protective clothing to prevent injury from contact with the hazardous substances.
- The project manager and the Engineer of Record will be notified immediately.
- Spills of toxic or hazardous materials will be reported to the appropriate federal, state, and/or local government agency, regardless of the size of the spill.
- If the spill exceeds a Reportable Quantity, the SWPPP must be modified within seven (7) calendar days of knowledge of the discharge to provide a description of the release, the circumstances leading to the release, and the date of the release. The plans must identify measures to prevent the recurrence of such releases and to respond to such releases.

The job site superintendent will be the spill prevention and response coordinator. He will designate the individuals who will receive spill prevention and response training. These individuals will each become responsible for a particular phase of prevention and response. The names of these personnel will be posted in the material storage area and in the office trailer on-site.

10.2.4 Allowable Non-Stormwater Discharge Management

Certain types of discharges are allowed under the NPDES General Permit for Construction Activity and it is the intent of this project to allow such discharges. These types of discharges will be allowed under the conditions that no pollutants will be allowed to come into contact with the water prior to or after its discharge. The control measures that have been outlined previously in this report will be strictly followed to ensure that no contamination of these non-stormwater discharges takes place. The following non-stormwater discharges that may occur from the job site include:

- Discharges from fire-fighting activities
- Fire hydrant flushing
- Waters used to wash vehicles where detergents are not used
- Water used to control dust in accordance with off-site vehicle tracking
- Potable water including uncontaminated water line flushing
- Routine external building wash down that does not use detergents
- Pavement wash waters where spills or leaks of toxic or hazardous materials have not occurred (unless all spilled material has been removed) and where detergents are not used
- Uncontaminated air conditioner compressor condensate

- Uncontaminated ground water or spring water
- Foundation or footing drains where flows are not contaminated with process materials such as solvents
- Uncontaminated excavation dewatering
- Landscape irrigation

11.0 STANDARD 9: OPERATION & MAINTENANCE PLAN

The goal of the Operation and Maintenance (O&M) plan is not only to protect resources on-site or nearby, but also to protect resources in the region that may be affected by the activities at the site. The City of New Bedford Department of Public Works will continue to be responsible for the operation and maintenance of the stormwater management system using current Department practices which include litter pick-up, street sweeping, and BMP cleanings.

12.0 STANDARD 10: PROHIBITION OF ILLICIT DISCHARGES

Standard 10 of the Massachusetts Stormwater Handbook prohibits illicit discharges to stormwater management systems. As stated in the handbook, "The stormwater management system is the system for conveying, treating, and infiltrating stormwater on-site, including stormwater best management practices and any pipes intended to transport stormwater to the groundwater, a surface water, or municipal separate storm sewer system. Illicit discharges to the stormwater management system are discharges that are not entirely comprised of stormwater."

Proponents of projects within Wetland's jurisdiction must demonstrate compliance with this requirement by submitting to the issuing authority an Illicit Discharge Compliance Statement verifying that no illicit discharges exist on the site and by including in the pollution prevention plan measures to prevent illicit discharges to the stormwater management system.

Standard 10 also states that "The Illicit Discharge Compliance Statement must be accompanied by a site map that is drawn to scale and that identifies the location of any systems for conveying stormwater on the site and shows that these systems do not allow the entry of any illicit discharges into the stormwater management system. The site map shall identify the location of any systems for conveying wastewater and/or groundwater on the site and show that there are no connections between the stormwater and wastewater management systems and the location of any measures taken to prevent the entry of illicit discharges into the stormwater management system." Included with the Notice of Intent Submission are construction plans that displays the location of all the stormwater management components as well as other utilities (existing and proposed) on the project site and conforms to requirements of a "site map" to accompany the Illicit Discharge Compliance Statement.

An Illicit Discharge Compliance Statement is included in *Appendix E – Illicit Discharge Compliance Statement* of this Report.

The majority of runoff discharges via overland flow to bioretention basins and eventually to Buttonwood Park Pond. Where a new, closed drainage system will be constructed, there will be no connections to sanitary sewer. There is an existing combined sewer system located outside the project limits within Fuller Parkway where a minor portion of the site will continue to discharge to it; however, there will be a reduction in peak rates to the combined system under proposed conditions.

APPENDIX A

CHECKLISTS

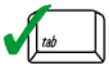
- Massachusetts Stormwater Report Checklist
- Redevelopment Checklist

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

Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature

6/17/2021

Signature and Date

Checklist

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

☐ New development

☐ Redevelopment

☒ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

☒ An Illicit Discharge Compliance Statement is attached;

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

Checklist for Redevelopment Projects

Redevelopment Location:
The entire work within the limit of disturbance is considered a mix of new development and redevelopment. The redevelopment is the realignment of the parking area and replacing existing sidewalks. The new development is the addition of new sidewalks.

Standard 7: A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural stormwater best management practice requirements of Standards 4, 5, and 6. Existing stormwater discharges shall comply with Standard 1 only to the maximum extent practicable. A redevelopment project shall also comply with all other requirements of the Stormwater Management Standards and improve existing conditions.

☒ Standard 1: (Untreated discharges)
No new stormwater conveyances (e.g., outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.

☒ Standard 2: (Peak rate control and flood prevention)
Stormwater management systems must be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates. This Standard may be waived for land subject to coastal storm flowage.

☒ Standard 3: (Recharge to Ground water)
Loss of annual recharge to ground water shall be eliminated or minimized through the use of infiltration measures, including environmentally sensitive site design, low impact development techniques, best management practices, and good operation and maintenance. At a minimum, the annual recharge from the post-development site shall approximate the annual recharge from the pre-development conditions based on soil type. This Standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.

☒ Standard 4: (80% TSS Removal)
Stormwater management systems must be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). This standard is met when:

a. *Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan and thereafter are implemented and maintained;*
b. *Stormwater BMPs are sized to capture the required water quality volume determined in accordance with the Massachusetts Stormwater Handbook; and*
c. *Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.*

☒ Standard 5 (Higher Potential Pollutant Loads (HPPL)
For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable. If through source control and/or pollution prevention, all land uses with higher potential pollutant loads cannot be completely protected from exposure to rain, snow, snow melt and stormwater runoff, the proponent shall use the specific stormwater BMPs determined by the Department to be suitable for such use as provided

in the Massachusetts Stormwater Handbook. Stormwater discharges from land uses with higher potential pollutant loads shall also comply with the requirements of the Massachusetts Clean Waters Act, M.G.L. c. 21, §§ 26-53, and the regulations promulgated thereunder at 314 CMR 3.00, 314 CMR 4.00 and 314 CMR 5.00.

Not Applicable.

☒ Standard 6 (Critical Areas)

Stormwater discharges to a Zone II or Interim Wellhead Protection Area of a public water supply and stormwater discharges near or any other critical area require the use of the specific source control and pollution prevention measures and the specific stormwater best management practices determined by the Department to be suitable for managing discharges to such area, as provided in the Massachusetts Stormwater Handbook. A discharge is near a critical area if there is a strong likelihood of a significant impact occurring to said area, taking into account site-specific factors. Stormwater discharges to Outstanding Resource Waters or Special Resource Waters shall be set back from the receiving water and receive the highest and best practical method of treatment. A "stormwater discharge," as defined in 314 CMR 3.04(2)(a)1. or (b), to an Outstanding Resource Water or Special Resource Water shall comply with 314 CMR 3.00 and 314 CMR 4.00. Stormwater discharges to a Zone I or Zone A are prohibited unless essential to the operation of the public water supply.

Not Applicable.

☒ Standard 8: (Erosion, Sediment Control)

A plan to control construction-related impacts, including erosion sedimentation and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan), must be developed and implemented.

☒ Standard 9: (Operation and Maintenance)

A long-term operation and maintenance plan must be developed and implemented to ensure that stormwater management systems function as designed.

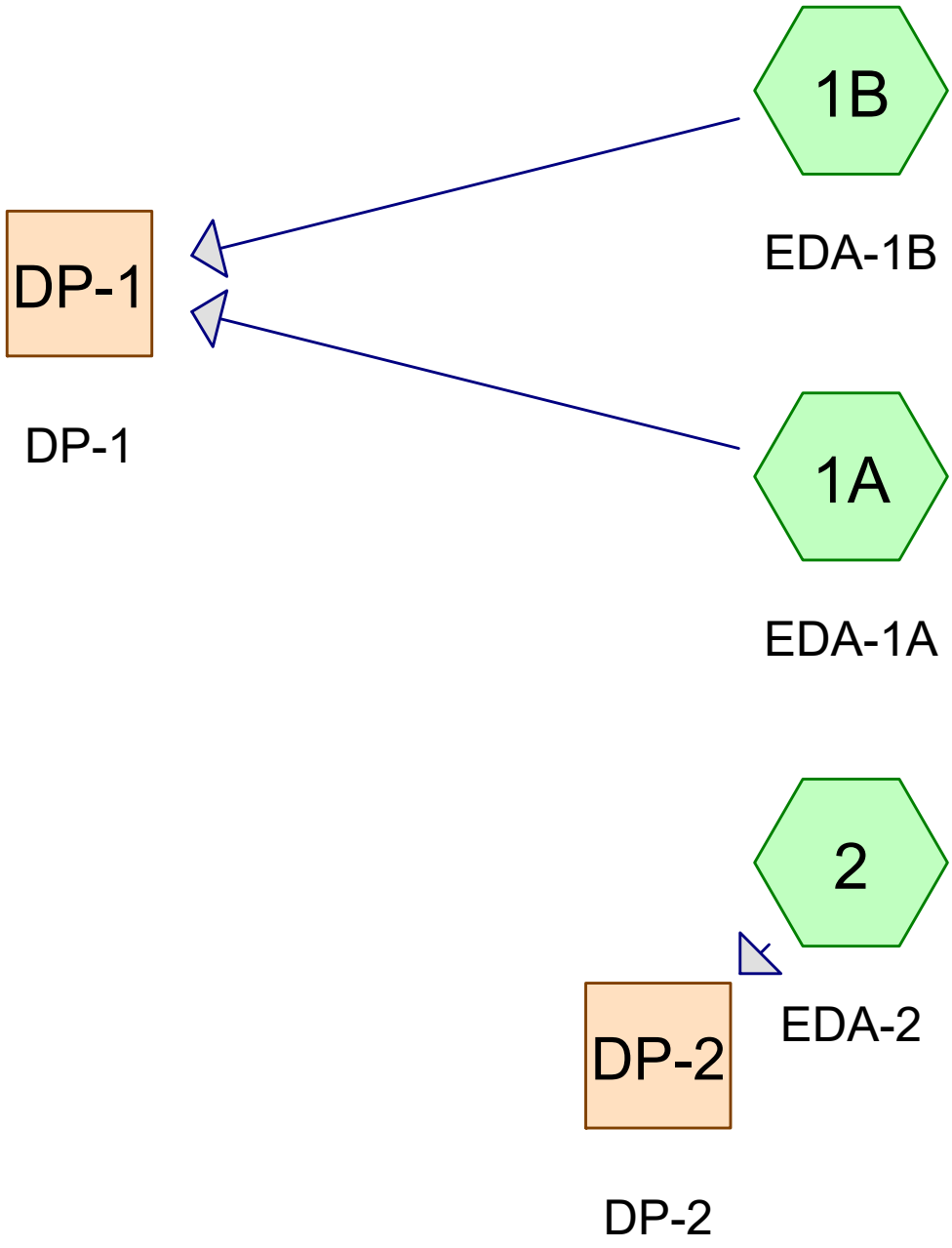
☒ Standard 10 (Illicit Discharges)

All illicit discharges to the stormwater management system are prohibited.

APPENDIX B

HYDROLOGIC CALCULATIONS

- Existing Conditions Calculations
- Proposed Conditions Calculations



Subcat Reach Pond Link

Routing Diagram for Existing Conditions

Prepared by Michael Wagner - Green International Affiliates, Printed 6/17/2021

HydroCAD® 10.10-5a s/n 06415 © 2020 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.011	77	>75% Grass cover, Good, AVG HSG C,D (2)
1.551	77	>75% Grass cover, Good, (AVG HSG C,D) (1B)
2.280	77	>75% Grass cover, Good, (AVG, HSG C,D) (1A)
0.043	74	>75% Grass cover, Good, HSG C (1B)
0.250	98	Paved parking, (AVG HSG C,D) (1A)
0.458	98	Paved parking, HSG D (1B, 2)
0.139	98	Roofs, (AVG HSG ,C,D) (1A)
4.732	**81**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
4.135	HSG C	1A, 1B, 2
0.458	HSG D	1B, 2
0.139	Other	1A
4.732		**TOTAL AREA**

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)
1	1B	0.00	0.00	136.0	0.0050	0.011	0.0	6.0	0.0

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1A: EDA-1A Runoff Area=116,262 sf 14.58% Impervious Runoff Depth=1.48"
Flow Length=685' Tc=14.0 min CN=80 Runoff=3.53 cfs 0.329 af

Subcatchment 1B: EDA-1B Runoff Area=86,896 sf 20.12% Impervious Runoff Depth=1.55"
Flow Length=696' Tc=13.8 min CN=81 Runoff=2.79 cfs 0.257 af

Subcatchment 2: EDA-2 Runoff Area=2,971 sf 83.74% Impervious Runoff Depth=2.74"
Tc=6.0 min CN=95 Runoff=0.20 cfs 0.016 af

Reach DP-1: DP-1 Inflow=6.32 cfs 0.586 af
Outflow=6.32 cfs 0.586 af

Reach DP-2: DP-2 Inflow=0.20 cfs 0.016 af
Outflow=0.20 cfs 0.016 af

Total Runoff Area = 4.732 ac Runoff Volume = 0.602 af Average Runoff Depth = 1.53"
82.09% Pervious = 3.885 ac 17.91% Impervious = 0.848 ac

Summary for Subcatchment 1A: EDA-1A

Runoff = 3.53 cfs @ 12.20 hrs, Volume= 0.329 af, Depth= 1.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.30"

	Area (sf)	CN	Description
*	6,056	98	Roofs, (AVG HSG ,C,D)
*	10,895	98	Paved parking, (AVG HSG C,D)
*	99,311	77	>75% Grass cover, Good, (AVG, HSG C,D)
	116,262	80	Weighted Average
	99,311		85.42% Pervious Area
	16,951		14.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	50	0.0100	0.11		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.30"
5.5	446	0.0375	1.36		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	66	0.0273	3.35		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.3	23	0.0053	1.48		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.6	100	0.0324	2.70		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
14.0	685	Total			

Summary for Subcatchment 1B: EDA-1B

[47] Hint: Peak is 595% of capacity of segment #5

Runoff = 2.79 cfs @ 12.20 hrs, Volume= 0.257 af, Depth= 1.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.30"

	Area (sf)	CN	Description
	17,481	98	Paved parking, HSG D
*	67,552	77	>75% Grass cover, Good, (AVG HSG C,D)
	1,863	74	>75% Grass cover, Good, HSG C
	86,896	81	Weighted Average
	69,415		79.88% Pervious Area
	17,481		20.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	50	0.0100	0.11		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.30"
5.0	408	0.0377	1.36		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	50	0.0292	3.47		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.4	52	0.0106	2.09		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.9	136	0.0050	2.39	0.47	**Pipe Channel,** 6.0" Round Area= 0.2 sf Perim= 1.6' r= 0.13' n= 0.011 Concrete pipe, straight & clean
13.8	696	Total			

Summary for Subcatchment 2: EDA-2

Runoff = 0.20 cfs @ 12.09 hrs, Volume= 0.016 af, Depth= 2.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.30"

	Area (sf)	CN	Description
	2,488	98	Paved parking, HSG D
*	483	77	>75% Grass cover, Good, AVG HSG C,D
	2,971	95	Weighted Average
	483		16.26% Pervious Area
	2,488		83.74% Impervious Area

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

Summary for Reach DP-1: DP-1

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 4.664 ac, 16.95% Impervious, Inflow Depth = 1.51" for 2-Year event
Inflow = 6.32 cfs @ 12.20 hrs, Volume= 0.586 af
Outflow = 6.32 cfs @ 12.20 hrs, Volume= 0.586 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Reach DP-2: DP-2

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.068 ac, 83.74% Impervious, Inflow Depth = 2.74" for 2-Year event
Inflow = 0.20 cfs @ 12.09 hrs, Volume= 0.016 af
Outflow = 0.20 cfs @ 12.09 hrs, Volume= 0.016 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1A: EDA-1A Runoff Area=116,262 sf 14.58% Impervious Runoff Depth=2.79"
Flow Length=685' Tc=14.0 min CN=80 Runoff=6.74 cfs 0.620 af

Subcatchment 1B: EDA-1B Runoff Area=86,896 sf 20.12% Impervious Runoff Depth=2.88"
Flow Length=696' Tc=13.8 min CN=81 Runoff=5.22 cfs 0.479 af

Subcatchment 2: EDA-2 Runoff Area=2,971 sf 83.74% Impervious Runoff Depth=4.30"
Tc=6.0 min CN=95 Runoff=0.31 cfs 0.024 af

Reach DP-1: DP-1 Inflow=11.96 cfs 1.099 af
Outflow=11.96 cfs 1.099 af

Reach DP-2: DP-2 Inflow=0.31 cfs 0.024 af
Outflow=0.31 cfs 0.024 af

Total Runoff Area = 4.732 ac Runoff Volume = 1.123 af Average Runoff Depth = 2.85"
82.09% Pervious = 3.885 ac 17.91% Impervious = 0.848 ac

Summary for Subcatchment 1A: EDA-1A

Runoff = 6.74 cfs @ 12.20 hrs, Volume= 0.620 af, Depth= 2.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.88"

	Area (sf)	CN	Description
*	6,056	98	Roofs, (AVG HSG ,C,D)
*	10,895	98	Paved parking, (AVG HSG C,D)
*	99,311	77	>75% Grass cover, Good, (AVG, HSG C,D)
	116,262	80	Weighted Average
	99,311		85.42% Pervious Area
	16,951		14.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	50	0.0100	0.11		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.30"
5.5	446	0.0375	1.36		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	66	0.0273	3.35		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.3	23	0.0053	1.48		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.6	100	0.0324	2.70		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
14.0	685	Total			

Summary for Subcatchment 1B: EDA-1B

[47] Hint: Peak is 1113% of capacity of segment #5

Runoff = 5.22 cfs @ 12.19 hrs, Volume= 0.479 af, Depth= 2.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.88"

	Area (sf)	CN	Description
	17,481	98	Paved parking, HSG D
*	67,552	77	>75% Grass cover, Good, (AVG HSG C,D)
	1,863	74	>75% Grass cover, Good, HSG C
	86,896	81	Weighted Average
	69,415		79.88% Pervious Area
	17,481		20.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	50	0.0100	0.11		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.30"
5.0	408	0.0377	1.36		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	50	0.0292	3.47		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.4	52	0.0106	2.09		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.9	136	0.0050	2.39	0.47	**Pipe Channel,** 6.0" Round Area= 0.2 sf Perim= 1.6' r= 0.13' n= 0.011 Concrete pipe, straight & clean
13.8	696	Total			

Summary for Subcatchment 2: EDA-2

Runoff = 0.31 cfs @ 12.09 hrs, Volume= 0.024 af, Depth= 4.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.88"

	Area (sf)	CN	Description
	2,488	98	Paved parking, HSG D
*	483	77	>75% Grass cover, Good, AVG HSG C,D
	2,971	95	Weighted Average
	483		16.26% Pervious Area
	2,488		83.74% Impervious Area

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

Summary for Reach DP-1: DP-1

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 4.664 ac, 16.95% Impervious, Inflow Depth = 2.83" for 10-Year event
Inflow = 11.96 cfs @ 12.19 hrs, Volume= 1.099 af
Outflow = 11.96 cfs @ 12.19 hrs, Volume= 1.099 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Reach DP-2: DP-2

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.068 ac, 83.74% Impervious, Inflow Depth = 4.30" for 10-Year event
Inflow = 0.31 cfs @ 12.09 hrs, Volume= 0.024 af
Outflow = 0.31 cfs @ 12.09 hrs, Volume= 0.024 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1A: EDA-1A Runoff Area=116,262 sf 14.58% Impervious Runoff Depth=6.15"
Flow Length=685' Tc=14.0 min CN=80 Runoff=14.61 cfs 1.368 af

Subcatchment 1B: EDA-1B Runoff Area=86,896 sf 20.12% Impervious Runoff Depth=6.27"
Flow Length=696' Tc=13.8 min CN=81 Runoff=11.15 cfs 1.043 af

Subcatchment 2: EDA-2 Runoff Area=2,971 sf 83.74% Impervious Runoff Depth=7.96"
Tc=6.0 min CN=95 Runoff=0.55 cfs 0.045 af

Reach DP-1: DP-1 Inflow=25.76 cfs 2.411 af
Outflow=25.76 cfs 2.411 af

Reach DP-2: DP-2 Inflow=0.55 cfs 0.045 af
Outflow=0.55 cfs 0.045 af

Total Runoff Area = 4.732 ac Runoff Volume = 2.456 af Average Runoff Depth = 6.23"
82.09% Pervious = 3.885 ac 17.91% Impervious = 0.848 ac

Summary for Subcatchment 1A: EDA-1A

Runoff = 14.61 cfs @ 12.19 hrs, Volume= 1.368 af, Depth= 6.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.56"

	Area (sf)	CN	Description
*	6,056	98	Roofs, (AVG HSG ,C,D)
*	10,895	98	Paved parking, (AVG HSG C,D)
*	99,311	77	>75% Grass cover, Good, (AVG, HSG C,D)
	116,262	80	Weighted Average
	99,311		85.42% Pervious Area
	16,951		14.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	50	0.0100	0.11		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.30"
5.5	446	0.0375	1.36		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	66	0.0273	3.35		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.3	23	0.0053	1.48		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.6	100	0.0324	2.70		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
14.0	685	Total			

Summary for Subcatchment 1B: EDA-1B

[47] Hint: Peak is 2378% of capacity of segment #5

Runoff = 11.15 cfs @ 12.19 hrs, Volume= 1.043 af, Depth= 6.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.56"

	Area (sf)	CN	Description
	17,481	98	Paved parking, HSG D
*	67,552	77	>75% Grass cover, Good, (AVG HSG C,D)
	1,863	74	>75% Grass cover, Good, HSG C
	86,896	81	Weighted Average
	69,415		79.88% Pervious Area
	17,481		20.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	50	0.0100	0.11		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.30"
5.0	408	0.0377	1.36		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	50	0.0292	3.47		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.4	52	0.0106	2.09		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.9	136	0.0050	2.39	0.47	**Pipe Channel,** 6.0" Round Area= 0.2 sf Perim= 1.6' r= 0.13' n= 0.011 Concrete pipe, straight & clean
13.8	696	Total			

Summary for Subcatchment 2: EDA-2

Runoff = 0.55 cfs @ 12.09 hrs, Volume= 0.045 af, Depth= 7.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.56"

	Area (sf)	CN	Description
	2,488	98	Paved parking, HSG D
*	483	77	>75% Grass cover, Good, AVG HSG C,D
	2,971	95	Weighted Average
	483		16.26% Pervious Area
	2,488		83.74% Impervious Area

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

Summary for Reach DP-1: DP-1

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 4.664 ac, 16.95% Impervious, Inflow Depth = 6.20" for 100-Year event
Inflow = 25.76 cfs @ 12.19 hrs, Volume= 2.411 af
Outflow = 25.76 cfs @ 12.19 hrs, Volume= 2.411 af, Atten= 0%, Lag= 0.0 min

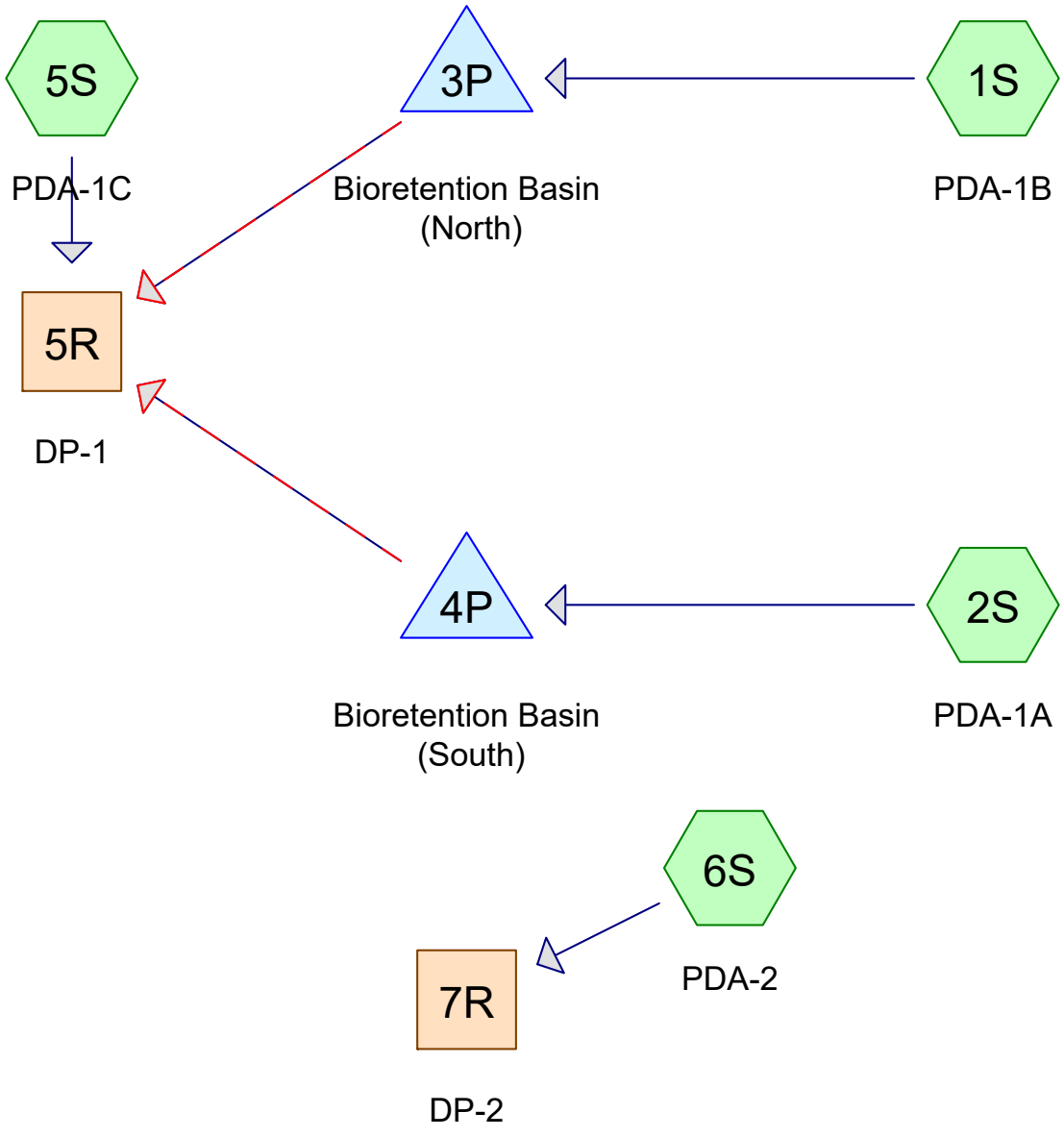
Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Reach DP-2: DP-2

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.068 ac, 83.74% Impervious, Inflow Depth = 7.96" for 100-Year event
Inflow = 0.55 cfs @ 12.09 hrs, Volume= 0.045 af
Outflow = 0.55 cfs @ 12.09 hrs, Volume= 0.045 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs



Subcat Reach Pond Link

Routing Diagram for Proposed Conditions - new pretreatment

Prepared by Michael Wagner - Green International Affiliates, Printed 6/17/2021
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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
3.695	77	>75% Grass cover, Good, AVG HSG C,D (1S, 2S, 5S, 6S)
0.043	74	>75% Grass cover, Good, HSG C (1S)
0.034	98	Paved parking, AVG GSG C, D (5S)
0.734	98	Paved parking, AVG HSG C,D (1S, 2S, 6S)
0.139	98	Roofs, HSG C,D (2S, 5S)
0.084	98	Water Surface, HSG C,D (1S, 2S)
4.729	**81**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
4.695	HSG C	1S, 2S, 5S, 6S
0.000	HSG D	
0.034	Other	5S
4.729		**TOTAL AREA**

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)
1	3P	95.00	94.00	81.0	0.0123	0.013	0.0	12.0	0.0

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: PDA-1B Runoff Area=71,329 sf 22.87% Impervious Runoff Depth=1.62"
Flow Length=538' Tc=13.1 min CN=82 Runoff=2.44 cfs 0.221 af

Subcatchment 2S: PDA-1A Runoff Area=102,493 sf 18.44% Impervious Runoff Depth=1.55"
Flow Length=623' Tc=13.4 min CN=81 Runoff=3.32 cfs 0.304 af

Subcatchment 5S: PDA-1C Runoff Area=29,756 sf 19.98% Impervious Runoff Depth=1.55"
Tc=6.0 min CN=81 Runoff=1.21 cfs 0.088 af

Subcatchment 6S: PDA-2 Runoff Area=2,412 sf 82.67% Impervious Runoff Depth=2.64"
Flow Length=78' Tc=6.0 min CN=94 Runoff=0.16 cfs 0.012 af

Reach 5R: DP-1 Inflow=5.73 cfs 0.532 af
Outflow=5.73 cfs 0.532 af

Reach 7R: DP-2 Inflow=0.16 cfs 0.012 af
Outflow=0.16 cfs 0.012 af

Pond 3P: Bioretention Basin (North) Peak Elev=98.84' Storage=2,501 cf Inflow=2.44 cfs 0.221 af
Primary=2.00 cfs 0.179 af Secondary=0.00 cfs 0.000 af Outflow=2.00 cfs 0.179 af

Pond 4P: Bioretention Basin (South) Peak Elev=96.66' Storage=2,340 cf Inflow=3.32 cfs 0.304 af
Outflow=3.17 cfs 0.265 af

Total Runoff Area = 4.729 ac Runoff Volume = 0.625 af Average Runoff Depth = 1.59"
79.05% Pervious = 3.738 ac 20.95% Impervious = 0.991 ac

Summary for Subcatchment 1S: PDA-1B

Runoff = 2.44 cfs @ 12.19 hrs, Volume= 0.221 af, Depth= 1.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.30"

	Area (sf)	CN	Description
*	53,154	77	>75% Grass cover, Good, AVG HSG C,D
*	14,721	98	Paved parking, AVG HSG C,D
	1,863	74	>75% Grass cover, Good, HSG C
*	1,591	98	Water Surface, HSG C,D
	71,329	82	Weighted Average
	55,017		77.13% Pervious Area
	16,312		22.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	50	0.0100	0.11		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.30"
5.6	443	0.0357	1.32		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	45	0.0260	3.27		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
13.1	538	Total			

Summary for Subcatchment 2S: PDA-1A

Runoff = 3.32 cfs @ 12.19 hrs, Volume= 0.304 af, Depth= 1.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.30"

	Area (sf)	CN	Description
*	83,589	77	>75% Grass cover, Good, AVG HSG C,D
*	15,270	98	Paved parking, AVG HSG C,D
*	1,584	98	Roofs, HSG C,D
*	2,050	98	Water Surface, HSG C,D
	102,493	81	Weighted Average
	83,589		81.56% Pervious Area
	18,904		18.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	50	0.0100	0.11		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.30"
5.4	443	0.0375	1.36		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.7	130	0.0220	3.01		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
13.4	623	Total			

Summary for Subcatchment 5S: PDA-1C

Runoff = 1.21 cfs @ 12.09 hrs, Volume= 0.088 af, Depth= 1.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.30"

	Area (sf)	CN	Description
*	23,810	77	>75% Grass cover, Good, AVG HSG C,D
*	1,482	98	Paved parking, AVG GSG C, D
*	4,464	98	Roofs, HSG C,D
	29,756	81	Weighted Average
	23,810		80.02% Pervious Area
	5,946		19.98% Impervious Area

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

Summary for Subcatchment 6S: PDA-2

Runoff = 0.16 cfs @ 12.09 hrs, Volume= 0.012 af, Depth= 2.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.30"

	Area (sf)	CN	Description
*	418	77	>75% Grass cover, Good, AVG HSG C,D
*	1,994	98	Paved parking, AVG HSG C,D
	2,412	94	Weighted Average
	418		17.33% Pervious Area
	1,994		82.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	78		0.22		**Direct Entry,**

Summary for Reach 5R: DP-1

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 4.674 ac, 20.22% Impervious, Inflow Depth = 1.37" for 2-Year event
Inflow = 5.73 cfs @ 12.26 hrs, Volume= 0.532 af
Outflow = 5.73 cfs @ 12.26 hrs, Volume= 0.532 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Reach 7R: DP-2

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.055 ac, 82.67% Impervious, Inflow Depth = 2.64" for 2-Year event
Inflow = 0.16 cfs @ 12.09 hrs, Volume= 0.012 af
Outflow = 0.16 cfs @ 12.09 hrs, Volume= 0.012 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Pond 3P: Bioretention Basin (North)

Inflow Area = 1.637 ac, 22.87% Impervious, Inflow Depth = 1.62" for 2-Year event
Inflow = 2.44 cfs @ 12.19 hrs, Volume= 0.221 af
Outflow = 2.00 cfs @ 12.29 hrs, Volume= 0.179 af, Atten= 18%, Lag= 6.4 min
Primary = 2.00 cfs @ 12.29 hrs, Volume= 0.179 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 98.84' @ 12.29 hrs Surf.Area= 2,111 sf Storage= 2,501 cf

Plug-Flow detention time= 120.9 min calculated for 0.179 af (81% of inflow)
Center-of-Mass det. time= 44.2 min (885.6 - 841.4)

Volume	Invert	Avail.Storage	Storage Description
#1	96.00'	4,457 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc) 7,639 cf Overall - 3,182 cf Embedded = 4,457 cf
#2	96.00'	955 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc) Inside #1 3,182 cf Overall x 30.0% Voids
		5,411 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
96.00	1,591	0	0
98.00	1,591	3,182	3,182
99.00	2,214	1,903	5,085
100.00	2,894	2,554	7,639

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
96.00	1,591	0	0
98.00	1,591	3,182	3,182

Device	Routing	Invert	Outlet Devices
#1	Device 3	98.50'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Secondary	99.00'	**10.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

#3	Primary	95.00'	**12.0" Round Culvert** L= 81.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 95.00' / 94.00' S= 0.0123 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.99 cfs @ 12.29 hrs HW=98.83' (Free Discharge)
└**3=Culvert** (Passes 1.99 cfs of 5.45 cfs potential flow)
└**1=Orifice/Grate** (Weir Controls 1.99 cfs @ 1.89 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=96.00' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 4P: Bioretention Basin (South)

Inflow Area = 2.353 ac, 18.44% Impervious, Inflow Depth = 1.55" for 2-Year event
Inflow = 3.32 cfs @ 12.19 hrs, Volume= 0.304 af
Outflow = 3.17 cfs @ 12.24 hrs, Volume= 0.265 af, Atten= 4%, Lag= 2.7 min
Primary = 3.17 cfs @ 12.24 hrs, Volume= 0.265 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 96.66' @ 12.24 hrs Surf.Area= 2,618 sf Storage= 2,340 cf

Plug-Flow detention time= 87.9 min calculated for 0.265 af (87% of inflow)
Center-of-Mass det. time= 29.2 min (874.1 - 844.9)

Volume	Invert	Avail.Storage	Storage Description
#1	94.70'	5,624 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc) 8,289 cf Overall - 2,665 cf Embedded = 5,624 cf
#2	94.70'	799 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc) Inside #1 2,665 cf Overall x 30.0% Voids
		6,423 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
94.70	2,050	0	0
96.00	2,050	2,665	2,665
97.00	2,910	2,480	5,145
98.00	3,378	3,144	8,289

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
94.70	2,050	0	0
96.00	2,050	2,665	2,665

Device	Routing	Invert	Outlet Devices
#1	Primary	96.40'	**10.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=3.14 cfs @ 12.24 hrs HW=96.66' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 3.14 cfs @ 1.21 fps)

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: PDA-1B Runoff Area=71,329 sf 22.87% Impervious Runoff Depth=2.97"
Flow Length=538' Tc=13.1 min CN=82 Runoff=4.49 cfs 0.406 af

Subcatchment 2S: PDA-1A Runoff Area=102,493 sf 18.44% Impervious Runoff Depth=2.88"
Flow Length=623' Tc=13.4 min CN=81 Runoff=6.22 cfs 0.565 af

Subcatchment 5S: PDA-1C Runoff Area=29,756 sf 19.98% Impervious Runoff Depth=2.88"
Tc=6.0 min CN=81 Runoff=2.26 cfs 0.164 af

Subcatchment 6S: PDA-2 Runoff Area=2,412 sf 82.67% Impervious Runoff Depth=4.19"
Flow Length=78' Tc=6.0 min CN=94 Runoff=0.25 cfs 0.019 af

Reach 5R: DP-1 Inflow=11.36 cfs 1.053 af
Outflow=11.36 cfs 1.053 af

Reach 7R: DP-2 Inflow=0.25 cfs 0.019 af
Outflow=0.25 cfs 0.019 af

Pond 3P: Bioretention Basin (North) Peak Elev=99.13' Storage=3,149 cf Inflow=4.49 cfs 0.406 af
Primary=3.00 cfs 0.348 af Secondary=1.09 cfs 0.016 af Outflow=4.09 cfs 0.363 af

Pond 4P: Bioretention Basin (South) Peak Elev=96.79' Storage=2,688 cf Inflow=6.22 cfs 0.565 af
Outflow=6.08 cfs 0.526 af

Total Runoff Area = 4.729 ac Runoff Volume = 1.153 af Average Runoff Depth = 2.93"
79.05% Pervious = 3.738 ac 20.95% Impervious = 0.991 ac

Summary for Subcatchment 1S: PDA-1B

Runoff = 4.49 cfs @ 12.18 hrs, Volume= 0.406 af, Depth= 2.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.88"

	Area (sf)	CN	Description
*	53,154	77	>75% Grass cover, Good, AVG HSG C,D
*	14,721	98	Paved parking, AVG HSG C,D
	1,863	74	>75% Grass cover, Good, HSG C
*	1,591	98	Water Surface, HSG C,D
	71,329	82	Weighted Average
	55,017		77.13% Pervious Area
	16,312		22.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	50	0.0100	0.11		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.30"
5.6	443	0.0357	1.32		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	45	0.0260	3.27		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
13.1	538	Total			

Summary for Subcatchment 2S: PDA-1A

Runoff = 6.22 cfs @ 12.19 hrs, Volume= 0.565 af, Depth= 2.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.88"

	Area (sf)	CN	Description
*	83,589	77	>75% Grass cover, Good, AVG HSG C,D
*	15,270	98	Paved parking, AVG HSG C,D
*	1,584	98	Roofs, HSG C,D
*	2,050	98	Water Surface, HSG C,D
	102,493	81	Weighted Average
	83,589		81.56% Pervious Area
	18,904		18.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	50	0.0100	0.11		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.30"
5.4	443	0.0375	1.36		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.7	130	0.0220	3.01		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
13.4	623	Total			

Summary for Subcatchment 5S: PDA-1C

Runoff = 2.26 cfs @ 12.09 hrs, Volume= 0.164 af, Depth= 2.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.88"

	Area (sf)	CN	Description
*	23,810	77	>75% Grass cover, Good, AVG HSG C,D
*	1,482	98	Paved parking, AVG GSG C, D
*	4,464	98	Roofs, HSG C,D
	29,756	81	Weighted Average
	23,810		80.02% Pervious Area
	5,946		19.98% Impervious Area

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

Summary for Subcatchment 6S: PDA-2

Runoff = 0.25 cfs @ 12.09 hrs, Volume= 0.019 af, Depth= 4.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.88"

	Area (sf)	CN	Description
*	418	77	>75% Grass cover, Good, AVG HSG C,D
*	1,994	98	Paved parking, AVG HSG C,D
	2,412	94	Weighted Average
	418		17.33% Pervious Area
	1,994		82.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	78		0.22		**Direct Entry,**

Summary for Reach 5R: DP-1

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 4.674 ac, 20.22% Impervious, Inflow Depth = 2.70" for 10-Year event
Inflow = 11.36 cfs @ 12.22 hrs, Volume= 1.053 af
Outflow = 11.36 cfs @ 12.22 hrs, Volume= 1.053 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Reach 7R: DP-2

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.055 ac, 82.67% Impervious, Inflow Depth = 4.19" for 10-Year event
Inflow = 0.25 cfs @ 12.09 hrs, Volume= 0.019 af
Outflow = 0.25 cfs @ 12.09 hrs, Volume= 0.019 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Pond 3P: Bioretention Basin (North)

Inflow Area = 1.637 ac, 22.87% Impervious, Inflow Depth = 2.97" for 10-Year event
Inflow = 4.49 cfs @ 12.18 hrs, Volume= 0.406 af
Outflow = 4.09 cfs @ 12.25 hrs, Volume= 0.363 af, Atten= 9%, Lag= 4.0 min
Primary = 3.00 cfs @ 12.25 hrs, Volume= 0.348 af
Secondary = 1.09 cfs @ 12.25 hrs, Volume= 0.016 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 99.13' @ 12.25 hrs Surf.Area= 2,302 sf Storage= 3,149 cf

Plug-Flow detention time= 80.0 min calculated for 0.363 af (90% of inflow)
Center-of-Mass det. time= 30.3 min (854.1 - 823.9)

Volume	Invert	Avail.Storage	Storage Description
#1	96.00'	4,457 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc) 7,639 cf Overall - 3,182 cf Embedded = 4,457 cf
#2	96.00'	955 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc) Inside #1 3,182 cf Overall x 30.0% Voids
		5,411 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
96.00	1,591	0	0
98.00	1,591	3,182	3,182
99.00	2,214	1,903	5,085
100.00	2,894	2,554	7,639

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
96.00	1,591	0	0
98.00	1,591	3,182	3,182

Device	Routing	Invert	Outlet Devices
#1	Device 3	98.50'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Secondary	99.00'	**10.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

#3	Primary	95.00'	**12.0" Round Culvert** L= 81.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 95.00' / 94.00' S= 0.0123 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=3.00 cfs @ 12.25 hrs HW=99.13' (Free Discharge)
↑└**3=Culvert** (Passes 3.00 cfs of 5.69 cfs potential flow)
↑└**1=Orifice/Grate** (Orifice Controls 3.00 cfs @ 3.82 fps)

Secondary OutFlow Max=1.08 cfs @ 12.25 hrs HW=99.13' (Free Discharge)
↑└**2=Broad-Crested Rectangular Weir** (Weir Controls 1.08 cfs @ 0.84 fps)

Summary for Pond 4P: Bioretention Basin (South)

Inflow Area = 2.353 ac, 18.44% Impervious, Inflow Depth = 2.88" for 10-Year event
Inflow = 6.22 cfs @ 12.19 hrs, Volume= 0.565 af
Outflow = 6.08 cfs @ 12.22 hrs, Volume= 0.526 af, Atten= 2%, Lag= 1.9 min
Primary = 6.08 cfs @ 12.22 hrs, Volume= 0.526 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 96.79' @ 12.22 hrs Surf.Area= 2,730 sf Storage= 2,688 cf

Plug-Flow detention time= 56.6 min calculated for 0.526 af (93% of inflow)
Center-of-Mass det. time= 20.6 min (847.5 - 827.0)

Volume	Invert	Avail.Storage	Storage Description
#1	94.70'	5,624 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc) 8,289 cf Overall - 2,665 cf Embedded = 5,624 cf
#2	94.70'	799 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc) Inside #1 2,665 cf Overall x 30.0% Voids
		6,423 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
94.70	2,050	0	0
96.00	2,050	2,665	2,665
97.00	2,910	2,480	5,145
98.00	3,378	3,144	8,289

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
94.70	2,050	0	0
96.00	2,050	2,665	2,665

Device	Routing	Invert	Outlet Devices
#1	Primary	96.40'	**10.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=5.98 cfs @ 12.22 hrs HW=96.79' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 5.98 cfs @ 1.55 fps)

Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: PDA-1B Runoff Area=71,329 sf 22.87% Impervious Runoff Depth=6.39"
Flow Length=538' Tc=13.1 min CN=82 Runoff=9.45 cfs 0.872 af

Subcatchment 2S: PDA-1A Runoff Area=102,493 sf 18.44% Impervious Runoff Depth=6.27"
Flow Length=623' Tc=13.4 min CN=81 Runoff=13.27 cfs 1.230 af

Subcatchment 5S: PDA-1C Runoff Area=29,756 sf 19.98% Impervious Runoff Depth=6.27"
Tc=6.0 min CN=81 Runoff=4.80 cfs 0.357 af

Subcatchment 6S: PDA-2 Runoff Area=2,412 sf 82.67% Impervious Runoff Depth=7.84"
Flow Length=78' Tc=6.0 min CN=94 Runoff=0.45 cfs 0.036 af

Reach 5R: DP-1 Inflow=25.14 cfs 2.378 af
Outflow=25.14 cfs 2.378 af

Reach 7R: DP-2 Inflow=0.45 cfs 0.036 af
Outflow=0.45 cfs 0.036 af

Pond 3P: Bioretention Basin (North) Peak Elev=99.37' Storage=3,733 cf Inflow=9.45 cfs 0.872 af
Primary=3.54 cfs 0.679 af Secondary=5.68 cfs 0.151 af Outflow=9.22 cfs 0.830 af

Pond 4P: Bioretention Basin (South) Peak Elev=97.02' Storage=3,331 cf Inflow=13.27 cfs 1.230 af
Outflow=13.10 cfs 1.191 af

Total Runoff Area = 4.729 ac Runoff Volume = 2.495 af Average Runoff Depth = 6.33"
79.05% Pervious = 3.738 ac 20.95% Impervious = 0.991 ac

Summary for Subcatchment 1S: PDA-1B

Runoff = 9.45 cfs @ 12.18 hrs, Volume= 0.872 af, Depth= 6.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.56"

	Area (sf)	CN	Description
*	53,154	77	>75% Grass cover, Good, AVG HSG C,D
*	14,721	98	Paved parking, AVG HSG C,D
	1,863	74	>75% Grass cover, Good, HSG C
*	1,591	98	Water Surface, HSG C,D
	71,329	82	Weighted Average
	55,017		77.13% Pervious Area
	16,312		22.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	50	0.0100	0.11		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.30"
5.6	443	0.0357	1.32		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	45	0.0260	3.27		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
13.1	538	Total			

Summary for Subcatchment 2S: PDA-1A

Runoff = 13.27 cfs @ 12.18 hrs, Volume= 1.230 af, Depth= 6.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.56"

	Area (sf)	CN	Description
*	83,589	77	>75% Grass cover, Good, AVG HSG C,D
*	15,270	98	Paved parking, AVG HSG C,D
*	1,584	98	Roofs, HSG C,D
*	2,050	98	Water Surface, HSG C,D
	102,493	81	Weighted Average
	83,589		81.56% Pervious Area
	18,904		18.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	50	0.0100	0.11		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.30"
5.4	443	0.0375	1.36		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.7	130	0.0220	3.01		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
13.4	623	Total			

Summary for Subcatchment 5S: PDA-1C

Runoff = 4.80 cfs @ 12.09 hrs, Volume= 0.357 af, Depth= 6.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.56"

	Area (sf)	CN	Description
*	23,810	77	>75% Grass cover, Good, AVG HSG C,D
*	1,482	98	Paved parking, AVG GSG C, D
*	4,464	98	Roofs, HSG C,D
	29,756	81	Weighted Average
	23,810		80.02% Pervious Area
	5,946		19.98% Impervious Area

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

Summary for Subcatchment 6S: PDA-2

Runoff = 0.45 cfs @ 12.09 hrs, Volume= 0.036 af, Depth= 7.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.56"

	Area (sf)	CN	Description
*	418	77	>75% Grass cover, Good, AVG HSG C,D
*	1,994	98	Paved parking, AVG HSG C,D
	2,412	94	Weighted Average
	418		17.33% Pervious Area
	1,994		82.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	78		0.22		**Direct Entry,**

Summary for Reach 5R: DP-1

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 4.674 ac, 20.22% Impervious, Inflow Depth = 6.11" for 100-Year event
Inflow = 25.14 cfs @ 12.19 hrs, Volume= 2.378 af
Outflow = 25.14 cfs @ 12.19 hrs, Volume= 2.378 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Reach 7R: DP-2

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.055 ac, 82.67% Impervious, Inflow Depth = 7.84" for 100-Year event
Inflow = 0.45 cfs @ 12.09 hrs, Volume= 0.036 af
Outflow = 0.45 cfs @ 12.09 hrs, Volume= 0.036 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Pond 3P: Bioretention Basin (North)

Inflow Area = 1.637 ac, 22.87% Impervious, Inflow Depth = 6.39" for 100-Year event
Inflow = 9.45 cfs @ 12.18 hrs, Volume= 0.872 af
Outflow = 9.22 cfs @ 12.21 hrs, Volume= 0.830 af, Atten= 2%, Lag= 1.8 min
Primary = 3.54 cfs @ 12.21 hrs, Volume= 0.679 af
Secondary = 5.68 cfs @ 12.21 hrs, Volume= 0.151 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 99.37' @ 12.21 hrs Surf.Area= 2,468 sf Storage= 3,733 cf

Plug-Flow detention time= 49.0 min calculated for 0.830 af (95% of inflow)
Center-of-Mass det. time= 21.8 min (824.1 - 802.3)

Volume	Invert	Avail.Storage	Storage Description
#1	96.00'	4,457 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc) 7,639 cf Overall - 3,182 cf Embedded = 4,457 cf
#2	96.00'	955 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc) Inside #1 3,182 cf Overall x 30.0% Voids
		5,411 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
96.00	1,591	0	0
98.00	1,591	3,182	3,182
99.00	2,214	1,903	5,085
100.00	2,894	2,554	7,639

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
96.00	1,591	0	0
98.00	1,591	3,182	3,182

Device	Routing	Invert	Outlet Devices
#1	Device 3	98.50'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Secondary	99.00'	**10.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

#3	Primary	95.00'	**12.0" Round Culvert** L= 81.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 95.00' / 94.00' S= 0.0123 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=3.53 cfs @ 12.21 hrs HW=99.37' (Free Discharge)
↑**3=Culvert** (Passes 3.53 cfs of 5.87 cfs potential flow)
↑**1=Orifice/Grate** (Orifice Controls 3.53 cfs @ 4.49 fps)

Secondary OutFlow Max=5.61 cfs @ 12.21 hrs HW=99.37' (Free Discharge)
↑**2=Broad-Crested Rectangular Weir** (Weir Controls 5.61 cfs @ 1.51 fps)

Summary for Pond 4P: Bioretention Basin (South)

Inflow Area = 2.353 ac, 18.44% Impervious, Inflow Depth = 6.27" for 100-Year event
Inflow = 13.27 cfs @ 12.18 hrs, Volume= 1.230 af
Outflow = 13.10 cfs @ 12.21 hrs, Volume= 1.191 af, Atten= 1%, Lag= 1.6 min
Primary = 13.10 cfs @ 12.21 hrs, Volume= 1.191 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 97.02' @ 12.21 hrs Surf.Area= 2,918 sf Storage= 3,331 cf

Plug-Flow detention time= 33.2 min calculated for 1.191 af (97% of inflow)
Center-of-Mass det. time= 14.6 min (819.5 - 804.9)

Volume	Invert	Avail.Storage	Storage Description
#1	94.70'	5,624 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc) 8,289 cf Overall - 2,665 cf Embedded = 5,624 cf
#2	94.70'	799 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc) Inside #1 2,665 cf Overall x 30.0% Voids
		6,423 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
94.70	2,050	0	0
96.00	2,050	2,665	2,665
97.00	2,910	2,480	5,145
98.00	3,378	3,144	8,289

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
94.70	2,050	0	0
96.00	2,050	2,665	2,665

Device	Routing	Invert	Outlet Devices
#1	Primary	96.40'	**10.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=12.99 cfs @ 12.21 hrs HW=97.01' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 12.99 cfs @ 2.11 fps)

APPENDIX C

WATER QUALITY CALCULATIONS

- Pretreatment Calculations
- Recharge Volume Calculations
- Water Quality Calculations
- HydroCAD Storage Tables
- TSS Removal Calculations

Green International Affiliates, Inc

PRETREATMENT CALCULATION

Date: March 25th, 2021
Revised:
Project: New Bedford Buttonwood
Project No: 21002
Location: New Bedford, MA

Prepared By: JT/MW
Checked By: DHS

Objective: To determine the required pretreatment Volume for adaqute stormwater treatment

Methodology: MA Department of Environmental Protection (DEP) Stormwater Management (Vol. 2, Ch. 2)

Design Criteria: Volume to be treated = 0.1" x Post Development Impervious Area

Calculation results:

Designation	Volume Required (cf)	Volume Provided (cf)
Drainage Area to Crushed Stone North	**123**	**126**
Drainage Area to crushed Stone South	**140**	**141**

Volume to be Treated:

Drainage to Crushed Stone North
Total Proposed Impervious Area: 14,721 sf
Total Volume to be treated: **123 cf**

Drainage to Crushed Stone South
Total Proposed Impervious Area: 16,854 sf
Total Volume to be treated: **140 cf**

Volume Provided:

Crushed Stone to Bioretention Area North

Top Elevation =	99.60	Area of contour =	210 sf		
Bottom Elev =	97.60	Area of contour =	210 sf	Vol. of Crushed Stone:	420 cf
	Void Ratio of Crushed Stone=		0.30	Vol. of Treatment:	**126 cf**

Crushed Stone to Bioretention Area South

Top Elevation =	96.75	Area of contour =	235 sf		
Bottom Elev =	94.75	Area of contour =	235 sf	Vol. of Crushed Stone:	470 cf
	Void Ratio of Crushed Stone=		0.30	Vol. of Treatment:	**141 cf**

GREEN INTERNATIONAL AFFILIATES, INC.
Civil and Structural Engineers

RECHARGE VOLUME CALCULATIONS

Date: May 28, 2021
Revised:
Project: New Bedford Buttonwood
Project No: 21002
Location: New Bedford, MA

Prepared By: JT/MW
Checked By: DHS

Recharge Volume Design

Objective: Size infiltration BMPs that will approximate the annual recharge from the existing conditions.

Methodology: MA Department of Environmental Protection (DEP) Massachusetts Stormwater Handbook (Vol.3, Ch.1)

Design Criteria:

The required recharge volume equals a depth of runoff corresponding to the soil type times the impervious areas covering that soil type at the post-development site.

Based on the Site Hydrologic Soil Group:

Hydrologic Soil Group	Soil Texture	Target Depth Factor (F)
A	Sand	0.60 inches
B	Loam	0.35 inches
C	Silty Loam	0.25 inches
D	Clay	0.10 inches

The soils are defined by the Soil Conservation Services (SCS) Soil Survey of Bristol County of Massachusetts. The site is comprised of 'C/D' soils. C soils were used for this calculation.

Required Drawdown Time: Maximum of 72 Hours using the following equation:

$$\text{Drawdown Time} = \frac{R_v}{(K x A_{Bot})}$$

R_v = Required Recharge Volume
K = Permeability
A_{Bot} = Bottom area of basin

Calculation Results:

Designation	Volume Required (cf)	Volume Provided (cf)
Total Recharge Volume	**587**	**3,516**

Recharge Volume Required: **Total Recharge Required**

Hydrologic Soil Group	Impervious Area (SF)	Target Depth	Volume Required
A	0	0.60	0 cf
B	0	0.35	0 cf
C	29,829	0.25	621 cf
D	0	0.10	0 cf
Total	**29,829**		**621** cf

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Receiving Impervious Area by BMP:

Drainage Area to North Bioretention Area=	14,721	sf
Drainage Area to South Bioretention Area=	16,854	sf
Total:	**31,575**	sf

Capture Area Adjustment

Hydrologic Soil Group	Impervious Area Routed to Basins		
A	0		
B	0		
C	31,575	Capture Area Adjustment	Volume Required
D	0		
Total	**31,575**	**0.945**	**587** cf

Recharge Volume Provided:

Sum of BMP's
METHOD USED: STATIC

Rv = combined storage below lowest outlets for all BMP's = **3,516 cf**

METHOD USED: STATIC

Drainage Area to North Bioretention Area

R_v = storage below lowest outlet (orifice) = **1,828 cf** (Elev. 98.40, See HydroCAD Table)
A_{Bot} = bottom area of basin = 1,591 sf

R_v cf	K in/hr	A_{Bot} sf	Drawdown Time Hours		
1,828	0.27	1,600	**50.78**	**<**	**72 Hours**

METHOD USED: STATIC

Drainage Area to South Bioretention Area

R_v = storage below lowest outlet (orifice) = **1,688 cf** (Elev. 96.40, See HydroCAD Table)
A_{Bot} = bottom area of basin = 2050 sf

R_v cf	K in/hr	A_{Bot} sf	Drawdown Time Hours		
1,688	0.27	2,050	**36.60**	**<**	**72 Hours**

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GREEN INTERNATIONAL AFFILIATES, INC.
Civil and Structural Engineers

WATER QUALITY CALCULATIONS

Date: May 28, 2021
Revised:
Project: New Bedford Buttonwood
Project No: 21002
Location: New Bedford, MA

Prepared By: JT/MW
Checked By: DHS

Objective: To determine the required Water Quality Volume (WQV) for adaqute stormwater treatment

Methodology: MA Department of Environmental Protection (DEP) Stormwater Management (Vol. 3, Ch. 1)

Design Criteria: Volume to be treated =0.5" x Post Development Impervious Area

All WQ calculations use 0.5"

Calculation results:

Designation	Volume Required (cf)	Volume Provided (cf)
Total Treatment Volume	**1,243**	**3,516**
Bioretention Area North	**613**	**1,828**
Bioretention Area South	**702**	**1,688**

Total Treatment Volume Required:
Total proposed impervious area within LOW: 29,829 sf
Total Treatment volume required: **1,243 cf**

Total Treatment Volume Provided:
Total receiving impervious area to BMPs = 31,575 sf (Sum of all BMPs)
WQv = combined storage below lowest outlet = **3,516 cf**

Volume to be Treated:

Drainage to Bioretention Basin North
Total Proposed Impervious Area: 14,721 sf
Total Volume to be treated: **613 cf**

Drainage to Bioretention Basin South
Total Proposed Impervious Area: 16,854 sf
Total Volume to be treated: **702 cf**

Volume Provided:

Drainage to Bioretention Basin North
WQv = storage provided below lowest outlet = **1,828 cf** (Elev. 98.50, See HydroCAD Table)

Drainage to Bioretention Basin South
WQv = storage provided below lowest outlet = **1,688 cf** (Elev. 96.40, See HydroCAD Table)

Stage-Area-Storage for Pond 3P: Bioretention Basin (North)

Elevation (feet)	Storage (cubic-feet)
96.00	0
96.05	24
96.10	48
96.15	72
96.20	95
96.25	119
96.30	143
96.35	167
96.40	191
96.45	215
96.50	239
96.55	263
96.60	286
96.65	310
96.70	334
96.75	358
96.80	382
96.85	406
96.90	430
96.95	453
97.00	477
97.05	501
97.10	525
97.15	549
97.20	573
97.25	597
97.30	620
97.35	644
97.40	668
97.45	692
97.50	716
97.55	740
97.60	764
97.65	788
97.70	811
97.75	835
97.80	859
97.85	883
97.90	907
97.95	931
98.00	955
98.05	1,035
98.10	1,117
98.15	1,200
98.20	1,285
98.25	1,372
98.30	1,460
98.35	1,550
98.40	1,641
98.45	1,734
98.50	1,828
98.55	1,924
98.60	2,021
98.65	2,120
98.70	2,221
98.75	2,323
98.80	2,427
98.85	2,532
98.90	2,639
98.95	2,747
99.00	2,857
99.05	2,969
99.10	3,082
99.15	3,197
99.20	3,314
99.25	3,432
99.30	3,552
99.35	3,674
99.40	3,797
99.45	3,922
99.50	4,049
99.55	4,178
99.60	4,308
99.65	4,440
99.70	4,574
99.75	4,709
99.80	4,846
99.85	4,985
99.90	5,125
99.95	5,267
100.00	**5,411**

Stage-Area-Storage for Pond 4P: Bioretention Basin (South)

Elevation (feet)	Storage (cubic-feet)
94.70	0
94.75	31
94.80	61
94.85	92
94.90	123
94.95	154
95.00	184
95.05	215
95.10	246
95.15	277
95.20	308
95.25	338
95.30	369
95.35	400
95.40	431
95.45	461
95.50	492
95.55	523
95.60	554
95.65	584
95.70	615
95.75	646
95.80	676
95.85	707
95.90	738
95.95	769
96.00	799
96.05	903
96.10	1,009
96.15	1,117
96.20	1,227
96.25	1,339
96.30	1,453
96.35	1,570
96.40	1,688
96.45	1,809
96.50	1,932
96.55	2,057
96.60	2,184
96.65	2,314
96.70	2,445
96.75	2,579
96.80	2,715
96.85	2,853
96.90	2,993
96.95	3,135
97.00	3,279
97.05	3,426
97.10	3,573
97.15	3,721
97.20	3,871
97.25	4,022
97.30	4,174
97.35	4,327
97.40	4,481
97.45	4,636
97.50	4,793
97.55	4,951
97.60	5,110
97.65	5,270
97.70	5,431
97.75	5,594
97.80	5,757
97.85	5,922
97.90	6,088
97.95	6,255
98.00	**6,423**

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: Buttonwood DP-1 North Bioretention Basin

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)
Bioretention Area	**0.90**	**1.00**	**0.90**	**0.10**
	0.00	**0.10**	**0.00**	**0.10**
	0.00	**0.10**	**0.00**	**0.10**
	0.00	**0.10**	**0.00**	**0.10**
	0.00	**0.10**	**0.00**	**0.10**

Total TSS Removal = **90%**

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

Project: 21002
Prepared By: MW
Date: 6/10/2021

*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

INSTRUCTIONS:

Version 1, Automated: Mar. 4, 2008

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

Location: Buttonwood DP-1 South Bioretention Basin

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)
Bioretention Area	**0.90**	**1.00**	**0.90**	**0.10**
	0.00	**0.10**	**0.00**	**0.10**
	0.00	**0.10**	**0.00**	**0.10**
	0.00	**0.10**	**0.00**	**0.10**
	0.00	**0.10**	**0.00**	**0.10**

Total TSS Removal = **90%**

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

Project: 21002
Prepared By: MW
Date: 6/10/2021

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

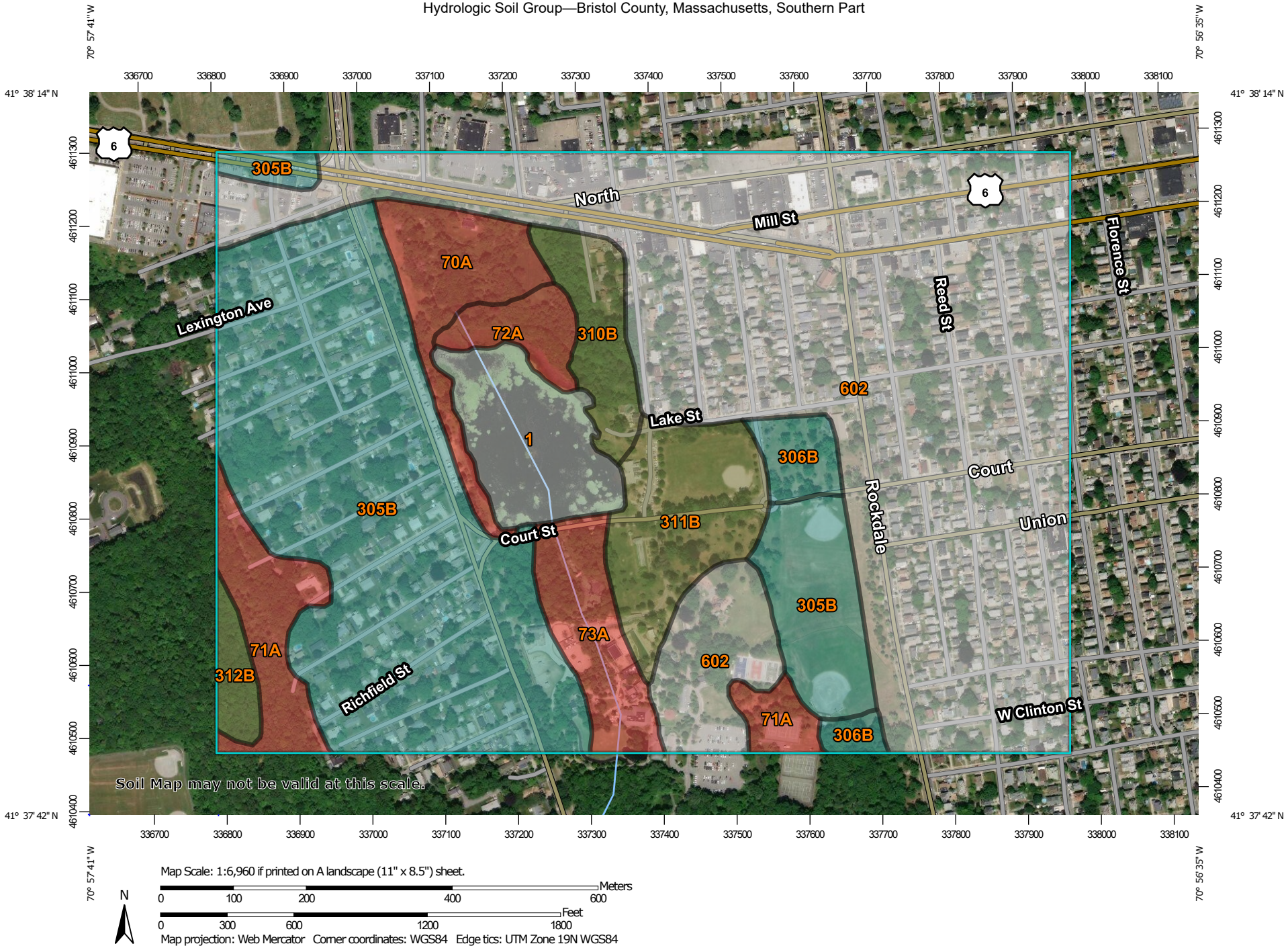
Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed

1. From MassDEP Stormwater Handbook Vol. 1

APPENDIX D

SOIL INFORMATION

- NRCS Soils Report (from NRCS Website)
- Geotechnical Engineering Report GEI


70° 57' 41" W
70° 56' 35" W
41° 38' 14" N
41° 37' 42" N
336700
336800
336900
337000
337100
337200
337300
337400
337500
337600
337700
337800
337900
338000
338100
4611300
4611200
4611100
4611000
4610900
4610800
4610700
4610600
4610500
4610400
6
305B
North
Mill St
70A
72A
310B
Lexington Ave
Reed St
Florence St
602
Lake St
1
306B
Court
Rockdale
Union
311B
Court St
305B
73A
71A
312B
Richfield St
602
305B
71A
306B
W Clinton St
Soil Map may not be valid at this scale.
Map Scale: 1:6,960 if printed on A landscape (11" x 8.5") sheet.
N
Meters
0
100
200
400
600
Feet
0
300
600
1200
1800
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A
A/D
B
B/D
C
C/D
D
Not rated or not available

Soil Rating Lines

A
A/D
B
B/D
C
C/D
D
Not rated or not available

Soil Rating Points

A
A/D
B
B/D
C
C/D
D
Not rated or not available

Water Features

Streams and Canals

Transportation

Rails
Interstate Highways
US Routes
Major Roads
Local Roads

Background

Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Bristol County, Massachusetts, Southern Part
Survey Area Data: Version 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.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1	Water		10.1	4.2%
70A	Ridgebury fine sandy loam, 0 to 3 percent slopes	D	8.7	3.7%
71A	Ridgebury fine sandy loam, 0 to 3 percent slopes, extremely stony	D	9.5	4.0%
72A	Whitman fine sandy loam, 0 to 3 percent slopes	D	3.7	1.5%
73A	Whitman fine sandy loam, 0 to 3 percent slopes, extremely stony	D	7.7	3.2%
305B	Paxton fine sandy loam, 3 to 8 percent slopes	C	66.4	27.8%
306B	Paxton fine sandy loam, 0 to 8 percent slopes, very stony	C	4.0	1.7%
310B	Woodbridge fine sandy loam, 3 to 8 percent slopes	C/D	6.1	2.6%
311B	Woodbridge fine sandy loam, 0 to 8 percent slopes, very stony	C/D	12.1	5.1%
312B	Woodbridge fine sandy loam, 0 to 8 percent slopes, extremely stony	C/D	2.4	1.0%
602	Urban land		107.9	45.2%
Totals for Area of Interest			**238.8**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

GEI Consultants

Consulting Engineers and Scientists

June 10, 2021
Project 2101938

Ms. Danielle Spicer, P.E.
Green International Affiliates, Inc.
239 Littleton Road, Suite 3
Westford, MA 01886

Dear Ms. Spicer:

Re: **Results of Test Pits and Laboratory Testing**
Proposed Stormwater Improvements
Buttonwood Senior Center
New Bedford, Massachusetts

This letter presents the results of test pits and laboratory testing performed to support the design of a proposed stormwater improvements at the Buttonwood Senior Center in New Bedford, Massachusetts.

Scope of Work

Our scope of work consisted of the following:

- Observed two test pits excavated by the City of New Bedford Department Public Works.
- Performed combined mechanical sieve and hydrometer analyses on five soil samples collected from the test pits to evaluate their suitability for stormwater infiltration.
- Determined the hydrologic soil groups based on the laboratory testing of the soils and made observations of probable high groundwater levels for use in designing the infiltration systems.
- Prepared this letter presenting the results of the explorations and the laboratory testing.

Exploration Program

The City of New Bedford excavated two test pits (TP1 and TP2) at the site on May 19, 2021. A GEI representative observed and documented the Test Pits. Test Pit logs are provided in Appendix A. Test Pit locations are shown in Figure 1.

The test pits were excavated in the general areas of proposed stormwater improvements and were marked out in the field by a representative of the City of New Bedford. The locations and ground surface elevations of the completed test pits were surveyed by the City of New Bedford.

GEI Consultants, Inc.
400 Unicorn Park Drive, Woburn, MA 01801
781.721.4000

Subsurface Conditions

TP1 encountered about 0.7 feet of silty sand topsoil overlying about 1.5 feet of silty sand fill overlying natural silty sand with gravel to the termination depth of 6.5 feet. The test pit exposed a 2-inch diameter steel pipe at a depth of about 1.6 feet. The pipe was running parallel to the edge of the adjacent paved parking area. The pipe appeared to be an old abandoned gas line. TP2 encountered about 1-foot of silty sand topsoil, overlying about 1-foot of silty sand subsoil, overlying natural silty sand with gravel to the termination depth of 7.5 feet. There were stumps and manmade debris in the topsoil layer.

Groundwater Levels

Groundwater was not encountered in the test pits. In addition, no soil mottling (indicative of previous seasonal high groundwater levels) was observed in TP1. Soil mottling indicative of previous seasonal high groundwater was observed in TP2 at a depth of about four feet.

Laboratory Testing

We performed five mechanical sieve and hydrometer analyses on soil samples collected from the test pits. The results of the laboratory tests are provided in Appendix B.

Soil Descriptions and Infiltration Rates at the Stormwater Infiltration Basin Test Pits

Soil descriptions on the test pit logs (Appendix A) and on the individual grain-size distribution reports (Appendix B) are based on the Unified Soil Classification System (USCS). Also included in Appendix B is a figure that provides the results of the grain-size analyses based on the United States Department of Agriculture (USDA) Soil Description System. The USDA soil descriptions were used to determine soil texture class, National Resource Conservation Services (NRCS) hydrologic soil group, and estimated infiltration rates (Rawls Rate), as described in the Massachusetts Stormwater Handbook. The soil texture class, hydrologic soil group, and Rawls Rates are provided in Table 1.

Please call Steve Sarandis at 781-264-8905 if you have any questions.

Sincerely,

GEI CONSULTANTS, INC.

Stephen J. Sarandis, P.E.
Geotechnical Engineer

Richard F. Tobin, P.E.
Senior Project Manager

SJS/RFT:jam
\\geiconsultants.com\data\Data_Storage\Working\GREEN INTERNATIONAL AFFILIATES\2101938 Stormwater Improvements New Bedford\06_Letter Report\Stormwater Results Ltr.docx

Attachments:
Table 1 – Exploration Data and Infiltration Rates
Figure 1 – Test Pit Location Plan
Appendix A – Test Pit Logs
Appendix B – Mechanical Sieve and Hydrometer Analyses Results for Stormwater Design

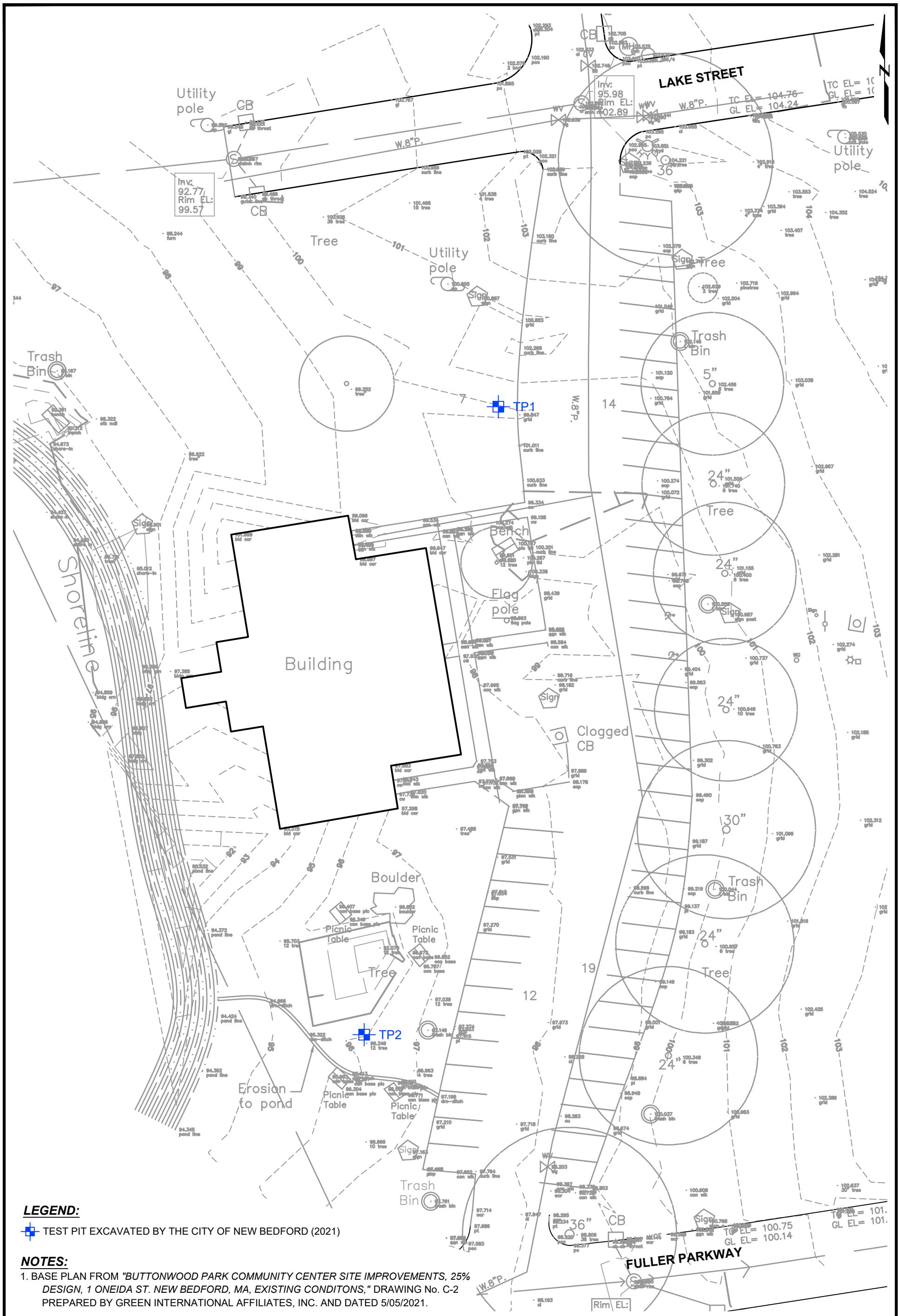
Table

Table 1. Exploration Data and Infiltration Rates
Proposed Stormwater Improvements
Buttonwood Senior Center
New Bedford, Massachusetts

Test Pit Number	Approx. Ground Surface Elevation[1, 2]	Bottom of Test pit		Layer Depth	Field Description of Soil	Soil Horizon	USDA Soil Texture[3]	NRCS Hydrologic Soil Group	Infiltration Rate[4]	Est. Depth to Probable High Water[5]
	(ft)	Depth (ft)	El. (ft)	(ft)					(in/hr)	(ft)
TP1	99.9	6.5	93.4	0.0 - 0.7	SILTY SAND(SM) ~70% mostly fine to medium sand,~20% slightly plastic fines,~10% fine gravel, organics, Dk. Brown <Top Soil>	(Fill)	NA	NA	--	>6.5
				0.7 - 2.2	SILTY SAND (SM) 47.7% mostly fine to medium sand, 44.9% slightly plastic fines,~7.4% fine gravel, occ. pockets of dk. Brown silty sand. Two cobbles, ~ 10 inches. Lt. Brown <Fill>	(Fill)	Sandy Loam	B	1.02	
				2.2 - >6.5	SILTY SAND WITH GRAVEL (SM) 44.6% mostly fine to medium sand, ~30.8% slightly plastic fines, 24.6% fine to coarse gravel, compact, lt gray.	C	Sandy Loam	B	1.02	
TP2	96.3	7.5	88.8	0.0 - 1.0	SILTY SAND(SM) 55.5% mostly fine to medium sand, 36.8% slightly plastic fines,~7.7% fine gravel, roots, stumps, debris, Dk. Brown <Top Soil>	A	Sandy Loam	B	1.02	4
				1.0 - 2.0	SILTY SAND (SM) 53.5% mostly fine sand, 36.1% slightly plastic fines, 10.4% fine gravel, orange-brown.	B	Sandy Loam	B	1.02	
				2.0 - >7.5	SILTY SAND WITH GRAVEL (SM) 49.5% fine to coarse sand, 30.6% non plastic fines, ~19.9% fine to coarse gravel, compact, lt gray. <Grain Size Test> Some minor mottles observed at 2.5 feet. Frequent mottles observed at four feet.	C	Sandy Loam	B	1.02	

Notes:
1. Elevation datum is the North American Vertical Datum (NAVD) of 1988.
2. Ground surface elevations surveyed by the City of New Bedford.
3. USDA soil texture is derived from Fig. 2.3.2, of the Massachusetts Stormwater Handbook (Vol 3, Ch. 1) using the results of grain size tests performed on soil samples obtained from the borings.
4. Infiltration rate is derived from Table 2.3.3, of the Massachusetts Stormwater Handbook (Vol. 3, Ch.1) using the results of grain size tests performed on soil samples obtained from the test pits.
5. Estimated depths to Probable High Water is based on visual observations of test pits and signs of mottling in the soils exposed on the sidewalls of the test pit.

Figure



LEGEND:

TEST PIT EXCAVATED BY THE CITY OF NEW BEDFORD (2021)

NOTES:

1. BASE PLAN FROM *"BUTTONWOOD PARK COMMUNITY CENTER SITE IMPROVEMENTS, 25% DESIGN, 1 ONEIDA ST. NEW BEDFORD, MA, EXISTING CONDITONS,"* DRAWING No. C-2 PREPARED BY GREEN INTERNATIONAL AFFILIATES, INC. AND DATED 5/05/2021.

0 30 60

SCALE, FEET

Proposed Stormwater Improvements
Buttonwood Senior Center
New Bedford, Massachusetts

Green International Affiliates, Inc.
Westford, Massachusetts

GEI Consultants

TEST PIT LOCATION PLAN

Project 2101938 | June 2021 | Fig. 1

CLINGEN, PAUL B:\Working\GREEN INTERNATIONAL AFFILIATES\2101938 Stormwater Improvements New Bedford\00_CAD\Figures\Gt\2101938-01.dwg - 6/4/2021

Appendix A

Test Pit Logs

TEST PIT LOG

TP1

Project	Proposed Stormwater Improvements - North Road			**PG.** 1 **OF** 1	
City/Town	City New Bedford			**Location**	See Plan
Client	Green International Affiliates, Inc.				
Contractor	City of Bedford			**Ground El.**	99.9
Equipment/Reach	John Deere 410L/ ~10 feet			**Datum**	NAVD88
Operator	Mike Barboza	**GEI Rep**	S. Sarandis	**GEI Proj. No.**	2101938
Weather	Sunny 70's			**Date**	5/19/2021

Depth	Sample No. and Type	Sample Depth (ft)	Soil Description
1	S1 (bag)	1.5'	0 - 0.7': SILTY SAND(SM) ~70% mostly fine to medium sand,~20% slightly plastic fines,~10% fine gravel, organics, Dk. Brown <Top Soil>
2			0.7' - 2.2': SILTY SAND (SM) 47.7% mostly fine to medium sand, 44.9% slightly plastic fines,~7.4% fine gravel, occ. pockets of dk. Brown silty sand. Two cobbles, ~ 10 inches. Lt. Brown <Fill> <Grain Size Test>
3	S2 (bag)	3.0'	
4			2.2 - .>6.5': SILTY SAND WITH GRAVEL (SM) 44.6% mostly fine to medium sand, ~30.8% slightly plastic fines, 24.6% fine to coarse gravel, compact, lt gray. <Grain Size Test>
5			
6			
7			Bottom of test pit at 6.5 ft. Test pit dry at completion Did not observe any mottles Test pit backfilled with the excavated soil placed in lifts and tamped with the excavator bucket.
8			
9			
10			

Notes:

1. Encountered 2-inch diameter steel pipe at a depth of 1.6 feet. Pile ran parallel to the curb line. Pipe was about 10.6 feet from front edge of curb.

Pit Dimensions (ft)

length	6
width	3
depth	6.5

GEI Consultants

Test Pit 1 - In progress. Pipe visible on far side of excavation

Test Pit 1 - Excavation complete.

TEST PIT LOG

TP2

Project	Proposed Stormwater Improvements - North Road			**PG.** 1 **OF** 1	
City/Town	City New Bedford			**Location**	See Plan
Client	Green International Affiliates, Inc.				
Contractor	City of Bedford			**Ground El.**	96.3
Equipment/Reach	John Deere 410L/ ~10 feet			**Datum**	NAVD88
Operator	Mike Barboza	**GEI Rep**	S. Sarandis	**GEI Proj. No.**	2101938
Weather	Sunny 70's			**Date**	5/19/2021

Depth	Sample No. and Type	Sample Depth (ft)	Soil Description
1			0 - 1.0': SILTY SAND(SM) 55.5% mostly fine to medium sand, 36.8% slightly plastic fines,~7.7% fine gravel, roots, stumps, debris, Dk. Brown <Top Soil> <Grain Size Test>
2			1.0' - 2.0': SILTY SAND (SM) 53.5% mostly fine sand, 36.1% slightly plastic fines, 10.4% fine gravel, orange-brown. <Grain Size Test>
3			2.0 ->7.5': SILTY SAND WITH GRAVEL (SM) 49.5% fine to coarse sand, 30.6% non plastic fines, ~19.9% fine to coarse gravel, compact, lt gray. <Grain Size Test> Some minor mottles observed at 2.5 feet. Frequent mottles observed at four feet.
4			
5			
6			
7			
8			Bottom of test pit at 7.5 ft. Test pit dry at completion Frequent mottles observed starting at 4 feet. Test pit backfilled with the excavated soil placed in lifts and tamped with the excavator bucket.
9			
10			

Notes:

Pit Dimensions (ft)

length	11
width	4
depth	7.5

GEI Consultants

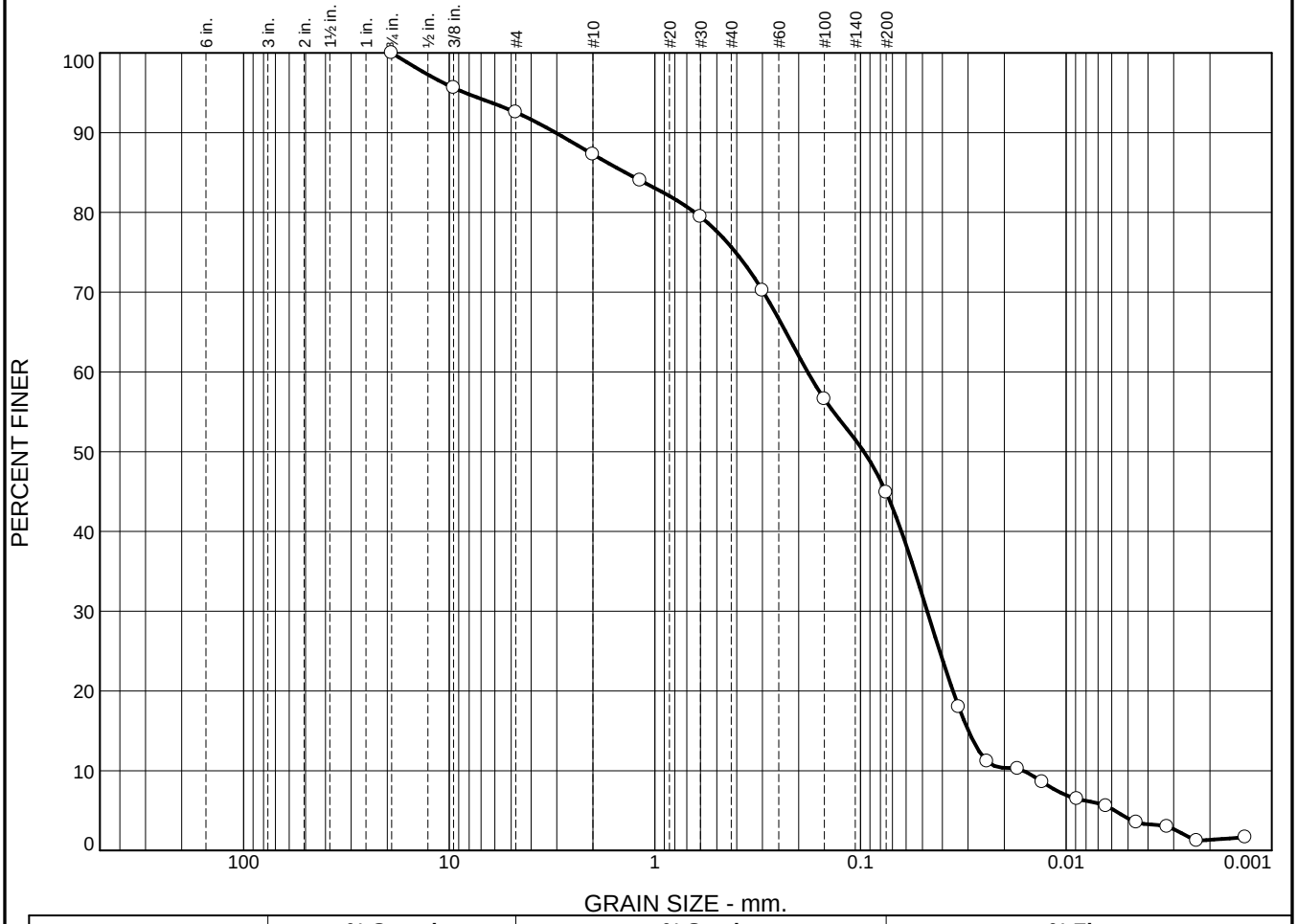
Test Pit 2 - In progress.

Test Pit 2 - Excavation complete.

Appendix B

Mechanical Sieve and Hydrometer Analyses Results for Stormwater Design

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	7.4	5.3	11.6	30.8	40.9	4.0

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			1.3921	0.1807	0.0963	0.0474	0.0299	0.0161	0.77	11.20

Material Description	USCS	AASHTO
○ Silty SAND	SM	

Project No. 2101938 **Client:** Green International Affiliates, Inc.

Project: Buttonwood Senior Center

○ **Source of Sample:** TP1 **Depth:** 1.5 ft **Sample Number:** S1

Remarks:

○As Received WC=13.5%

Fines classified visually

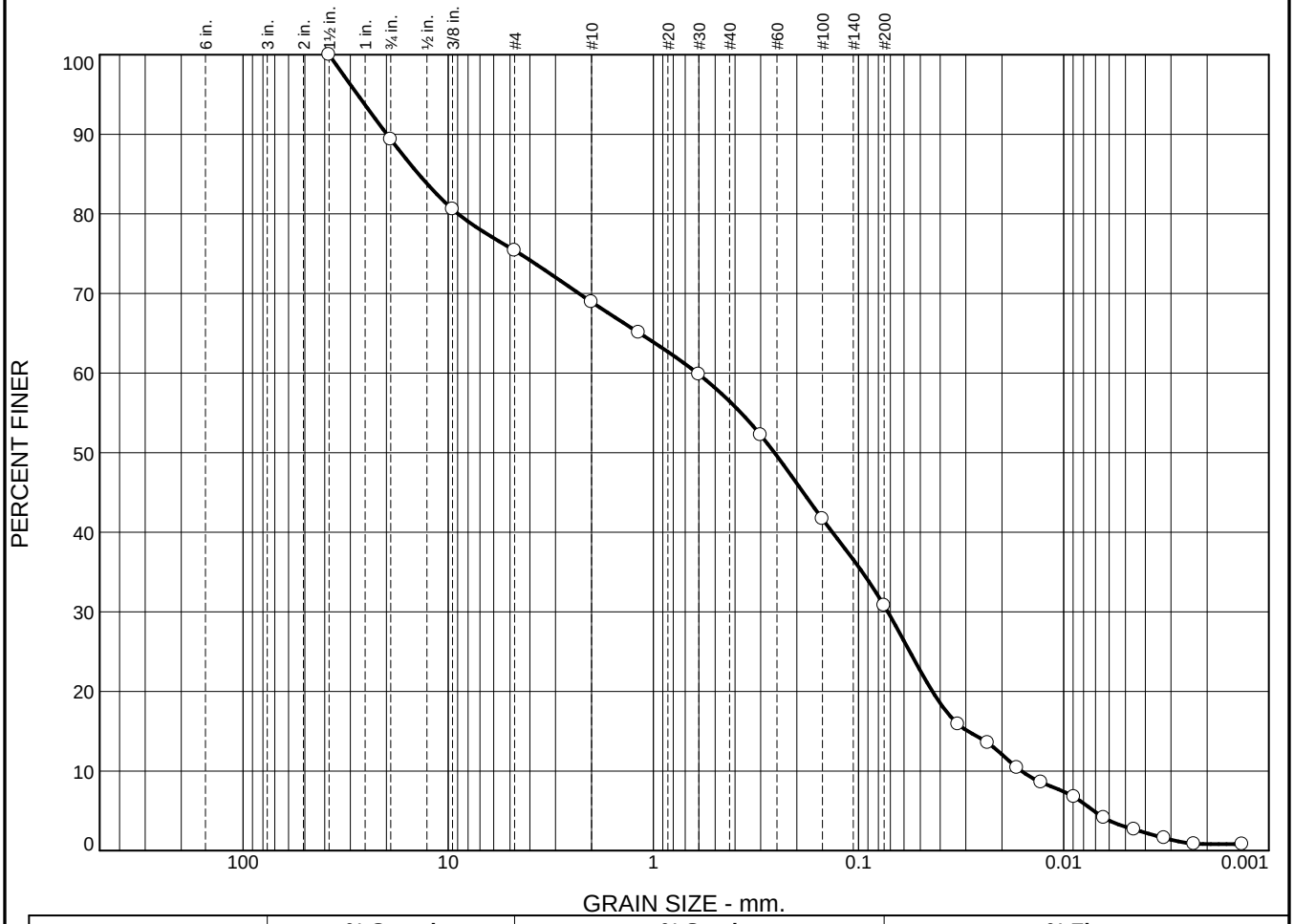
GEI Consultants, Inc.
400 Unicorn Park Drive
Woburn, MA 01801

GEI Consultants

Figure

Tested By: MA **Checked By:** EF

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	10.6	14.0	6.5	12.4	25.7	27.8	3.0

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			13.9452	0.6115	0.2571	0.0719	0.0293	0.0161	0.53	38.04

Material Description	USCS	AASHTO
○ Silty SAND with Gravel	SM	

Project No. 2101938 **Client:** Green International Affiliates, Inc.

Project: Buttonwood Senior Center

○ **Source of Sample:** TP1 **Depth:** 3.0 ft **Sample Number:** S2

Remarks:

○As Received WC=7.8%

Fines classified visually

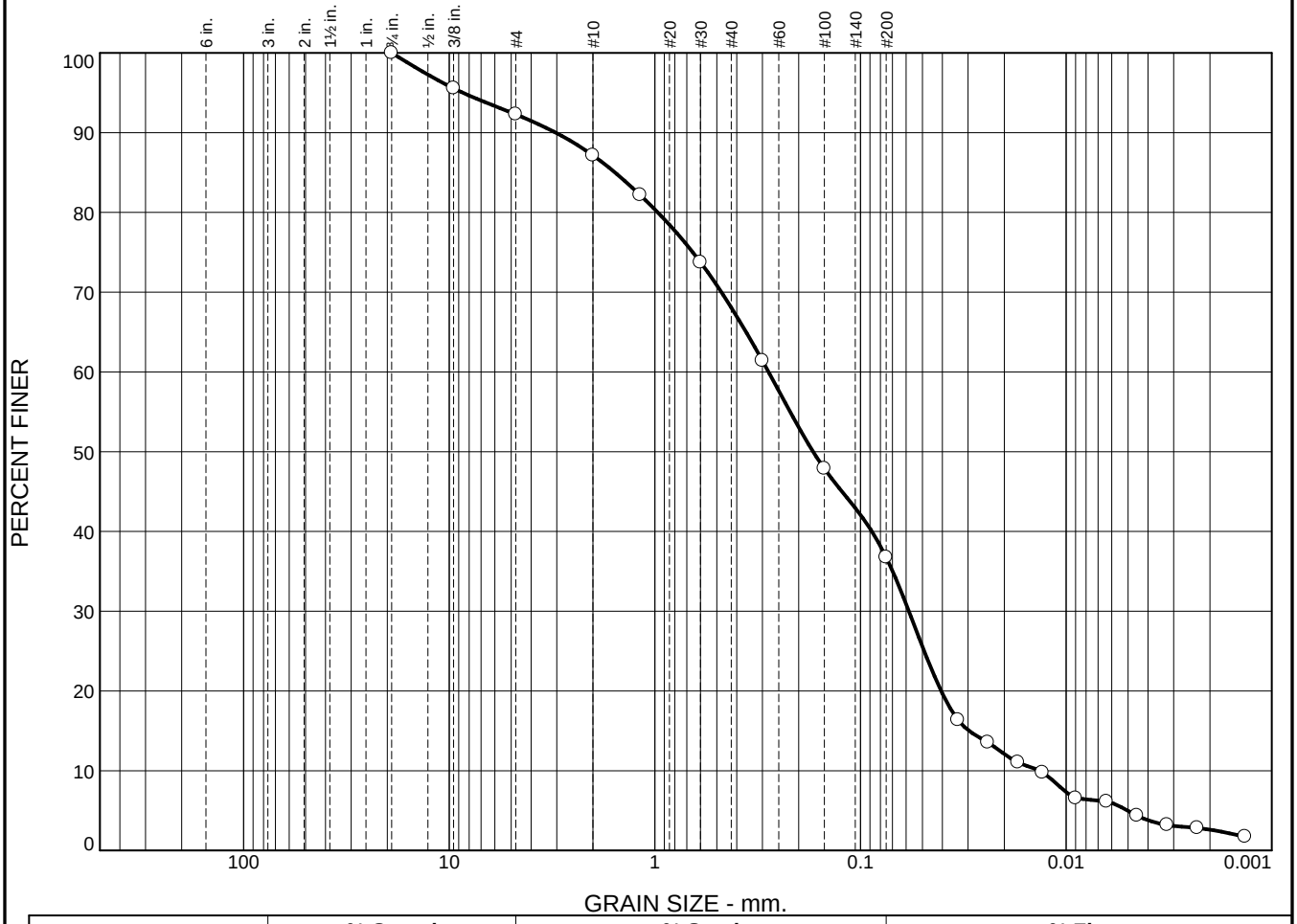
GEI Consultants, Inc.
400 Unicorn Park Drive
Woburn, MA 01801

GEI Consultants

Figure

Tested By: MA **Checked By:** EF

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	7.7	5.2	19.0	31.3	31.8	5.0

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			1.5630	0.2801	0.1700	0.0582	0.0297	0.0135	0.90	20.76

Material Description	USCS	AASHTO
○ Silty SAND	SM	

Project No. 2101938 **Client:** Green International Affiliates, Inc.

Project: Buttonwood Senior Center

○ **Source of Sample:** TP2 **Depth:** 0.5 ft **Sample Number:** S1

Remarks:

○As Received WC=18.1%

Fines classified visually

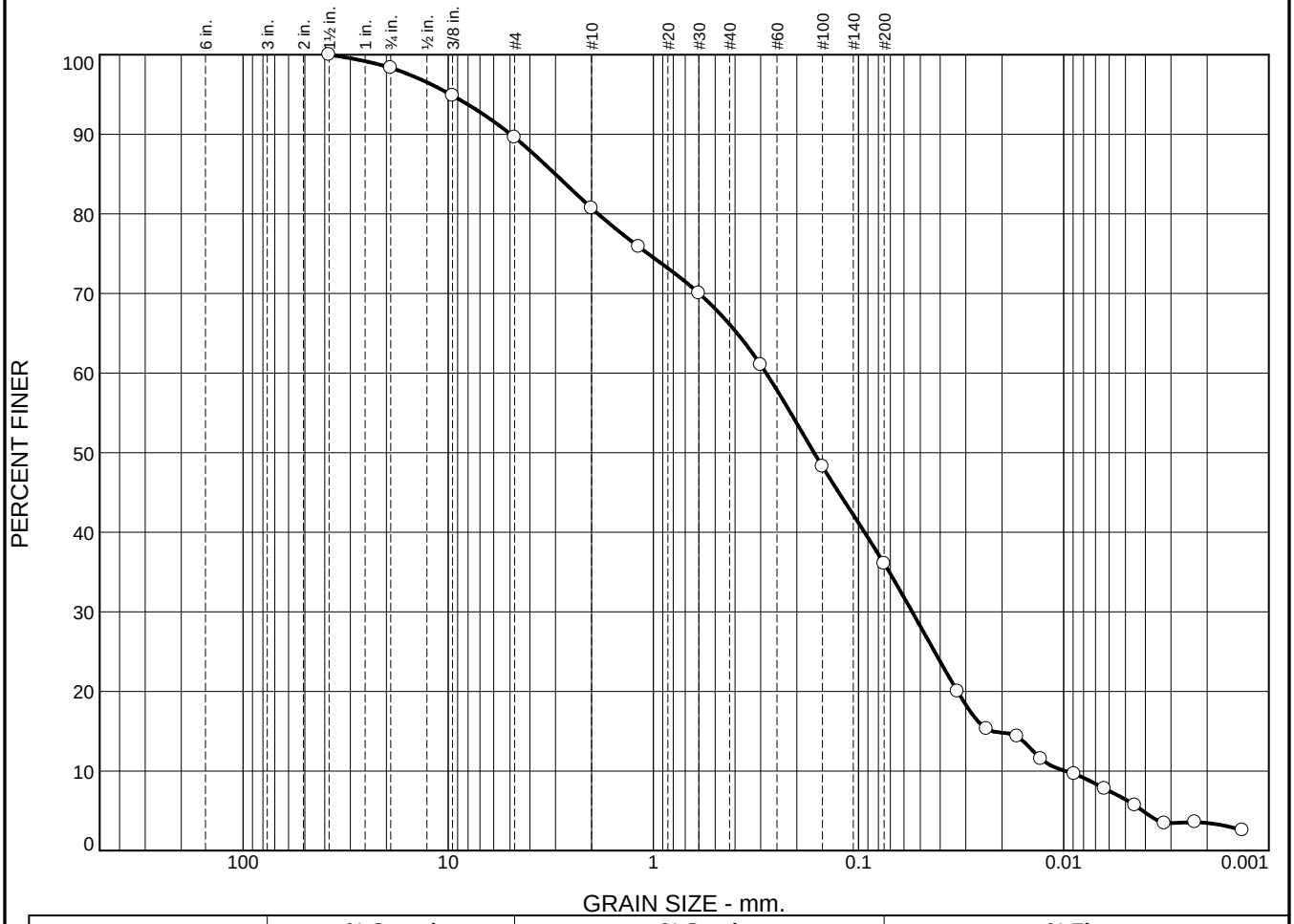
GEI Consultants, Inc.
400 Unicorn Park Drive
Woburn, MA 01801

GEI Consultants

Figure

Tested By: MA **Checked By:** EF

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	1.7	8.7	8.9	14.6	30.0	29.7	6.4

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			3.0070	0.2820	0.1647	0.0547	0.0223	0.0098	1.08	28.78

	Material Description	USCS	AASHTO
○	Silty SAND	SM	

Project No. 2101938 **Client:** Green International Affiliates, Inc.

Project: Buttonwood Senior Center

○ **Source of Sample:** TP2 **Depth:** 1.5 ft **Sample Number:** S2

Remarks:

○As Received WC=18.8%

Fines classified visually

GEI Consultants, Inc.
400 Unicorn Park Drive
Woburn, MA 01801

GEI Consultants

Figure

Tested By: MA **Checked By:** EF

Particle Size Distribution Report

	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	4.2	15.7	8.3	13.9	27.3	27.1	3.5

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			8.8684	0.5169	0.2413	0.0727	0.0292	0.0155	0.66	33.35

Material Description	USCS	AASHTO
○ Silty SAND with Gravel	SM	

Project No. 2101938 **Client:** Green International Affiliates, Inc.

Project: Buttonwood Senior Center

○ **Source of Sample:** TP2 **Depth:** 3.5 ft **Sample Number:** S3

Remarks:

○As Received WC=7.0%

Fines classified visually

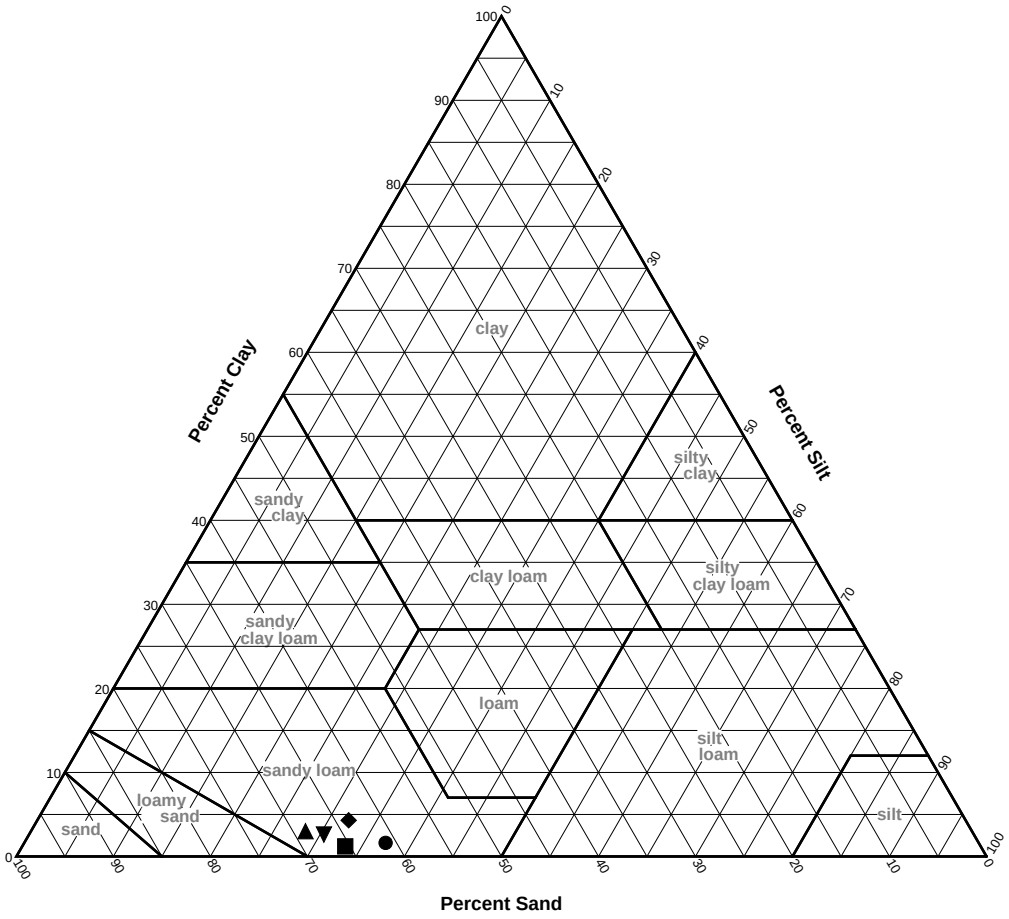
GEI Consultants, Inc.
400 Unicorn Park Drive
Woburn, MA 01801

GEI Consultants

Figure

Tested By: MA **Checked By:** EF

USDA Soil Classification



SOIL DATA							
	Source	Sample No.	Depth	Percentages From Material Passing a #10 Sieve			Classification
				Sand	Silt	Clay	
●	TP1	S1	1.5 ft	61.1	37.5	1.5	Sandy loam
■	TP1	S2	3.0 ft	65.5	33.4	1.2	Sandy loam
▲	TP2	S1	0.5 ft	68.7	28.4	3.0	Sandy loam
◆	TP2	S2	1.5 ft	63.6	32.1	4.3	Sandy loam
▼	TP2	S3	3.5 ft	67.0	30.4	2.6	Sandy loam

GEI Consultants, Inc.
400 Unicorn Park Drive
Woburn, MA 01801

Client: Green International Affiliates, Inc.

Project: Buttonwood Senior Center

Project No.: 2101938 **Figure**

APPENDIX E

ILLICIT DISCHARGE COMPLIANCE STATEMENT

Illicit Discharge Compliance Statement

Per Standard 10 of the Massachusetts Stormwater Handbook, the following is an Illicit Discharge Compliance Statement:

The design plans submitted for the Notice of Intent have been designed in full compliance with current standards.

The Long-Term Pollution Prevention Plan is part of the Operation and Maintenance Plan and includes measures to prevent illicit discharges. There are no known combined sewer outfalls within the project limits and to the best of our knowledge all closed stormwater systems discharge per Massachusetts DEP requirements. There is an existing combine sewer system located outside of the project limits within Fuller Parkway that a portion of our site discharges to; however, there will be a decrease in peak rates to this system under proposed conditions. Based on observations during a site visit in March 2021 the site does not contain any known existing illicit discharges.

Registered Professional Engineer Block and Signature

6/17/2021

Signature and Date

APPENDIX F

PLANS (UNDER SEPARATE COVER)