STORMWATER REPORT

EVERSOURCE

37 DOTY STREET
WAREHAM , MASSACHUSETTS 02576

Applicant:

NSTAR ELECTRIC COMPANY
DBA EVERSOURCE ENERGY
247 STATION DRIVE
WESTWOOD, MA 02090

Prepared By:

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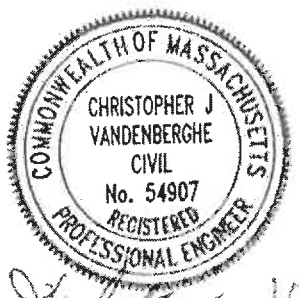
CEC Project 323-322

October 2023



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1.0 PROJECT NARRATIVE

1.1 INTRODUCTION

On behalf of NSTAR Electric Company (DBA Eversource Energy), (the "Applicant"), Civil & Environmental Consultants, Inc. (CEC) has prepared this stormwater report and analysis to demonstrate compliance with the Massachusetts Department of Environmental Protection (MassDEP) Stormwater Management Standards

The Applicant is proposing to redevelop the existing Flagship Cinema site at 37 Doty St. (Assessors Map 103 Lots A1, B1, C1, and D1) as an Eversource Training Facility and will serve as a staging area for emergency response vehicles on an as needed basis The proposed project will include new gravel area to serve as various electrified/no-electrified training zones with associated permanent equipment, poles, and structures. In addition, the existing cinema building on site will be redeveloped into an indoor training area with classrooms and offices. Other improvements include new light poles with security cameras, installation of new fencing, enlarging the existing stormwater basin and grassed water quality swale, and new landscaping (the "Project")

1.2 EXISTING CONDITIONS

The former Flagship Cinemas previously operated on the site. The site is bounded by Doty Street to the south, Route 58 to the west and Route 495 to the north. The existing grounds of the facility consist mostly of pavement, with sidewalks and some vegetation along the north and south property boundries, with a wetland and well established wooded area to the east.

The former cinema was served by water, electric and gas and a private septic system.

Stormwater is currently collected in an existing stormwater management system, which consists of a series of catch basins and manholes that ultimately discharge into a grassed water quaity swale and into a stormwater detention basin. The stormwater basin discharges overland, eventually reaching the bordering vegetated wetland. See Figure 1 for a Site Locus Map.

1.3 PROPOSED PROJECT

The propsoed site will become an Eversource Training Facility and will serve as a staging area for emergency response vehicles on an as needed basis. The proposed improvements at the site will include new gravel area to serve as various electrified/no-electrified training zones with associated permanent equipment, poles, and structures. In addition, the existing cinema on site will be redeveloped into an indoor training area with classrooms and offices. Other improvements include

new light poles with security cameras, installation of new fencing, enlarging the existing stormwater basin and grassed water quality swale, removing the existing grassed parking islands and curbing, and new landscaping.

An analysis of the proposed stormwater management system was performed to analyize how the existing stormwater management system performs during the 2, 10, 25 and 100-yr storm. The additonal stormwater runoff generated from the additonal pavement, new gravel areas, and concrete pads, and other post construction site features will require the basin to be approximatley 35% larger in order to achieve the same/reduction in runoff rates. In addition to maintain the one foot of freeboard, the top of berm will be raised 8" to el. 35.5 from the existing el. 34.8. The majorty of runoff from the proposed gravel training areas will be captured into new deep sump hooded catch basins that will be piped to discharge into the resized grassed water quality swale prior to entering the resized detention basin. With the proposed project resulting in the increase of impervious area by about a 22%, the existing sediment forebay has been resized accordingly in order to account for the additonal post construction impervious area. The outlet control structure within the detention basin has been redesigned to accomplish reductions in post construction runoff rates. See design plans and Appendix C.

1.4 CONSTRUCTION SEQUENCE PLAN

The purpose of the Construction Sequence Plan is to develop a working schedule for the implementation of the proposed stormwater improvements. Prior to initiating work, the siltation control barriers will be installed along the limit of work. Once the appropriate permits are obtained, the construction project will commence in the following sequence:

1. Notify all appropriate town departments prior to construction commencement in accordance with all approvals
2. Flag limits of construction necessary to facilitate a pre-construction meeting.
3. Hold a pre-construction meeting. Remember to notify "Call Before You Dig" (1-800-922-4455)
4. Install all necessary siltation barriers and inlet protection as shown on the design drawings.
5. Placed crushed stoned stabilized construction pad and set up construction trailers and fence
6. Demo existing grassed parking islands/ remove existing light poles and install new binder asphalt within demoed parking island areas per Erosion & Sedimentation Control/Demolition Plan
7. Clear and grub/remove trees, as shown on the design drawings.

8. Perform excavation and install new drainage structures and any subsurface utilities
9. Resize and reshape existing grassed water quality swale and detention basin area as shown on the design drawings.
10. Construct training zone areas with associated permanent equipment, poles, and structures.
11. Loam and seed all disturbed areas and install proposed final landscaping.
12. Remove existing erosion control measures upon site stabilization.

All construction water will be collected and treated in accordance with the Erosion and Sediment Control Plan included in Section 4.0.

2.0 STORMWATER ANALYSIS

2.1 METHOD OF ANALYSIS

A hydrologic analysis has been performed for the Site comparing existing conditions and post-development conditions using a software program developed by HydroCAD. This program analyzes site hydrology by the graphic peak discharge method documented in Technical Release No. 20 and Technical Release No. 55 published by the United States Department of Agriculture (USDA) Soil Conservation Service.

The following variables were developed for the contributing watersheds (drainage areas) in order to complete the analysis:

- **Rainfall Depth:** A hydrologic analysis was performed for the 24-hour 2-year, 10-year, 25-year, and 100-year, Type III 24-hr storm events (3.35, 4.95, 6.19, and 8.68 inches respectively) for each drainage area. The rainfall depths for the study area were obtained from available charts published in Technical Paper No. 40.

- **Runoff Curve Number (RCN):** The RCN is a hydrologic characteristic that contributes to the peak rate of runoff and volume from a given storm event. It is dependent upon soil conditions and land use. Generally, higher curve numbers are associated with less pervious soils and, hence, greater amounts of runoff. Per NRCS, the majority of the site consist of Hydrologic Soil Groups (HSG) A and this HSG was used in the HydroCAD analysis. See Appendix B for NRCS custom Soil Resource Report.

- **Time of Concentration:** The time of concentration is defined as the time it takes runoff to travel from the hydraulically most distant part of the watershed to the downstream point of interest. This parameter is dependent on the characteristics of the ground surface and condition of the travel path. Times of concentration were calculated for the various sub catchments using the HydroCAD program, with a minimum time of concentration of five (5) minutes used in accordance with the protocol outlined in Technical Release No. 55.

2.2 DRAINAGE AREAS

In order to perform the analysis, the contributing drainage areas for pre-development, existing, and post-development conditions were delineated. The delineation of the drainage areas was

determined by the topography depicted on the Existing Conditions plan. Brief descriptions of the existing conditions and proposed conditions drainage areas are as follows:

- **Existing Conditions:** The existing drainage boundaries were taken from the previous Flagship Cinema drainage report by SITEC Inc. dated October 18th , 2000. The Site is divided into two (2) drainage areas and the stormwater runoff was evaluated for one (1) design point, Flow to Wetlands (Design Point 1). Refer to Figure HYD-EX for the existing conditions drainage areas. For the purpose of the analysis, the times of concentration were calculated to the edge of the wetlands where present.

- **Proposed Conditions:** In the proposed condition, site hydraulic patterns were maintained from existing conditions. The Site is composed of two (2) drainage areas and the stormwater runoff will continue to flow to one (1) design point, Flow to Wetlands (Design Point 1). Refer to Figure HYD-PR for the proposed conditions drainage area.

2.3 RESULTS OF ANALYSIS

A stormwater analysis was performed for the 24-hour 2-year, 10-year, 25-year, and 100-year storm events to determine that there will be no increase in stormwater runoff discharge off-site once the proposed construction is complete. Detailed calculations are attached in Appendix C. Compliance for existing and post-development conditions was evaluated for the site as a whole. A summary of the peak stormwater runoff is provided below.

As shown below in Table 2.3, post-development runoff rates from the Site do not exceed existing runoff rates. Supporting calculations are provided in Appendix C.

TABLE 2.3
PROJECT STORMWATER RUNOFF RATES

Design Point	Peak Runoff Rate (cfs)							
	2-Year		10-Year		25-Year		100-Year	
	Ex.	Prop.	Ex.	Prop.	Ex.	Prop.	Ex.	Prop.
1	0.7	0.4	1.6	1.2	5.6	4.5	19.4	18.7

cfs = cubic feet per second

3.0 STORMWATER CONTROL SYSTEM DESIGN CRITERIA

3.1 MASSDEP STORMWATER MANAGEMENT POLICY

Stormwater discharge from the proposed Project is subject to the Massachusetts DEP Stormwater Management Policy (the Policy). The Policy is designed *"to protect the wetlands and waters of the Commonwealth from adverse impacts of storm water runoff."* To accomplish this goal, the Policy establishes ten (10) performance standards to control stormwater quantity and quality. These standards establish the level of required controls that can be achieved with site planning, structural and non-structural controls, and other best management practices (BMPs). The Stormwater Checklist is provided in Appendix A. Stormwater modeling methodology is discussed in detail in Section 2.0. Results of the stormwater modeling of the existing and proposed conditions are provided as Appendix C.

3.1.1 Stormwater Management Standards

The following section documents compliance with the MassDEP Stormwater Management Standards.

Standard 1

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

The project is designed to limit to the extent possible new stormwater conveyances that could discharge untreated stormwater into, or cause erosion to, wetlands or waters of the Commonwealth. The proposed project captures and provides treatment for all of the new impervious paved areas and will discharge clean runoff to the existing offsite wetlands.

Stormwater runoff from any new paved areas will be conveyed through the existing deep sump catch basins that will discharge into the existing drainage system network. Each new stormwater outfall into the existing grass water quality swale will have riprap installed at the outlet to prevent scour.

Standard 2

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 discharges to land subject to coastal storm flowage as defined in 310 CMR 10.04.

The post-development peak discharge rate to design point 1, do not exceed pre-development rates. Stormwater modeling methodology is discussed in detail in Section 2.0. The model output is provided as Appendix C. A summary of the model results are provided above in Table 2.3.

Standard 3

Loss of annual recharge to groundwater should be minimized through the use of infiltration measures to the maximum extent practicable. The annual recharge from the post-development site should approximate the annual recharge from the pre-development or existing site conditions, based on soil types.

The use of recharge is not feasible at this site within the areas of the proposed detention basin. The proposed building has existing roof drain dry wells to infiltrate roof runoff. These roof drain dry wells are to remain in place for the proposed redevelopment project.

Standard 4

For new development, stormwater management systems must be designed to remove 80% of the average annual load (post-development conditions) of Total Suspended Solids (TSS). It is presumed that this standard is met when:

A. *Suitable nonstructural practices for source control and pollution prevention are implemented;*
B. *Stormwater management best practices (BMPs) are sized to capture the prescribed runoff volume; and*
C. *Stormwater management BMPs are maintained as designed.*

The proposed redevelopment proposes to use deep sump catch basin that will discharge into the existing and resized grassed water quality swale before discharging into the reconfigured detention basin.

The estimated TSS removal rate from the proposed BMP pre-treatment train for the existing reconfigured detention basin exceeds the 80% requirement with approximately 83% TSS removal.

Refer to Appendix C for the TSS removal spreadsheet. Supporting information is provided in Appendix C.

A comprehensive Operations and Maintenance Plan (O&M) has been developed and is included in Section 5.0 of this report.

Standard 5

Stormwater discharges from areas with higher potential pollutant loads require the use of specific stormwater management BMPs. The use of infiltration practices without pre-treatment is prohibited.

The site is not within area with higher potential pollutant loads.

Standard 6

Stormwater discharges to critical areas must utilize certain stormwater management BMPs approved for critical areas. Critical areas are Outstanding Resources Waters (ORWs), shellfish beds, bathing beaches, cold water fisheries, and recharge areas for public water supplies.

The Site is not located within critical areas

Standard 7

Redevelopment of previously developed sites must meet the Stormwater Management Standards to the maximum extent practicable. Where it is not practicable to meet all the Standards, new (retrofitted or expanded) stormwater management systems must be designed to improve existing conditions.

As an existing facility, the Project has been designed to meet the Stormwater Management Standard to the maximum extent practicable. The redevelopment project has been designed comply fully with the Stormwater Management Standards 1, 8, 9 and 10. The project will comply to Stormwater Management Standards 2, and 3 through 7 to the maximum extent practicable and will result in a net improvement over existing conditions.

Standard 8

Erosion and sediment controls must be implemented to prevent impacts during construction, or land disturbance activities.

Erosion and sediment controls are integral to the project improvements. The plan includes Filter Fabric fence reinforced by staked straw bales, which will be installed down-gradient of the proposed work area. If necessary, a temporary stabilized construction exit will be constructed as well. Prior to, and during construction, the Site's Erosion and Sediment Control Plan, included in Section 4.0 of this report will be followed. These measures will be utilized throughout construction to prevent erosion, control sediments, and stabilize exposed soils as discussed in Section 4.0.

Standard 9

All stormwater management systems must have an operations and maintenance plan to ensure that systems function as designed.

A comprehensive Operations and Maintenance Plan (O&M) has been developed and is included in Section 5.0 of this report.

Standard 10

All illicit discharges to the stormwater management system are prohibited.

There are no known illicit discharges at the Site. If found, any illicit discharges will be eliminated, and the project will not be constructed with any illicit connections. A draft Illicit Discharge Statement is provided in Appendix D.

4.0 CONSTRUCTION SEDIMENTATION AND EROSION CONTROL PLAN

4.1 INTRODUCTION

The greatest potential for sediment generation will occur during the construction. An extensive erosion and sedimentation program is proposed and will be diligently implemented during construction of the project. The erosion control program will minimize erosion and sedimentation that could potentially impact resources areas. Water quality will be maintained by minimizing erosion of exposed soils and siltation. Erosion control barriers will be installed and exposed soil areas re-vegetated as soon as possible after work in an area is completed.

Responsible Party for Plan Compliance:

NSTAR ELECTRIC COMPANY
DPA EVERSOURCE ENERGY
247 STATION DRIVE
WESTWOOD, MA 02090

Contact: Jason St. Martin (Facilities Operation Manager)
Phone: 617-780-9365

4.2 SITE DESCRIPTION

The propsoed site will become an Eversource Training Facility and will serve as a staging area for emergency response vehicles on an as needed basis. The proposed improvements at the site will include approximately 90,000 square feet of new gravel area to serve as various electrified/no-electrified training zones with associated permanent equipment, poles, and structures. In addition, the existing cinema on site will be redeveloped into an indoor training area with classrooms and offices.

Soil disturbing activities will include installing perimeter and other sediment controls, finish grading of the site, followed by the resizing of the stormwater detention system, pavement area, utilities, curbing and sidewalks. Upon completion of construction, landscaping will be installed and all disturbed areas will be stabilized.

4.3 SEQUENCE OF MAJOR ACTIVITIES

1. Notify all appropriate town departments prior to construction commencement in accordance with all approvals
2. Flag limits of construction necessary to facilitate a pre-construction meeting.

3. Hold a pre-construction meeting. Remember to notify "Call Before You Dig" (1-800-922-4455)
4. Install all necessary siltation barriers and inlet protection as shown on the design drawings.
5. Placed crushed stoned stabilized construction pad and set up construction trailers and fence
6. Demo existing grassed parking islands/ remove existing light poles and install new binder asphalt within demoed parking island areas per Erosion & Sedimentation Control/Demolition Plan
7. Clear and grub/remove trees, as shown on the design drawings.
8. Perform excavation and install new drainage structures and any subsurface utilities
9. Resize and reshape existing grassed water quality swale and detention basin area as shown on the design drawings.
10. Construct training zone areas with associated permanent equipment, poles, and structures.
11. Loam and seed all disturbed areas and install proposed final landscaping.
12. Remove existing erosion control measures upon site stabilization.

4.4 EROSION AND SEDIMENT CONTROLS

In addition to the perimeter controls, erosion control will be accomplished using temporary measures such as tracking entrance, seeding or mulching, spraying of liquid stabilizers or any combination of these measures. Seeds should be applied at a rate of 2 lbs/ 1000 square feet at a depth of 1/2 inch. Soil netting or covering should be used in extreme conditions.

Only minor stockpiling of soils will be allowed on site. Soil stockpiles will be ringed with hay bales/ silt fencing or covered in extreme conditions.

Maintenance / Inspection Procedures for Erosion and Sediment Controls

- Construction to commence in a phased manner.

- All control measures will be inspected at least once each week and following any storm event of 0.5 inches of precipitation or greater.

- All measures will be maintained in good working order; if repair is necessary, it will be initiated within 24 hours of report.

- Built up sediment will be removed from erosion control when it has reached one-third the height of the fence or bale.

- Silt fence will be inspected for depth of sediment, tears and to see if fabric is securely attached to the fence post, are firmly in the ground.

- Any temporary sediment basin used will be inspected for depth of sediment. Any buildup of sediment will be removed when it reaches 10% of the design capacity or at the end of the project completion.

- Temporary and permanent seeding and planting will be inspected for bare spots, washouts and healthy growth.

- A maintenance and inspection report will be made after each inspection. A copy of the report form to be completed by the inspector and kept on site.

- Construction site supervisor will be responsible for training workers in all inspection and maintenance practices necessary for keeping erosion and sediment controls in good working order.

4.5 OTHER CONTROLS

4.5.1 Waste Disposal

All waste materials will be disposed of offsite in accordance with all applicable local, State, and Federal regulations. No construction waste is to be buried on site. All personnel will be instructed regarding the correct procedure for waste disposal. The individual who manages the day-to-day site operations will be responsible for seeing that these procedures are followed.

4.5.2 Hazardous Waste

All hazardous waste materials will be disposed of in a manner specified by local, State, and Federal regulations and in accordance with any manufacturer's recommendations.

4.5.3 Sanitary Waste

All sanitary waste will be collected in portable units installed on site. The portable units will be cleaned and emptied by a qualified licensed contractor.

4.5.4 Concrete Waste

All concrete washings will be disposed on in a designated area away from wetlands and any property line. When the concrete hardens it be removed from the site.

4.6 POLLUTION AND SPILL PREVENTION

4.6.1 Materials

The following materials are anticipated to be present onsite during construction:

- General construction materials
- Asphalt/concrete
- Paint
- Petroleum-based products
- Cleaning solvents

4.6.2 Material Management Practices

Good Housekeeping Practices

- Store only enough materials needed for current construction activities.
- All materials that are stored outside will be stored in a neat, orderly manner, in the original containers.
- Materials will be kept in their original containers with manufacturer's labels.
- Whenever possible, all materials should be used before disposing the container.
- The site contractor shall be responsible for daily inspections to ensure proper handling and disposal of materials on site.

Product Specific Practices

Petroleum/Fertilizer Products:

- Refueling vehicles shall be DOT certified and shall contain SPCC Plans in place along with emergency equipment to contain and clean up spills.
- All on site construction vehicles shall be inspected for leaks and receive regular preventive maintenance to reduce the chance of leakage.
- Petroleum-based products will be stored in tightly sealed containers, which are properly marked.
- All fertilizers will be stored in a dry protected area and only used according to manufacturer's recommendation.

Paints:

- All containers will be tightly sealed and stored when not required for use.
- All procedures will be followed to minimize spills and to keep products in the original containers.

Concrete Trucks:

- The site contractor is responsible for designating a safe area, away from abutting property and resource areas, for excess concrete disposal.

Product Specific Practices

In addition to the good housekeeping and material management practices discussed in the previous sections of this plan, the following practices will be followed for spill prevention and cleanup during construction:

- Manufacturer recommended methods for spill clean up will be clearly posted and site personnel will be made aware of the procedures and the location of the information and cleanup supplies.
- All spills will be cleaned up immediately after discovery.
- In any case or threat of explosion or life threatening condition, all personnel shall evacuate the area to safety and then contact the local fire department for assistance.
- The spill area will be ventilated and personnel will wear appropriate protective clothing to prevent injury from contact with a hazardous substance.
- The site contractor shall be responsible for spill prevention and cleanup and will designate at least three personnel who will receive spill prevention and cleanup training. The names of the assigned three personnel will be posted in the material storage area in the field office on site.

4.7 RECORDKEEPING

The following records will be maintained on the Site:

1. Dates when major grading activities occur,
2. Dates when construction activities temporarily or permanently cease on a portion of the Site,
3. Dates when stabilization measures are initiated, and
4. In addition, the following records will also be kept:
   - The Order of Conditions; and any additional permit conditions/approvals,
   - All inspection reports, and
   - Any spill reports.

5.0 OPERATIONS AND MAINTENANCE (O&M) PLAN

5.1 GENERAL

Stormwater management systems with multiple components, such as the one proposed for the project, assures the cleanest possible discharges of stormwater to the environment. However, these systems must be routinely maintained to keep them in good working order. Additionally, this plan identifies potential sources of pollution that may affect the quality of stormwater discharges and describes the implementation of Long-Term Pollution Prevention practices to reduce potential pollutants in stormwater discharge. The party identified below will be responsible for the operation and maintenance of the stormwater management system and Site. Schedules and procedures for inspection and maintenance of the existing and proposed stormwater management system components are provided in the following sections.

Responsible Party for Plan Compliance:

NSTAR ELECTRIC COMPANY
DPA EVERSOURCE ENERGY
247 STATION DRIVE
WESTWOOD, MA 02090

Contact: Jason St. Martin (Facilities Operation Manager)
Phone: 617-780-9365

Emergency Contact Information:
Civil & Environmental Consultants, Inc.
(774) 501-2176

Upon a transfer of ownership, if any, the future owner shall assume the responsibilities for compliance with this O&M Plan.

5.2 ROUTINE INSPECTIONS

Inspections of the stormwater management system as a whole, and of the individual components of the system, will be carried out on a routine basis in accordance with the schedule identified in Section 5.3. Components to be inspected include the catch basins and subsurface infiltration chambers. Each will be inspected for sediment buildup, presence of oil, color, and structural damage. The results of each inspection will be entered into an inspection log. Refer to Table 5.1 for the inspection log forms.

5.3 MAINTENANCE PLAN

The Responsible Party will incorporate a routine maintenance program to assure proper operation of the stormwater management system. The program will include the following maintenance activities:

Catch Basin Structures

- See the attached Manufacturer's instructions on operation and maintenance requirements and methodology.
- Inspect and clean twice per year or as required by manufacturer.
- Remove sediment and other trapped pollutants at the frequency or level specified by the manufacturer.

Grassed Water Quality Swale and Detention Basin

- See the attached Manufacturer's instructions on operation and maintenance requirements and methodology.
- Perform routine inspections on a monthly basis for the first three months after installation. Then, at a minimum, the treatment structure is to be inspected twice annually and the infiltrating structure is to be inspected annually.
- The subsurface infiltration system will be inspected twice during for the first year and annually thereafter by removing the manhole/access port covers and determining the thickness of sediment that has accumulated.
- If sediment is more than two inches deep, it must be suspended via flushing with clean water and removed using a vactor truck.
- Emergency overflow pipes will be examined at least once each year and verified that no blockage has occurred.

Rip-Rap Outlet

- Inspect after the first several rainfall events and after any major storm events within the first year. After the first year, inspect regularly on an annual basis.
- Remove any sediment, trash, debris, leaves and grass clippings. Remove any tree seedlings before they become firmly established.
- Note and repair any erosion or low spots.

5.4 LONG TERM POLLUTION PREVENTION MAINTENANCE

The Responsible Party will incorporate a routine maintenance program to ensure the continued effectiveness of the structural water quality controls. Maintenance will be performed based on the

results of inspections in accordance with the schedules identified below. The program will include the following maintenance activities:

Maintenance of Pavement Systems

Regular maintenance of pavement surfaces will prevent pollutants such as oil and grease, trash, and sediments from entering the stormwater management system. The following practices should be performed:

- Sweep or vacuum asphalt pavement areas annually with a commercial cleaning unit and dispose of removed material.
- Routinely pick up and remove litter from the parking areas, islands, and perimeter landscaping.

Maintenance of Vegetated Areas

Proper maintenance of vegetated areas can prevent the pollution of stormwater runoff by controlling the source of pollutants such as suspended sediments, excess nutrients, and chemicals from landscape care products. Practices that should be followed under the regular maintenance of the vegetated landscape include:

- Inspect planted areas on a semi-annual basis and remove any litter.
- Maintain planted areas adjacent to pavement to prevent soil washout.
- Immediately clean any soil deposited on pavement.
- Re-seed bare areas: install appropriate erosion control measures when native soil is exposed, or erosion channels are forming.
- Plant alternative mixture of grass species in the event of unsuccessful establishment.
- Grass vegetation should not be cut to a height less than four inches.
- Pesticide/Herbicide Usage – No pesticides are to be used unless a single spot treatment is required for a specific control application.
- Fertilizer usage should be avoided. If deemed necessary, slow-release fertilizer should be used. Fertilizer may be used to begin the establishment of vegetation in bare or damaged areas but should not be applied on a regular basis unless necessary.

Management of Snow and Ice

Should significant snow fall events occur, which result in stockpiled snow impacting the operation of the Project Site, through the temporary loss of parking or limiting access in any way, the

property manager may choose to have snow removed from the site. All snow removal operations will be done in accordance with Massachusetts DEP guidelines BRPG01-01, effective date March 8, 2001.

Salt and Deicing Chemicals

The amount of salt and deicing chemicals to be used on the site shall be reduced to the minimum amount needed to provide safe pedestrian and vehicle travel. The following practices should be followed to control the amount of salt and deicing materials that come into contact with stormwater runoff:

- Devices used for spreading salt and deicing chemicals should be capable of varying the rate of application based on the site-specific conditions.
- Sand and salt should be stockpiled under covered storage facilities that prevent precipitation and adjacent runoff from coming in contact with the deicing materials.

5.5 EMPLOYEE TRAINING

Training of personnel is essential to achieving proper operation and maintenance of the stormwater management system. Therefore, those Facility personnel who are responsible for operation and maintenance will be trained on the following subjects:

- Environmental laws and regulations relating to stormwater,
- The components and goals of the current Erosion and Sediment Control Plan,
- Site specific permit conditions and requirements,
- General Facility spill response procedures,
- General good housekeeping procedures, and
- General material management procedures.

Refresher training sessions will be held once a year following the completion of the Site Compliance Evaluation.

5.6 RECORDKEEPING

Records of inspections and maintenance shall be up to date and available for review and inspection, if requested

FIGURES

Figure 1 – Site Locus

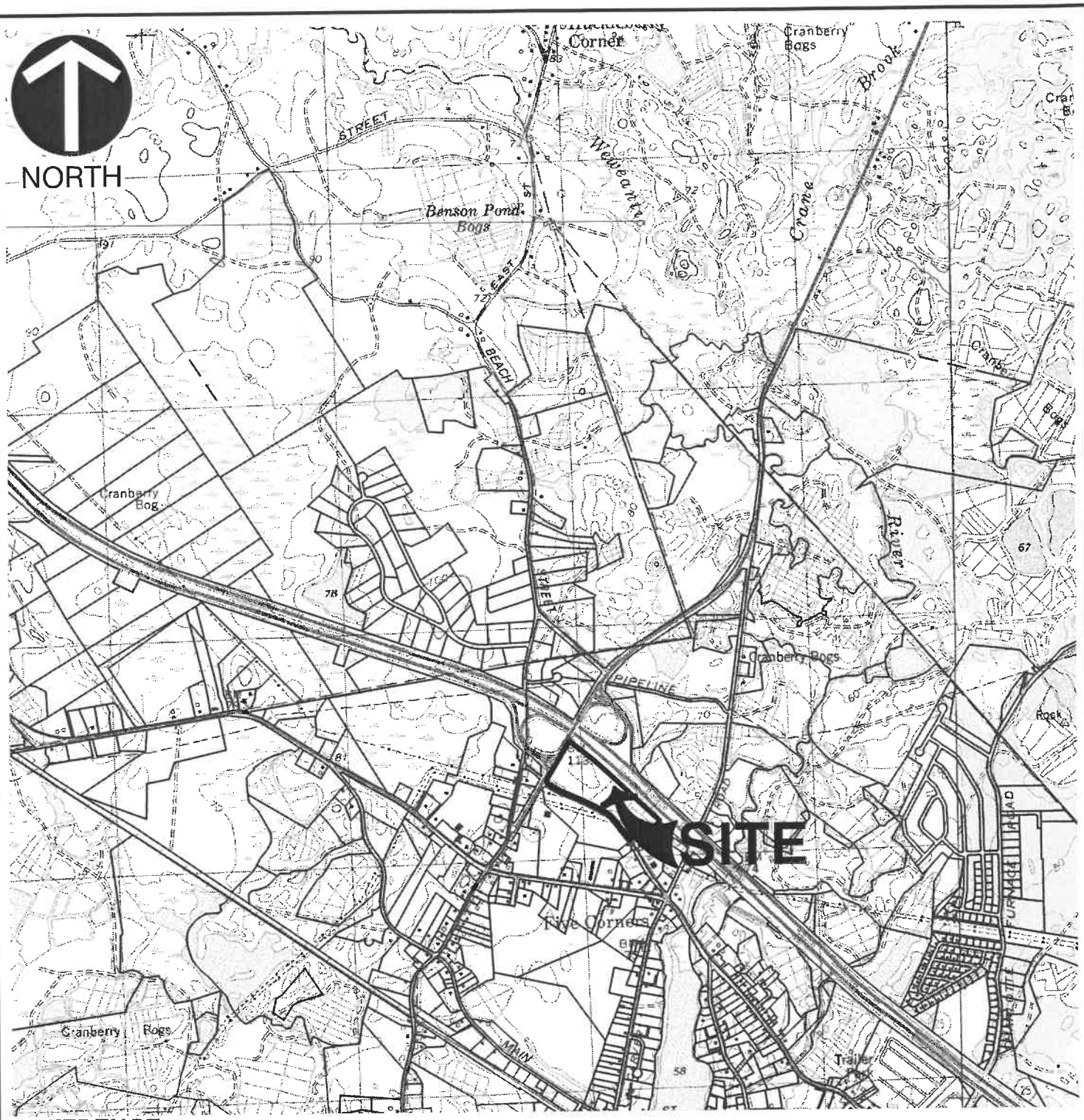
Figure 2 – Aerial Exhibit

Figure 3 – FEMA Firmette

Figure 4 – Critical Areas Map

Figure HYD-EX – Existing Conditions Drainage Area Map

Figure HYD-POST – Proposed Conditions Drainage Area Map



REFERENCE

1. USGS TOPOGRAPHIC MAP QUADRANGLES q265838 and q261838, DATED 2011.
2. USGS MAPS ARE BASED ON GIS DATA PROVIDED BY THE BUREAU OF GEOGRAPHIC INFORMATION (MASS GIS), COMMONWEALTH OF MASSACHUSETTS EXECUTIVE OFFICE OF TECHNOLOGY AND SECURITY SERVICES.

SCALE IN FEET

0 2000 4000

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37 DOTY STREET
WAREHAM, MASSACHUSETTS

SITE LOCUS

DRAWN BY:	CJV	CHECKED BY:	BEP	APPROVED BY:	BEP	FIGURE NO.:	1
DATE:	JULY 2023	DWG SCALE:	1"=2000'	PROJECT NO:	323-322		

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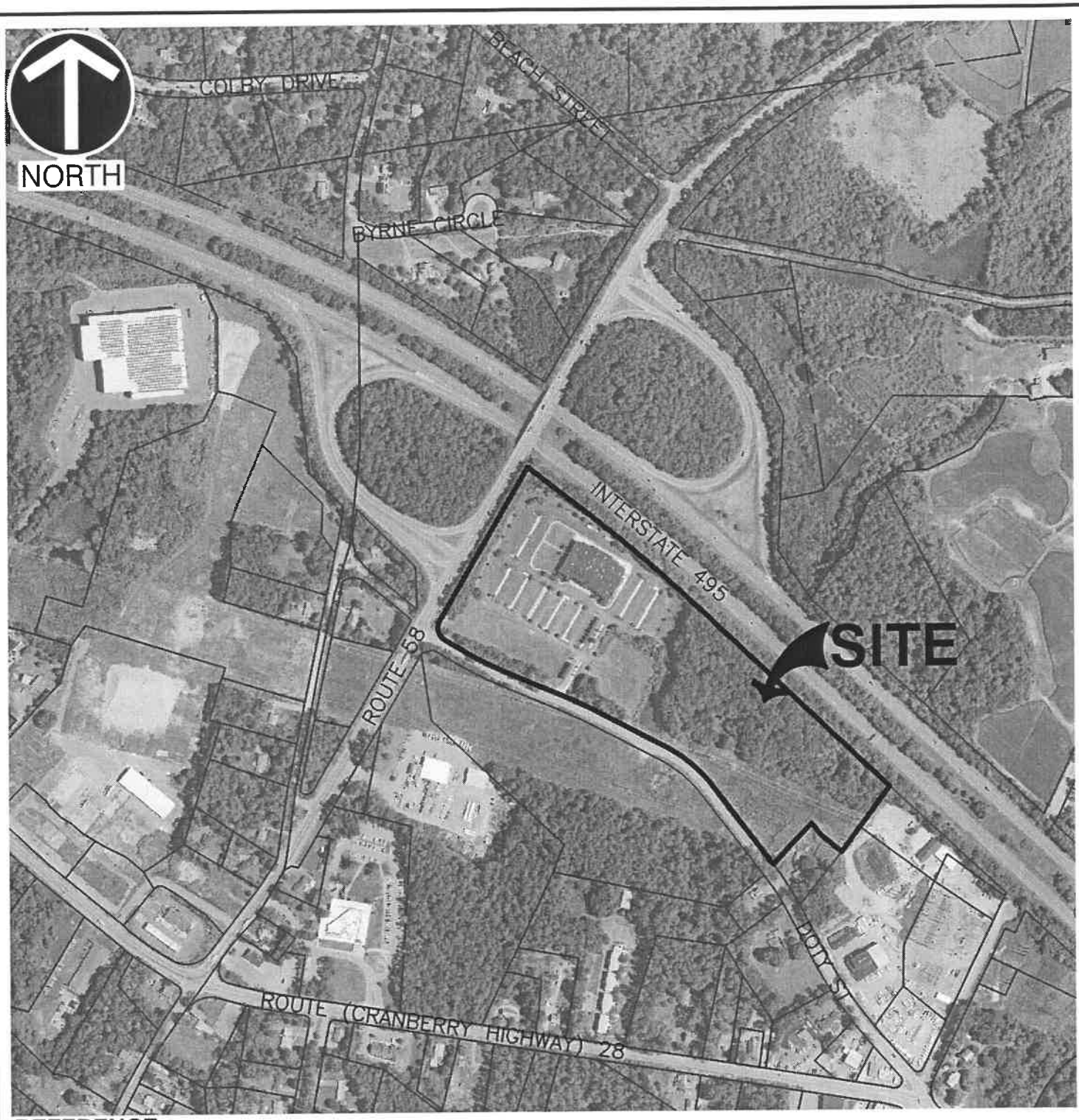

REFERENCE

1. AERIAL PHOTOGRAPHY BY EARTHSTAR GEOGRAPHICS SIO, PROVIDED BY AUTODESK, ACCESSED 05/10/2023.

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37 DOTY STREET
WAREHAM, MASSACHUSETTS

AERIAL EXHIBIT

DRAWN BY:	CJV	CHECKED BY:	BEP	APPROVED BY:	BEP	FIGURE NO.:	2
DATE:	JULY 2023	DWG SCALE:	1"=500'	PROJECT NO:	323-322		

National Flood Hazard Layer FIRMette

FEMA

70°46'26"W 41°48'31"N

70°45'49"W 41°48'4"N

0 250 500 1,000 1,500 2,000 Feet 1:6,000

Legend

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

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

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

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

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

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

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

N

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

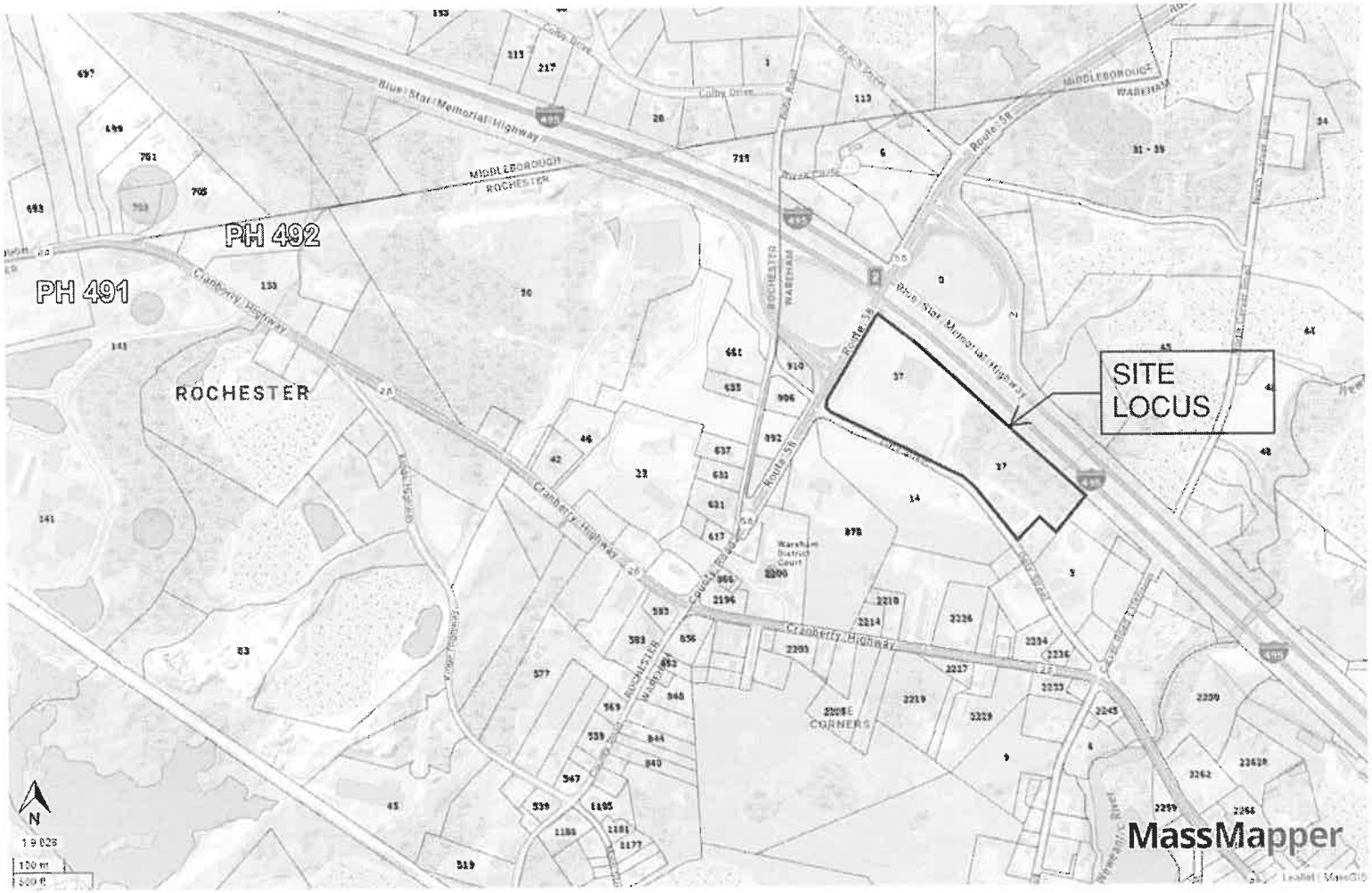
This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 8/2/2023 at 3:03 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

FIGURE 2

Critical Areas Map



Areas of Critical Environmental Concern
ACECs

NHESP Priority Habitats of Rare Specie

NHESP Estimated Habitats of Rare Wildlife

Zone C

Zone B

Zone A

Zone Is

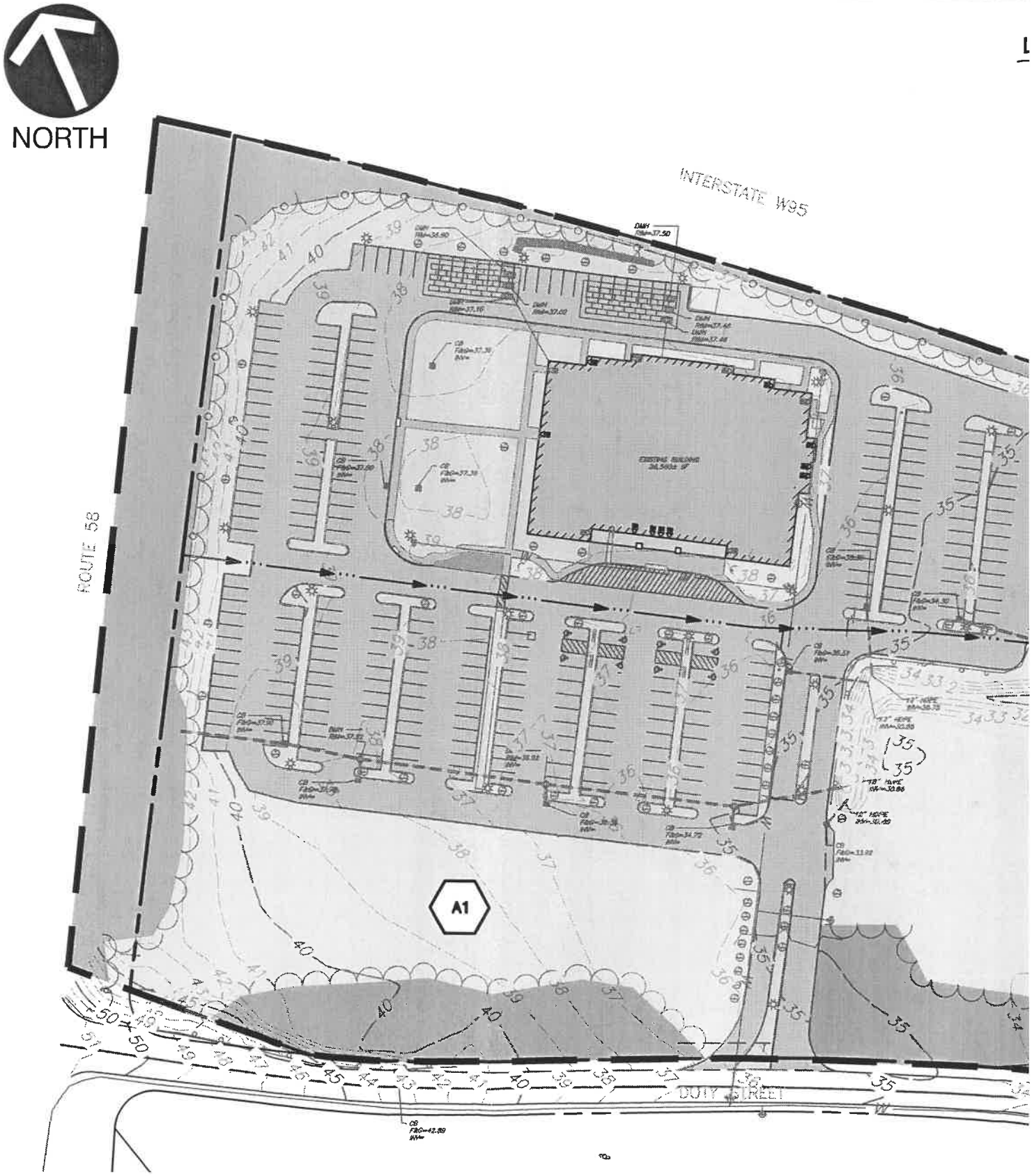
Zone IIs

NHESP Certified Vernal Pools

Potential Vernal Pools

Property Tax Parcels

FIGURE 4



REFERENCE

1. EXISTING CONDITIONS INFORMATION WAS COMPILED FROM AN ON THE GROUND SURVEY PERFORMED BY CIVIL & ENVIRONMENTAL CONSULTANTS, CONDUCTED IN JULY AND AUGUST 2021.

APPENDIX A

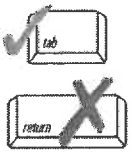
DEP STORMWATER CHECKLIST

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

Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

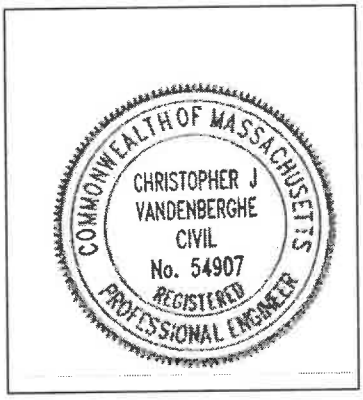
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature



10-12-23

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.

APPENDIX B

GEOTECHNICAL INFORMATION

NRCS Soil Resource Report

NRCS Soil Resource Report

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for Plymouth County, Massachusetts

June 1, 2023

Preface

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

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

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

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

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

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

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

Soil Map

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

Custom Soil Resource Report
Soil Map

Map Scale: 1:2,860 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 40, 80, 160, 240

Feet: 0, 100, 200, 400, 600

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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

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

Special Point Features

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Plymouth County, Massachusetts
Survey Area Data: Version 15, Sep 9, 2022

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

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

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
253A	Hinckley loamy sand, 0 to 3 percent slopes	4.1	26.2%
253B	Hinckley loamy sand, 3 to 8 percent slopes	2.3	14.8%
256A	Deerfield loamy fine sand, 0 to 3 percent slopes	1.9	12.2%
259A	Carver loamy coarse sand, 0 to 3 percent slopes	3.2	20.6%
259B	Carver loamy coarse sand, 3 to 8 percent slopes	1.9	12.5%
321A	Birchwood sand, 0 to 3 percent slopes, very stony	1.9	11.9%
430C	Barnstable loamy sand, 8 to 15 percent slopes	0.0	0.0%
656B	Udorthents - Urban land complex, 0 to 8 percent slopes	0.3	1.7%
Totals for Area of Interest		**15.6**	**100.0%**

Map Unit Descriptions

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

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

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas

are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

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

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

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

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

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

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

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

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

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

Plymouth County, Massachusetts

253A—Hinckley loamy sand, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2svm7
Elevation: 0 to 1,420 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Hinckley and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hinckley

Setting

Landform: Outwash terraces, outwash plains, kame terraces, outwash deltas
Landform position (three-dimensional): Tread
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Parent material: Sandy and gravelly glaciofluvial deposits derived from gneiss and/or granite and/or schist

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 8 inches: loamy sand
Bw1 - 8 to 11 inches: gravelly loamy sand
Bw2 - 11 to 16 inches: gravelly loamy sand
BC - 16 to 19 inches: very gravelly loamy sand
C - 19 to 65 inches: very gravelly sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A
Ecological site: F144AY022MA - Dry Outwash
Hydric soil rating: No

Minor Components

Windsor

Percent of map unit: 5 percent
Landform: Outwash deltas, kame terraces, outwash terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Sudbury

Percent of map unit: 5 percent
Landform: Outwash deltas, outwash terraces, kame terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Merrimac

Percent of map unit: 5 percent
Landform: Outwash deltas, outwash terraces, kame terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

253B—Hinckley loamy sand, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2svm8
Elevation: 0 to 1,430 feet
Mean annual precipitation: 36 to 53 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 250 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Hinckley and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hinckley

Setting

Landform: Outwash deltas, outwash terraces, kames, kame terraces, moraines, eskers, outwash plains
Landform position (two-dimensional): Summit, shoulder, backslope, footslope
Landform position (three-dimensional): Nose slope, side slope, base slope, crest, riser, tread
Down-slope shape: Concave, convex, linear

Across-slope shape: Convex, linear, concave
Parent material: Sandy and gravelly glaciofluvial deposits derived from gneiss and/or granite and/or schist

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 8 inches: loamy sand
Bw1 - 8 to 11 inches: gravelly loamy sand
Bw2 - 11 to 16 inches: gravelly loamy sand
BC - 16 to 19 inches: very gravelly loamy sand
C - 19 to 65 inches: very gravelly sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Very low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A
Ecological site: F144AY022MA - Dry Outwash
Hydric soil rating: No

Minor Components

Windsor

Percent of map unit: 8 percent
Landform: Outwash deltas, outwash terraces, moraines, eskers, kames, outwash plains, kame terraces
Landform position (two-dimensional): Summit, shoulder, backslope, footslope
Landform position (three-dimensional): Nose slope, side slope, base slope, crest, riser, tread
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Sudbury

Percent of map unit: 5 percent
Landform: Outwash deltas, outwash terraces, moraines, outwash plains, kame terraces
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Head slope, side slope, base slope, tread
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Hydric soil rating: No

Agawam

Percent of map unit: 2 percent

Landform: Outwash deltas, outwash terraces, moraines, eskers, kames, outwash plains, kame terraces
Landform position (two-dimensional): Summit, shoulder, backslope, footslope
Landform position (three-dimensional): Nose slope, side slope, base slope, crest, riser, tread
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

256A—Deerfield loamy fine sand, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2xfg8
Elevation: 0 to 1,100 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Deerfield and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Deerfield

Setting

Landform: Outwash terraces, outwash deltas, outwash plains, kame terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Parent material: Sandy outwash derived from granite, gneiss, and/or quartzite

Typical profile

Ap - 0 to 9 inches: loamy fine sand
Bw - 9 to 25 inches: loamy fine sand
BC - 25 to 33 inches: fine sand
Cg - 33 to 60 inches: sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: About 15 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)

Sodium adsorption ratio, maximum: 11.0
Available water supply, 0 to 60 inches: Moderate (about 6.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: A
Ecological site: F144AY027MA - Moist Sandy Outwash
Hydric soil rating: No

Minor Components

Windsor

Percent of map unit: 7 percent
Landform: Outwash terraces, kame terraces, outwash deltas, outwash plains
Landform position (three-dimensional): Tread
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Wareham

Percent of map unit: 5 percent
Landform: Drainageways, depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Sudbury

Percent of map unit: 2 percent
Landform: Outwash plains, kame terraces, outwash deltas, outwash terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Ninigret

Percent of map unit: 1 percent
Landform: Outwash terraces, kame terraces, outwash plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear, convex
Across-slope shape: Concave, convex
Hydric soil rating: No

259A—Carver loamy coarse sand, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2y07s
Elevation: 0 to 990 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days

Farmland classification: Not prime farmland

Map Unit Composition

Carver, loamy coarse sand, and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Carver, Loamy Coarse Sand

Setting

Landform: Moraines, outwash plains
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Side slope, crest, tread
Down-slope shape: Convex, linear
Across-slope shape: Linear
Parent material: Sandy glaciofluvial deposits

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
Oe - 2 to 3 inches: moderately decomposed plant material
A - 3 to 7 inches: loamy coarse sand
E - 7 to 10 inches: coarse sand
Bw1 - 10 to 15 inches: coarse sand
Bw2 - 15 to 28 inches: coarse sand
BC - 28 to 32 inches: coarse sand
C - 32 to 67 inches: coarse sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A
Ecological site: F149BY005MA - Dry Outwash
Hydric soil rating: No

Minor Components

Deerfield

Percent of map unit: 10 percent
Landform: Outwash terraces, outwash deltas, outwash plains, kame terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: No

Hinckley

Percent of map unit: 5 percent
Landform: Outwash deltas, outwash terraces, moraines, eskers, kames, outwash plains, kame terraces
Landform position (two-dimensional): Summit, shoulder, backslope, footslope, toeslope
Landform position (three-dimensional): Head slope, nose slope, side slope, crest, riser, tread
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Merrimac

Percent of map unit: 3 percent
Landform: Outwash terraces, kame terraces, outwash deltas
Landform position (three-dimensional): Riser, tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Mashpee

Percent of map unit: 2 percent
Landform: Depressions, drainageways, terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

259B—Carver loamy coarse sand, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2y07t
Elevation: 0 to 240 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Carver, loamy coarse sand, and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Carver, Loamy Coarse Sand

Setting

Landform: Moraines, outwash plains
Landform position (two-dimensional): Summit, shoulder, backslope, footslope, toeslope

Landform position (three-dimensional): Head slope, nose slope, side slope, crest, tread
Down-slope shape: Convex, linear
Across-slope shape: Linear
Parent material: Sandy glaciofluvial deposits

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
Oe - 2 to 3 inches: moderately decomposed plant material
A - 3 to 7 inches: loamy coarse sand
E - 7 to 10 inches: coarse sand
Bw1 - 10 to 15 inches: coarse sand
Bw2 - 15 to 28 inches: coarse sand
BC - 28 to 32 inches: coarse sand
C - 32 to 67 inches: coarse sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A
Ecological site: F149BY005MA - Dry Outwash
Hydric soil rating: No

Minor Components

Deerfield

Percent of map unit: 10 percent
Landform: Outwash terraces, outwash plains, kame terraces, outwash deltas
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: No

Hinckley

Percent of map unit: 5 percent
Landform: Moraines, eskers, kames, outwash deltas, outwash terraces, outwash plains, kame terraces
Landform position (two-dimensional): Summit, shoulder, backslope, footslope, toeslope
Landform position (three-dimensional): Head slope, nose slope, side slope, crest, riser, tread
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Merrimac

Percent of map unit: 3 percent
Landform: Kame terraces, outwash deltas, outwash terraces
Landform position (three-dimensional): Riser, tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Mashpee

Percent of map unit: 2 percent
Landform: Depressions, drainageways, terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

321A—Birchwood sand, 0 to 3 percent slopes, very stony

Map Unit Setting

National map unit symbol: 9y46
Elevation: 0 to 400 feet
Mean annual precipitation: 41 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Birchwood, very stony, and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Birchwood, Very Stony

Setting

Landform: Till plains, ground moraines, drumlins
Landform position (two-dimensional): Summit, footslope
Landform position (three-dimensional): Interfluve
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Sandy eolian deposits and/or sandy glaciofluvial deposits over coarse-loamy lodgment till

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
Oe - 1 to 3 inches: moderately decomposed plant material
Oa - 3 to 4 inches: highly decomposed plant material
E - 4 to 5 inches: sand
Ap - 5 to 8 inches: loamy sand
Bs - 8 to 13 inches: loamy sand
Bw1 - 13 to 19 inches: loamy sand

Bw2 - 19 to 29 inches: loamy sand
BC - 29 to 40 inches: sand
Cd1 - 40 to 55 inches: gravelly sandy loam
Cd2 - 55 to 75 inches: gravelly sandy loam

Properties and qualities

Slope: 0 to 3 percent
Surface area covered with cobbles, stones or boulders: 1.0 percent
Depth to restrictive feature: 35 to 59 inches to densic material
Drainage class: Moderately well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: About 12 to 29 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5s
Hydrologic Soil Group: B/D
Ecological site: F144AY037MA - Moist Dense Till Uplands
Hydric soil rating: No

Minor Components

Poquonock, very stony

Percent of map unit: 6 percent
Landform: Till plains, ground moraines, drumlins
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Mattapoisett, extremely stony

Percent of map unit: 6 percent
Landform: Drainageways, depressions
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Scituate, very stony

Percent of map unit: 5 percent
Landform: Drumlins, ridges
Landform position (two-dimensional): Summit, footslope
Landform position (three-dimensional): Interfluve
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: No

Newfields, extremely stony

Percent of map unit: 3 percent
Landform: Till plains, hills, moraines

Landform position (two-dimensional): Summit, footslope
Landform position (three-dimensional): Interfluve
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: No

430C—Barnstable loamy sand, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 9y3r
Elevation: 10 to 400 feet
Mean annual precipitation: 41 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Barnstable and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Barnstable

Setting

Landform: Moraines
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Coarse-loamy supraglacial meltout till over sandy and gravelly glaciofluvial deposits

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
Oe - 2 to 3 inches: moderately decomposed plant material
Oa - 3 to 4 inches: highly decomposed plant material
E - 4 to 6 inches: loamy sand
Bs - 6 to 7 inches: gravelly sandy loam
Bw1 - 7 to 13 inches: stony sandy loam
Bw2 - 13 to 27 inches: very stony coarse sandy loam
2C1 - 27 to 40 inches: very gravelly coarse sand
2C2 - 40 to 64 inches: very gravelly coarse sand

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 23 to 27 inches to strongly contrasting textural stratification
Drainage class: Well drained
Runoff class: Low

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: F149BY011MA - Well Drained Till Uplands
Hydric soil rating: No

Minor Components

Plymouth

Percent of map unit: 7 percent
Landform: Outwash plains, moraines
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope, riser
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

Merrimac

Percent of map unit: 5 percent
Landform: Kames, terraces, outwash plains
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

Canton

Percent of map unit: 5 percent
Landform: Till plains, ridges, hills
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

Newfields

Percent of map unit: 3 percent
Landform: Moraines, hills, till plains
Landform position (two-dimensional): Shoulder, footslope
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: No

656B—Udorthents - Urban land complex, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: bd08
Elevation: 0 to 390 feet
Mean annual precipitation: 41 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Udorthents, loamy, and similar soils: 45 percent
Urban land: 40 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents, Loamy

Setting

Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Coarse-loamy human transported material

Typical profile

^A - 0 to 5 inches: loam
^C1 - 5 to 21 inches: gravelly loam
^C2 - 21 to 80 inches: gravelly sandy loam

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to very high (0.01 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 7.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: B
Ecological site: F149BY100NY - Urban Site Complex
Hydric soil rating: No

Minor Components

Udipsamments, wet substratum

Percent of map unit: 5 percent
Landform: Dikes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear, convex
Across-slope shape: Linear
Hydric soil rating: No

Udipsamments

Percent of map unit: 5 percent
Landform: Dikes
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Linear, convex
Across-slope shape: Linear
Hydric soil rating: No

Udorthents, wet substratum

Percent of map unit: 5 percent
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

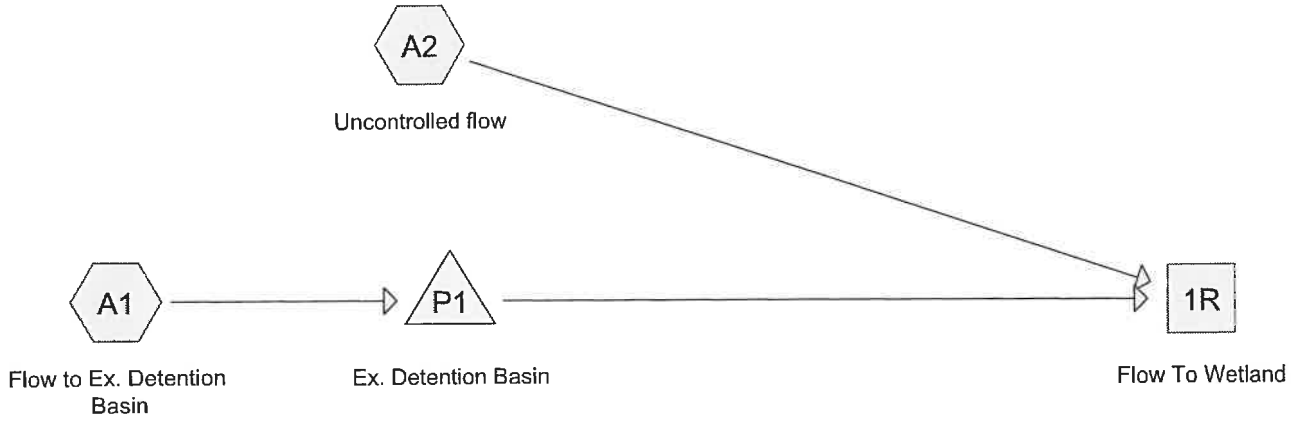
United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

APPENDIX C

SUPPORTING CALCULATIONS

HydroCAD Drainage Analysis
TSS Calculations
Water Quality Volume Calculations

HydroCAD Drainage Analysis



Subcat Reach Pond Link

Routing Diagram for Pre Drainage Calcs
Prepared by CEC Inc, Printed 10/11/2023

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	Type III 24-hr		Default	24.00	1	3.35	2
2	10-Year	Type III 24-hr		Default	24.00	1	4.95	2
3	25-Year	Type III 24-hr		Default	24.00	1	6.19	2
4	100-Year	Type III 24-hr		Default	24.00	1	8.68	2

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
3.91	39	>75% Grass cover, Good, HSG A (A1)
0.43	39	Landscaped islands, Good, HSG A (A1)
3.44	98	Paved parking, HSG A (A1)
0.91	98	Unconnected roofs, HSG A (A1)
2.77	45	Woods, Poor, HSG A (A1, A2)
0.50	98	detention pond (A1)
0.18	98	paved sidewalks, HSG A (A1)

Summary for Subcatchment A1: Flow to Ex. Detention Basin

Runoff = 7.2 cfs @ 12.14 hrs, Volume= 0.60 af, Depth> 0.64"
Routed to Pond P1 : Ex. Detention Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.35"

	Area (sf)	CN	Description
	39,640	98	Unconnected roofs, HSG A
*	18,731	39	Landscaped islands, Good, HSG A
*	7,841	98	paved sidewalks, HSG A
	82,000	45	Woods, Poor, HSG A
	149,846	98	Paved parking, HSG A
	170,212	39	>75% Grass cover, Good, HSG A
*	21,780	98	detention pond
	490,050	66	Weighted Average
	270,943		55.29% Pervious Area
	219,107		44.71% Impervious Area
	39,640		18.09% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	30	0.0400	0.2		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.20"
5.4	660	0.0100	2.0		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
8.2	690	Total			

Summary for Subcatchment A2: Uncontrolled flow

Runoff = 0.0 cfs @ 15.06 hrs, Volume= 0.00 af, Depth> 0.04"
Routed to Reach 1R : Flow To Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.35"

	Area (sf)	CN	Description
	38,860	45	Woods, Poor, HSG A
	38,860		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	50	0.0500	0.1		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.20"
0.2	53	0.0900	4.8		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
8.7	103	Total			

Summary for Reach 1R: Flow To Wetland

Inflow Area = 12.14 ac, 41.43% Impervious, Inflow Depth > 0.37" for 2-Year event
Inflow = 0.7 cfs @ 15.00 hrs, Volume= 0.38 af
Outflow = 0.7 cfs @ 15.00 hrs, Volume= 0.38 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Pond P1: Ex. Detention Basin

Inflow Area = 11.25 ac, 44.71% Impervious, Inflow Depth > 0.64" for 2-Year event
Inflow = 7.2 cfs @ 12.14 hrs, Volume= 0.60 af
Outflow = 0.7 cfs @ 15.00 hrs, Volume= 0.37 af, Atten= 91%, Lag= 171.3 min
Primary = 0.7 cfs @ 15.00 hrs, Volume= 0.37 af
Routed to Reach 1R : Flow To Wetland

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 30.75' @ 15.00 hrs Surf.Area= 13,565 sf Storage= 13,532 cf

Plug-Flow detention time= 210.4 min calculated for 0.37 af (62% of inflow)
Center-of-Mass det. time= 125.6 min (963.8 - 838.2)

Volume	Invert	Avail.Storage	Storage Description
#1	29.00'	101,165 cf	**Custom Stage Data (Irregular)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
29.00	515	100.0	0	0	515
30.00	10,000	845.0	4,261	4,261	56,542
31.00	14,725	1,210.0	12,287	16,548	116,239
32.00	18,875	1,245.0	16,757	33,305	123,186
33.00	22,820	1,255.0	20,816	54,121	125,536
34.00	26,550	1,275.0	24,661	78,783	129,757
34.80	29,430	1,300.0	22,382	101,165	134,982

Device	Routing	Invert	Outlet Devices
#1	Primary	32.00'	**2.5' long x 2.80' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s) 3.0' Crest Height
#2	Primary	30.00'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.7 cfs @ 15.00 hrs HW=30.75' (Free Discharge)
↑—**1=Sharp-Crested Rectangular Weir** (Controls 0.0 cfs)
└—**2=Orifice/Grate** (Orifice Controls 0.7 cfs @ 3.4 fps)

Summary for Subcatchment A1: Flow to Ex. Detention Basin

Runoff = 19.3 cfs @ 12.13 hrs, Volume= 1.45 af, Depth> 1.55"
Routed to Pond P1 : Ex. Detention Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.95"

	Area (sf)	CN	Description
	39,640	98	Unconnected roofs, HSG A
*	18,731	39	Landscaped islands, Good, HSG A
*	7,841	98	paved sidewalks, HSG A
	82,000	45	Woods, Poor, HSG A
	149,846	98	Paved parking, HSG A
	170,212	39	>75% Grass cover, Good, HSG A
*	21,780	98	detention pond
	490,050	66	Weighted Average
	270,943		55.29% Pervious Area
	219,107		44.71% Impervious Area
	39,640		18.09% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	30	0.0400	0.2		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.20"
5.4	660	0.0100	2.0		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
8.2	690	Total			

Summary for Subcatchment A2: Uncontrolled flow

Runoff = 0.2 cfs @ 12.35 hrs, Volume= 0.03 af, Depth> 0.36"
Routed to Reach 1R : Flow To Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.95"

Area (sf)	CN	Description
38,860	45	Woods, Poor, HSG A
38,860		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	50	0.0500	0.1		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.20"
0.2	53	0.0900	4.8		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
8.7	103	Total			

Summary for Reach 1R: Flow To Wetland

Inflow Area = 12.14 ac, 41.43% Impervious, Inflow Depth > 0.86" for 10-Year event
Inflow = 1.6 cfs @ 14.38 hrs, Volume= 0.87 af
Outflow = 1.6 cfs @ 14.38 hrs, Volume= 0.87 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Pond P1: Ex. Detention Basin

Inflow Area = 11.25 ac, 44.71% Impervious, Inflow Depth > 1.55" for 10-Year event
Inflow = 19.3 cfs @ 12.13 hrs, Volume= 1.45 af
Outflow = 1.6 cfs @ 14.40 hrs, Volume= 0.84 af, Atten= 92%, Lag= 136.6 min
Primary = 1.6 cfs @ 14.40 hrs, Volume= 0.84 af
Routed to Reach 1R : Flow To Wetland

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 32.10' @ 14.40 hrs Surf.Area= 19,275 sf Storage= 35,418 cf

Plug-Flow detention time= 222.0 min calculated for 0.84 af (58% of inflow)
Center-of-Mass det. time= 139.3 min (956.8 - 817.5)

Volume	Invert	Avail.Storage	Storage Description
#1	29.00'	101,165 cf	**Custom Stage Data (Irregular)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
29.00	515	100.0	0	0	515
30.00	10,000	845.0	4,261	4,261	56,542
31.00	14,725	1,210.0	12,287	16,548	116,239
32.00	18,875	1,245.0	16,757	33,305	123,186
33.00	22,820	1,255.0	20,816	54,121	125,536
34.00	26,550	1,275.0	24,661	78,783	129,757
34.80	29,430	1,300.0	22,382	101,165	134,982

Device	Routing	Invert	Outlet Devices
#1	Primary	32.00'	**2.5' long x 2.80' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s) 3.0' Crest Height
#2	Primary	30.00'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.5 cfs @ 14.40 hrs HW=32.10' (Free Discharge)
1=Sharp-Crested Rectangular Weir (Weir Controls 0.3 cfs @ 1.0 fps)
2=Orifice/Grate (Orifice Controls 1.3 cfs @ 6.6 fps)

Summary for Subcatchment A1: Flow to Ex. Detention Basin

Runoff = 30.6 cfs @ 12.12 hrs, Volume= 2.23 af, Depth> 2.38"
Routed to Pond P1 : Ex. Detention Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.19"

	Area (sf)	CN	Description
	39,640	98	Unconnected roofs, HSG A
*	18,731	39	Landscaped islands, Good, HSG A
*	7,841	98	paved sidewalks, HSG A
	82,000	45	Woods, Poor, HSG A
	149,846	98	Paved parking, HSG A
	170,212	39	>75% Grass cover, Good, HSG A
*	21,780	98	detention pond
	490,050	66	Weighted Average
	270,943		55.29% Pervious Area
	219,107		44.71% Impervious Area
	39,640		18.09% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	30	0.0400	0.2		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.20"
5.4	660	0.0100	2.0		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
8.2	690	Total			

Summary for Subcatchment A2: Uncontrolled flow

Runoff = 0.5 cfs @ 12.17 hrs, Volume= 0.06 af, Depth> 0.77"
Routed to Reach 1R : Flow To Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.19"

Area (sf)	CN	Description
38,860	45	Woods, Poor, HSG A
38,860		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	50	0.0500	0.1		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.20"
0.2	53	0.0900	4.8		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
8.7	103	Total			

Summary for Reach 1R: Flow To Wetland

Inflow Area = 12.14 ac, 41.43% Impervious, Inflow Depth > 1.57" for 25-Year event
Inflow = 5.6 cfs @ 12.66 hrs, Volume= 1.59 af
Outflow = 5.6 cfs @ 12.66 hrs, Volume= 1.59 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Pond P1: Ex. Detention Basin

Inflow Area = 11.25 ac, 44.71% Impervious, Inflow Depth > 2.38" for 25-Year event
Inflow = 30.6 cfs @ 12.12 hrs, Volume= 2.23 af
Outflow = 5.4 cfs @ 12.68 hrs, Volume= 1.53 af, Atten= 82%, Lag= 33.6 min
Primary = 5.4 cfs @ 12.68 hrs, Volume= 1.53 af
Routed to Reach 1R : Flow To Wetland

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 32.63' @ 12.68 hrs Surf.Area= 21,344 sf Storage= 46,332 cf

Plug-Flow detention time= 162.6 min calculated for 1.53 af (69% of inflow)
Center-of-Mass det. time= 92.3 min (900.2 - 807.9)

Volume	Invert	Avail.Storage	Storage Description
#1	29.00'	101,165 cf	**Custom Stage Data (Irregular)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
29.00	515	100.0	0	0	515
30.00	10,000	845.0	4,261	4,261	56,542
31.00	14,725	1,210.0	12,287	16,548	116,239
32.00	18,875	1,245.0	16,757	33,305	123,186
33.00	22,820	1,255.0	20,816	54,121	125,536
34.00	26,550	1,275.0	24,661	78,783	129,757
34.80	29,430	1,300.0	22,382	101,165	134,982

Device	Routing	Invert	Outlet Devices
#1	Primary	32.00'	**2.5' long x 2.80' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s) 3.0' Crest Height
#2	Primary	30.00'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=5.4 cfs @ 12.68 hrs HW=32.63' (Free Discharge)
↑—**1=Sharp-Crested Rectangular Weir** (Weir Controls 3.9 cfs @ 2.7 fps)
└—**2=Orifice/Grate** (Orifice Controls 1.5 cfs @ 7.4 fps)

Summary for Subcatchment A1: Flow to Ex. Detention Basin

Runoff = 55.1 cfs @ 12.12 hrs, Volume= 3.99 af, Depth> 4.25"
Routed to Pond P1 : Ex. Detention Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.68"

	Area (sf)	CN	Description
	39,640	98	Unconnected roofs, HSG A
*	18,731	39	Landscaped islands, Good, HSG A
*	7,841	98	paved sidewalks, HSG A
	82,000	45	Woods, Poor, HSG A
	149,846	98	Paved parking, HSG A
	170,212	39	>75% Grass cover, Good, HSG A
*	21,780	98	detention pond
	490,050	66	Weighted Average
	270,943		55.29% Pervious Area
	219,107		44.71% Impervious Area
	39,640		18.09% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	30	0.0400	0.2		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.20"
5.4	660	0.0100	2.0		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
8.2	690	Total			

Summary for Subcatchment A2: Uncontrolled flow

Runoff = 1.7 cfs @ 12.15 hrs, Volume= 0.14 af, Depth> 1.89"
Routed to Reach 1R : Flow To Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.68"

Area (sf)	CN	Description
38,860	45	Woods, Poor, HSG A
38,860		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	50	0.0500	0.1		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.20"
0.2	53	0.0900	4.8		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
8.7	103	Total			

Summary for Reach 1R: Flow To Wetland

Inflow Area = 12.14 ac, 41.43% Impervious, Inflow Depth > 3.30" for 100-Year event
Inflow = 19.4 cfs @ 12.45 hrs, Volume= 3.34 af
Outflow = 19.4 cfs @ 12.45 hrs, Volume= 3.34 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Pond P1: Ex. Detention Basin

Inflow Area = 11.25 ac, 44.71% Impervious, Inflow Depth > 4.25" for 100-Year event
Inflow = 55.1 cfs @ 12.12 hrs, Volume= 3.99 af
Outflow = 18.6 cfs @ 12.47 hrs, Volume= 3.20 af, Atten= 66%, Lag= 21.0 min
Primary = 18.6 cfs @ 12.47 hrs, Volume= 3.20 af
Routed to Reach 1R : Flow To Wetland

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 33.71' @ 12.47 hrs Surf.Area= 25,461 sf Storage= 71,581 cf

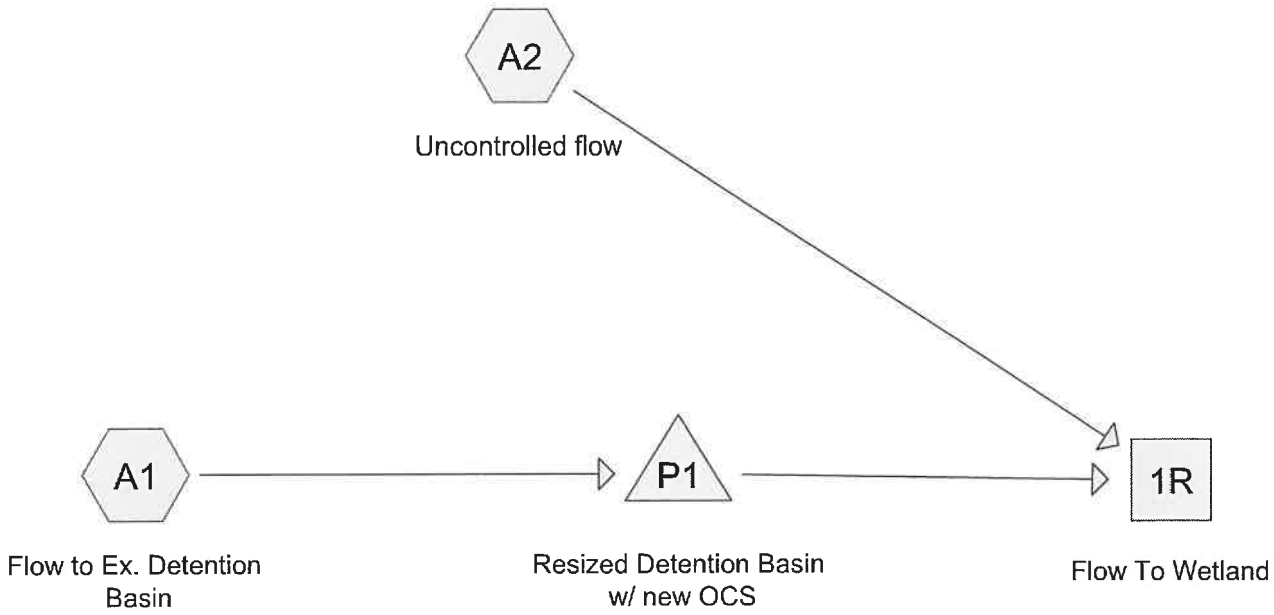
Plug-Flow detention time= 110.8 min calculated for 3.19 af (80% of inflow)
Center-of-Mass det. time= 59.1 min (854.0 - 794.9)

Volume	Invert	Avail.Storage	Storage Description
#1	29.00'	101,165 cf	**Custom Stage Data (Irregular)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
29.00	515	100.0	0	0	515
30.00	10,000	845.0	4,261	4,261	56,542
31.00	14,725	1,210.0	12,287	16,548	116,239
32.00	18,875	1,245.0	16,757	33,305	123,186
33.00	22,820	1,255.0	20,816	54,121	125,536
34.00	26,550	1,275.0	24,661	78,783	129,757
34.80	29,430	1,300.0	22,382	101,165	134,982

Device	Routing	Invert	Outlet Devices
#1	Primary	32.00'	**2.5' long x 2.80' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s) 3.0' Crest Height
#2	Primary	30.00'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=18.6 cfs @ 12.47 hrs HW=33.71' (Free Discharge)
↑—**1=Sharp-Crested Rectangular Weir** (Weir Controls 16.8 cfs @ 4.6 fps)
└—**2=Orifice/Grate** (Orifice Controls 1.8 cfs @ 9.0 fps)



Subcat Reach Pond Link

Routing Diagram for Post Drainage Calcs
Prepared by CEC Inc, Printed 10/11/2023

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	Type III 24-hr		Default	24.00	1	3.35	2
2	10-Year	Type III 24-hr		Default	24.00	1	4.95	2
3	25-Year	Type III 24-hr		Default	24.00	1	6.19	2
4	100-Year	Type III 24-hr		Default	24.00	1	8.68	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.83	39	>75% Grass cover, Good, HSG A (A1)
0.11	98	Conc. slab areas/Shed roofs, HSG A (A1)
0.11	76	Field Transmission Material Storage area, HSG A (A1)
2.16	76	Gravel areas, HSG A (A1)
4.08	98	Paved parking, HSG A (A1)
0.91	98	Unconnected roofs, HSG A (A1)
1.99	45	Woods, Poor, HSG A (A1, A2)
0.75	98	detention pond (A1)
0.18	98	paved sidewalks, HSG A (A1)

Summary for Subcatchment A1: Flow to Ex. Detention Basin

Runoff = 17.3 cfs @ 12.12 hrs, Volume= 1.25 af, Depth> 1.34"
Routed to Pond P1 : Resized Detention Basin w/ new OCS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.35"

	Area (sf)	CN	Description
	39,640	98	Unconnected roofs, HSG A
*	7,841	98	paved sidewalks, HSG A
	47,778	45	Woods, Poor, HSG A
	177,900	98	Paved parking, HSG A
	79,926	39	>75% Grass cover, Good, HSG A
*	32,875	98	detention pond
*	94,298	76	Gravel areas, HSG A
*	4,792	98	Conc. slab areas/Shed roofs, HSG A
*	5,000	76	Field Transmission Material Storage area, HSG A
	490,050	79	Weighted Average
	227,002		46.32% Pervious Area
	263,048		53.68% Impervious Area
	39,640		15.07% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	30	0.0400	0.2		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.20"
5.4	660	0.0100	2.0		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
8.2	690	Total			

Summary for Subcatchment A2: Uncontrolled flow

Runoff = 0.0 cfs @ 15.06 hrs, Volume= 0.00 af, Depth> 0.04"
Routed to Reach 1R : Flow To Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.35"

Area (sf)	CN	Description
38,860	45	Woods, Poor, HSG A
38,860		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	50	0.0500	0.1		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.20"
0.2	53	0.0900	4.8		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
8.7	103	Total			

Summary for Reach 1R: Flow To Wetland

Inflow Area = 12.14 ac, 49.73% Impervious, Inflow Depth > 0.12" for 2-Year event
Inflow = 0.4 cfs @ 20.00 hrs, Volume= 0.12 af
Outflow = 0.4 cfs @ 20.00 hrs, Volume= 0.12 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Pond P1: Resized Detention Basin w/ new OCS

Inflow Area = 11.25 ac, 53.68% Impervious, Inflow Depth > 1.34" for 2-Year event
Inflow = 17.3 cfs @ 12.12 hrs, Volume= 1.25 af
Outflow = 0.4 cfs @ 20.00 hrs, Volume= 0.11 af, Atten= 98%, Lag= 472.7 min
Primary = 0.4 cfs @ 20.00 hrs, Volume= 0.11 af
Routed to Reach 1R : Flow To Wetland

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 31.89' @ 20.00 hrs Surf.Area= 24,740 sf Storage= 49,685 cf

Plug-Flow detention time= 392.1 min calculated for 0.11 af (9% of inflow)
Center-of-Mass det. time= 267.7 min (1,073.8 - 806.0)

Volume	Invert	Avail.Storage	Storage Description
#1	29.00'	135,946 cf	**Custom Stage Data (Irregular)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
29.00	7,430	450.0	0	0	7,430
30.00	14,900	725.0	10,951	10,951	33,150
31.00	21,300	1,220.0	18,005	28,956	109,772
32.00	25,150	1,250.0	23,198	52,154	115,796
33.00	28,800	1,260.0	26,954	79,108	118,155
34.00	32,550	1,285.0	30,656	109,764	123,376
34.80	32,905	1,295.0	26,182	135,946	125,674

Device	Routing	Invert	Outlet Devices
#1	Device 2	33.00'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#2	Primary	31.20'	**24.0" Round Culvert** L= 35.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 31.20' / 30.00' S= 0.0343 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf
#3	Device 2	31.50'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.4 cfs @ 20.00 hrs HW=31.89' (Free Discharge)
↑**2=Culvert** (Passes 0.4 cfs of 2.2 cfs potential flow)
↑**1=Broad-Crested Rectangular Weir** (Controls 0.0 cfs)
3=Orifice/Grate (Orifice Controls 0.4 cfs @ 2.1 fps)

Summary for Subcatchment A1: Flow to Ex. Detention Basin

Runoff = 33.3 cfs @ 12.12 hrs, Volume= 2.41 af, Depth> 2.57"
Routed to Pond P1 : Resized Detention Basin w/ new OCS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.95"

	Area (sf)	CN	Description
	39,640	98	Unconnected roofs, HSG A
*	7,841	98	paved sidewalks, HSG A
	47,778	45	Woods, Poor, HSG A
	177,900	98	Paved parking, HSG A
	79,926	39	>75% Grass cover, Good, HSG A
*	32,875	98	detention pond
*	94,298	76	Gravel areas, HSG A
*	4,792	98	Conc. slab areas/Shed roofs, HSG A
*	5,000	76	Field Transmission Material Storage area, HSG A
	490,050	79	Weighted Average
	227,002		46.32% Pervious Area
	263,048		53.68% Impervious Area
	39,640		15.07% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	30	0.0400	0.2		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.20"
5.4	660	0.0100	2.0		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
8.2	690	Total			

Summary for Subcatchment A2: Uncontrolled flow

Runoff = 0.2 cfs @ 12.35 hrs, Volume= 0.03 af, Depth> 0.36"
Routed to Reach 1R : Flow To Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.95"

Area (sf)	CN	Description
38,860	45	Woods, Poor, HSG A
38,860		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	50	0.0500	0.1		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.20"
0.2	53	0.0900	4.8		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
8.7	103	Total			

Summary for Reach 1R: Flow To Wetland

Inflow Area = 12.14 ac, 49.73% Impervious, Inflow Depth > 0.67" for 10-Year event
Inflow = 1.2 cfs @ 16.41 hrs, Volume= 0.68 af
Outflow = 1.2 cfs @ 16.41 hrs, Volume= 0.68 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Pond P1: Resized Detention Basin w/ new OCS

Inflow Area = 11.25 ac, 53.68% Impervious, Inflow Depth > 2.57" for 10-Year event
Inflow = 33.3 cfs @ 12.12 hrs, Volume= 2.41 af
Outflow = 1.1 cfs @ 16.46 hrs, Volume= 0.65 af, Atten= 97%, Lag= 260.6 min
Primary = 1.1 cfs @ 16.46 hrs, Volume= 0.65 af
Routed to Reach 1R : Flow To Wetland

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 33.03' @ 16.46 hrs Surf.Area= 28,903 sf Storage= 79,950 cf

Plug-Flow detention time= 288.9 min calculated for 0.65 af (27% of inflow)
Center-of-Mass det. time= 187.5 min (978.8 - 791.3)

Volume	Invert	Avail.Storage	Storage Description
#1	29.00'	135,946 cf	**Custom Stage Data (Irregular)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
29.00	7,430	450.0	0	0	7,430
30.00	14,900	725.0	10,951	10,951	33,150
31.00	21,300	1,220.0	18,005	28,956	109,772
32.00	25,150	1,250.0	23,198	52,154	115,796
33.00	28,800	1,260.0	26,954	79,108	118,155
34.00	32,550	1,285.0	30,656	109,764	123,376
34.80	32,905	1,295.0	26,182	135,946	125,674

Device	Routing	Invert	Outlet Devices
#1	Device 2	33.00'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#2	Primary	31.20'	**24.0" Round Culvert** L= 35.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 31.20' / 30.00' S= 0.0343 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf
#3	Device 2	31.50'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.1 cfs @ 16.46 hrs HW=33.03' (Free Discharge)
└**2=Culvert** (Passes 1.1 cfs of 10.9 cfs potential flow)
├**1=Broad-Crested Rectangular Weir** (Weir Controls 0.1 cfs @ 0.5 fps)
└**3=Orifice/Grate** (Orifice Controls 1.1 cfs @ 5.4 fps)

Summary for Subcatchment A1: Flow to Ex. Detention Basin

Runoff = 46.3 cfs @ 12.12 hrs, Volume= 3.38 af, Depth> 3.60"
Routed to Pond P1 : Resized Detention Basin w/ new OCS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.19"

	Area (sf)	CN	Description
	39,640	98	Unconnected roofs, HSG A
*	7,841	98	paved sidewalks, HSG A
	47,778	45	Woods, Poor, HSG A
	177,900	98	Paved parking, HSG A
	79,926	39	>75% Grass cover, Good, HSG A
*	32,875	98	detention pond
*	94,298	76	Gravel areas, HSG A
*	4,792	98	Conc. slab areas/Shed roofs, HSG A
*	5,000	76	Field Transmission Material Storage area, HSG A
	490,050	79	Weighted Average
	227,002		46.32% Pervious Area
	263,048		53.68% Impervious Area
	39,640		15.07% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	30	0.0400	0.2		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.20"
5.4	660	0.0100	2.0		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
8.2	690	Total			

Summary for Subcatchment A2: Uncontrolled flow

Runoff = 0.5 cfs @ 12.17 hrs, Volume= 0.06 af, Depth> 0.77"
Routed to Reach 1R : Flow To Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.19"

Area (sf)	CN	Description
38,860	45	Woods, Poor, HSG A
38,860		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	50	0.0500	0.1		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.20"
0.2	53	0.0900	4.8		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
8.7	103	Total			

Summary for Reach 1R: Flow To Wetland

Inflow Area = 12.14 ac, 49.73% Impervious, Inflow Depth > 1.59" for 25-Year event
Inflow = 4.5 cfs @ 13.13 hrs, Volume= 1.61 af
Outflow = 4.5 cfs @ 13.13 hrs, Volume= 1.61 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Pond P1: Resized Detention Basin w/ new OCS

Inflow Area = 11.25 ac, 53.68% Impervious, Inflow Depth > 3.60" for 25-Year event
Inflow = 46.3 cfs @ 12.12 hrs, Volume= 3.38 af
Outflow = 4.4 cfs @ 13.14 hrs, Volume= 1.55 af, Atten= 91%, Lag= 61.6 min
Primary = 4.4 cfs @ 13.14 hrs, Volume= 1.55 af
Routed to Reach 1R : Flow To Wetland

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 33.42' @ 13.14 hrs Surf.Area= 30,368 sf Storage= 91,923 cf

Plug-Flow detention time= 217.5 min calculated for 1.54 af (46% of inflow)
Center-of-Mass det. time= 133.3 min (916.8 - 783.5)

Volume	Invert	Avail.Storage	Storage Description
#1	29.00'	135,946 cf	**Custom Stage Data (Irregular)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
29.00	7,430	450.0	0	0	7,430
30.00	14,900	725.0	10,951	10,951	33,150
31.00	21,300	1,220.0	18,005	28,956	109,772
32.00	25,150	1,250.0	23,198	52,154	115,796
33.00	28,800	1,260.0	26,954	79,108	118,155
34.00	32,550	1,285.0	30,656	109,764	123,376
34.80	32,905	1,295.0	26,182	135,946	125,674

Device	Routing	Invert	Outlet Devices
#1	Device 2	33.00'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#2	Primary	31.20'	**24.0" Round Culvert** L= 35.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 31.20' / 30.00' S= 0.0343 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf
#3	Device 2	31.50'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=4.4 cfs @ 13.14 hrs HW=33.42' (Free Discharge)
↑—**2=Culvert** (Passes 4.4 cfs of 13.2 cfs potential flow)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 3.2 cfs @ 1.9 fps)
—**3=Orifice/Grate** (Orifice Controls 1.2 cfs @ 6.2 fps)

Summary for Subcatchment A1: Flow to Ex. Detention Basin

Runoff = 73.0 cfs @ 12.11 hrs, Volume= 5.42 af, Depth> 5.78"
Routed to Pond P1 : Resized Detention Basin w/ new OCS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.68"

	Area (sf)	CN	Description
	39,640	98	Unconnected roofs, HSG A
*	7,841	98	paved sidewalks, HSG A
	47,778	45	Woods, Poor, HSG A
	177,900	98	Paved parking, HSG A
	79,926	39	>75% Grass cover, Good, HSG A
*	32,875	98	detention pond
*	94,298	76	Gravel areas, HSG A
*	4,792	98	Conc. slab areas/Shed roofs, HSG A
*	5,000	76	Field Transmission Material Storage area, HSG A
	490,050	79	Weighted Average
	227,002		46.32% Pervious Area
	263,048		53.68% Impervious Area
	39,640		15.07% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	30	0.0400	0.2		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.20"
5.4	660	0.0100	2.0		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
8.2	690	Total			

Summary for Subcatchment A2: Uncontrolled flow

Runoff = 1.7 cfs @ 12.15 hrs, Volume= 0.14 af, Depth> 1.89"
Routed to Reach 1R : Flow To Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.68"

Area (sf)	CN	Description
38,860	45	Woods, Poor, HSG A
38,860		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	50	0.0500	0.1		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.20"
0.2	53	0.0900	4.8		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
8.7	103	Total			

Summary for Reach 1R: Flow To Wetland

Inflow Area = 12.14 ac, 49.73% Impervious, Inflow Depth > 3.63" for 100-Year event
Inflow = 18.7 cfs @ 12.46 hrs, Volume= 3.68 af
Outflow = 18.7 cfs @ 12.46 hrs, Volume= 3.68 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Pond P1: Resized Detention Basin w/ new OCS

Inflow Area = 11.25 ac, 53.68% Impervious, Inflow Depth > 5.78" for 100-Year event
Inflow = 73.0 cfs @ 12.11 hrs, Volume= 5.42 af
Outflow = 17.9 cfs @ 12.53 hrs, Volume= 3.53 af, Atten= 75%, Lag= 24.9 min
Primary = 17.9 cfs @ 12.53 hrs, Volume= 3.53 af
Routed to Reach 1R : Flow To Wetland

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 34.46' @ 12.53 hrs Surf.Area= 32,752 sf Storage= 124,673 cf

Plug-Flow detention time= 155.8 min calculated for 3.52 af (65% of inflow)
Center-of-Mass det. time= 86.6 min (858.9 - 772.3)

Volume	Invert	Avail.Storage	Storage Description
#1	29.00'	135,946 cf	**Custom Stage Data (Irregular)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
29.00	7,430	450.0	0	0	7,430
30.00	14,900	725.0	10,951	10,951	33,150
31.00	21,300	1,220.0	18,005	28,956	109,772
32.00	25,150	1,250.0	23,198	52,154	115,796
33.00	28,800	1,260.0	26,954	79,108	118,155
34.00	32,550	1,285.0	30,656	109,764	123,376
34.80	32,905	1,295.0	26,182	135,946	125,674

Device	Routing	Invert	Outlet Devices
#1	Device 2	33.00'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#2	Primary	31.20'	**24.0" Round Culvert** L= 35.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 31.20' / 30.00' S= 0.0343 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf
#3	Device 2	31.50'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=17.9 cfs @ 12.53 hrs HW=34.45' (Free Discharge)
└**2=Culvert** (Inlet Controls 17.9 cfs @ 5.7 fps)
├**1=Broad-Crested Rectangular Weir** (Passes < 23.3 cfs potential flow)
└**3=Orifice/Grate** (Passes < 1.6 cfs potential flow)

TSS Calculations

INSTRUCTIONS:

Version 1, Automated: Mar. 4, 2008

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

Location: 37 Doty Street Wareham MA

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
Water Quality Swale - Dry	**0.70**	**0.75**	**0.53**	**0.23**
Extended Dry Detention Basin with Forebay	**0.70**	**0.23**	**0.16**	**0.07**

Total TSS Removal = **93%**

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

Project: **Eversource Training Facility**

Prepared By: **CJV**

Date: **10/11/2023**

*Equals remaining load from previous BMP (E)

which enters the BMP

*** Stormtech Isolator Row conservatively assumed to provide a minimum of 25% TSS removal*

Water Quality Volume Calculations

Water Quality Volume Flow Rate Calculations

Project Name:	Eversource	Date:	10/11/2023
Project Location:	37 Doty Street Wareham MA	Calculated By:	CJV
Project Number:	323-322	Checked By:	BEP

Structure Name: 1P
Subcatchment: A1-PR

Description: Detention Basin

Total Drainage Area:	490,050	sq ft
	2.40	ac
Total Impervious Area:	190,533	sq ft
	0.61	ac

** Roof Areas are considered clean and are not subject to WQV calculation*

Runoff Depth to be Treated: 1.0 inches

Required Water Quality Volume:	15,878	cf
	0.36	ac ft

Provided Water Quality Volume

Bottom of basin:	7430	sq ft
Low Flow Outlet Elevation:	31.5	ft
**Water Quality Volume Provided:	40,555	cu ft

Provided Water Quality Volume:	40,555	cf
	0.93	ac ft

(**See attached documentation.)

* Flow rate conversion based on the Massachusetts Department of Environmental Protection Wetlands Program - Standard Method to Convert Required Water Quality Volume to a Discharge Rate for Sizing Flow Based Manufactured Proprietary Stormwater Treatment Practices

APPENDIX D

SUPPORTING INFORMATION

Illicit Discharge Statement

Illicit Discharge Statement

ILLICIT DISCHARGE COMPLIANCE STATEMENT

I VERIFY THAT NO ILLICIT DISCHARGES EXIST FROM THE EVERSOURCE TRAINING FACILITY DEVELOPMENT. THROUGH THE IMPLEMENTATION OF THE *CONSTRUCTION PERIOD POLLUTION PREVENTION AND SEDIMENTATION AND EROSION CONTROL PLAN* AS WELL AS THE *OPERATION AND MAINTENANCE PLAN*, MEASURES ARE SET FORTH TO PREVENT ILLICIT DISCHARGES FROM ENTERING THE STORMWATER MANAGEMENT DRAINAGE SYSTEM.

SIGNATURE	**PRINT NAME**	**DATE**

TITLE	**COMPANY**

SIGNATURE	**PRINT NAME**	**DATE**

TITLE	**COMPANY**

NOTE: THIS CERTIFICATION MUST BE SIGNED BEFORE STORMWATER IS CONVEYED TO THE PROPOSED STORMWATER DRAINAGE SYSTEM IN ACCORDANCE WITH STANDARD 10 OF THE MASSACHUSETTS STORMWATER MANAGEMENT STANDARDS.