STORMWATER MANAGEMENT REPORT

# Commonwealth Fusion Systems Campus – Building 4

## 111 Hospital Road
## Devens, Massachusetts

PREPARED FOR

Commonwealth Fusion Systems
148 Sidney Street
Cambridge, Massachusetts
509.942.4255

PREPARED BY

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Providence, Rhode Island 02903
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September 2025
Revised November 2025

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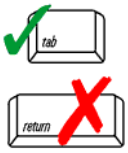
# Checklist for Stormwater Report

**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


November 2025

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:

- [X] No disturbance to any Wetland Resource Areas
- [ ] Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- [ ] Reduced Impervious Area (Redevelopment Only)
- [X] 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**

- [X] No new untreated discharges
- [X] Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- [X] 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.

# Project Summary

This Stormwater Management Report has been prepared to demonstrate compliance with the Massachusetts Stormwater Management Standards in accordance with the Massachusetts Wetlands Protection Act Regulations (310 CMR 10.00) and Water Quality Certification Regulations (314 CMR 9.00). This report also demonstrates compliance with the requirements of 974 CMR 3.04(4), Stormwater Management Design Standards, and 974 CMR 4.08, General: Stormwater Management.

The proposed project will result in the disturbance of greater than one acre of land and therefore requires the development and implementation of a Stormwater Pollution Prevention Plan (SWPPP) by the site contractor and owner in accordance with the Environmental Protection Agency's (EPA's) National Pollutant Discharge Elimination System (NPDES) Construction General Permit for Stormwater Discharges from Construction Sites.

## Campus Description

The Applicant, Commonwealth Fusion Systems (CFS), is in the process of constructing a corporate campus on an approximately 44-acre parcel of land located at 111 Hospital Road in Devens, Massachusetts. CFS partnered with King Street Properties (KSP) to own and develop the first building of the campus (CFS-1), which completed construction in 2022. CFS-1 is home to the headquarters of CFS and includes office space and a manufacturing warehouse. The second building of the campus (CFS-2) was permitted and began construction simultaneously with CFS-1, and is still under constriction at the time of this application. CFS-2 is a research and development facility that houses a Tokamak fusion system that allows for the advanced research of creating commercial fusion energy.

CFS is now further developing its campus with third and fourth projects (CFS-3 and CFS-4) that will expand its research and manufacturing capacity. CFS-3 is being developed as a joint venture with Pivotal Manufacturing, LLC. as a large-magnet manufacturing facility and will be the subject of a future Level 2 Permit submission.

**The current permit submission, and this associated Stormwater Report, are in support of the development of the fourth building, hereafter referred to as CFS-4 (also referred to as "the Site" or "the Project").**

## Site Description

The CFS-4 site will be directly owned by CFS and will be located north of the CFS-2 building on the same 35.7-acre parcel located at 111 Hospital Road. The Site is composed of two buildings: the

approximately 11,000 square foot "CFS-4" building, and an ancillary 4,800 square foot "Annex" building. In addition to these buildings will be two large exterior industrial equipment pads totaling approximately 34,000 square feet. The CFS-4 buildings and adjacent concrete pads will together contain an experimental system called a "FLiBe Loop" that will serve as a research and development facility for CFS-2.

The Site lies within the surface watershed of Nashua River (Class B) and is bounded by Nashua River to the North and West, the CFS-2 site (and Hospital Road beyond) to the South, and an adjacent CFS parcel to the East (the future location of CFS-3). See *Figure 1, Site Locus Map*.

According to the Natural Resources Conservation Service (NRCS), surface soils on the Site include:

- **260A** – Sudbury fine sandy loam, 0 to 3 percent slopes → Hydrologic soil group **B**
- **262A** – Quonset loamy sand, 0 to 3 percent slopes → Hydrologic soil group **A**
- **262B** – Quonset loamy sand, 3 to 8 percent slopes → Hydrologic soil group **A**
- **262C** – Quonset loamy sand, 8 to 15 percent slopes → Hydrologic soil group **A**
- **262D** – Quonset loamy sand, 15to 25 percent slopes → Hydrologic soil group **A**

On-site soils are classified as Hydrologic Soil Groups (HSG) A and B, with most of the site falling within HSG A. Based on the soil evaluation included in Appendix C, the Site is primarily in sand and is therefore characterized as a Site within an area of rapid infiltration (greater than 2.4 inches per hour). An infiltration rate of 8.27 inches per hour was used to model the stormwater best management practices (BMP's), based on geotechnical investigations performed in the area of the basins. Test pit and boring logs did not indicate signs of groundwater or redoximorphic features within the stormwater treatment areas.

A wetland site reconnaissance was performed by TRC Environmental Corp in September 2020 and did not identify any state or federally jurisdictional wetlands or waterbodies within the Site. The banks of the Nashua River are just offsite to the north and west of the Site. The 100- and 200-foot riverfront area associated with the river does extend onto the property, however it is well outside the limit of work for the project.

# Existing Drainage Conditions

Under existing conditions, the Site is a combination of areas previously disturbed by the CFS-2 development and undeveloped woodlands with generally hilly topography. Elevations range from approximately 283 to the south (at the connection to CFS-2) to 257 to the north. In accordance with the Devens Enterprise Commission *Development Rules and Regulations* the existing drainage conditions were analyzed in an undeveloped "green field" condition. Due to the Site's heavily wooded "green field" condition, long times of concentration, natural topographical depressions, and its well-draining sandy soils, this analysis resulted in negligible peak discharge flows and runoff volumes. Therefore, peak discharge rates were conservatively considered to be zero under existing conditions, and a detailed existing conditions analysis was not provided in this report.

## Proposed Drainage Conditions

Figure 3 illustrates the proposed "post construction" drainage conditions for the project. As shown, the Site is only composed of one design point that captures 100% of the impervious ground cover and directs it to a subsurface infiltration system designed to capture and infiltrate stormwater runoff from all storm events up to and including the 100-year storm. There is no proposed discharge from the Site during any storm event.

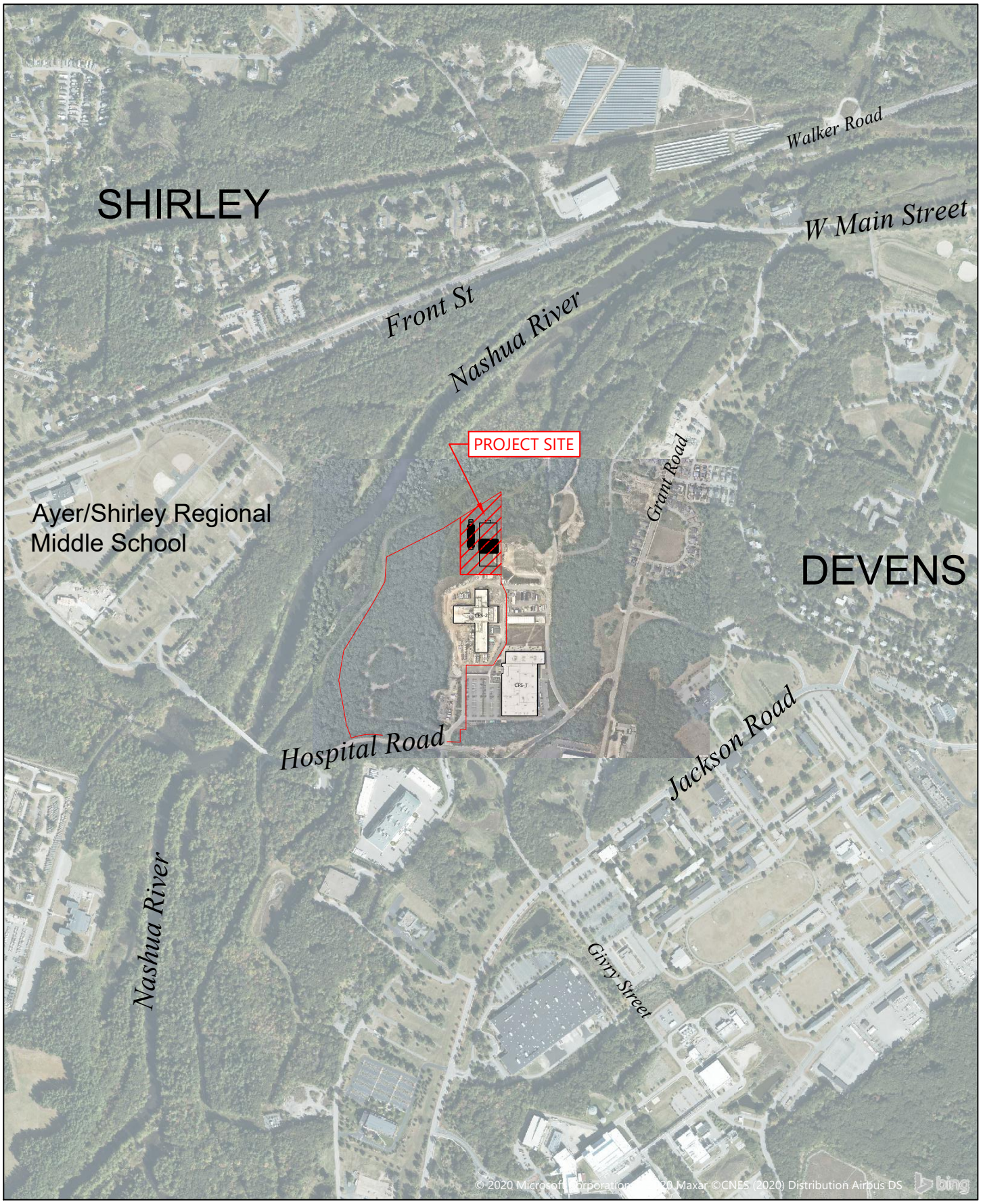
The site design integrates a comprehensive stormwater management system that has been developed in accordance with the Massachusetts Stormwater Handbook. Because the Project is located within an area of rapid infiltration and is near a critical area, the proposed stormwater management system has been designed to treat the one inch Water Quality Volume and provide 44% Total Suspended Solids (TSS) pretreatment prior to infiltration. Pursuant to 974 CMR 4.08(6)(h), stormwater discharging to a subsurface infiltration system has been treated to achieve 80% TSS removal prior to infiltration using a combination of deep-sump hooded catch basins and a proprietary water quality unit. At least 60% reduction in annual Total Phosphorus (TP) load is also achieved pursuant to 974 CMR 4.08(3)(i).

North and west of the development are perimeter landscaped areas that will be seeded with a meadow mix in the proposed condition. Meadow and woods have an equivalent curve number (CN) in HSG A soil conditions; therefore, this will not result in increased runoff from the Site.

## Consideration of Future Development

This stormwater report and associated site plans are in support of the CFS-4 development only. Future development of the CFS-3 parcel may impact the stormwater design herein, resulting in an expansion of the infiltration system, increased pipe sizes, additional drainage structures, additional pretreatment devices, and/or other unforeseen modifications. In the event that the CFS-3 project impacts the drainage design as shown in this application, those changes will be analyzed and incorporated into the separate CFS-3 plans and stormwater report.

## Figure 1 Site Locus Map




Project Location

0 500 1000 2000 Feet

vhb

Locus Map

111 Hospital Road
Devens, MA

**Figure 1**

**Figure 2 FEMA Map**

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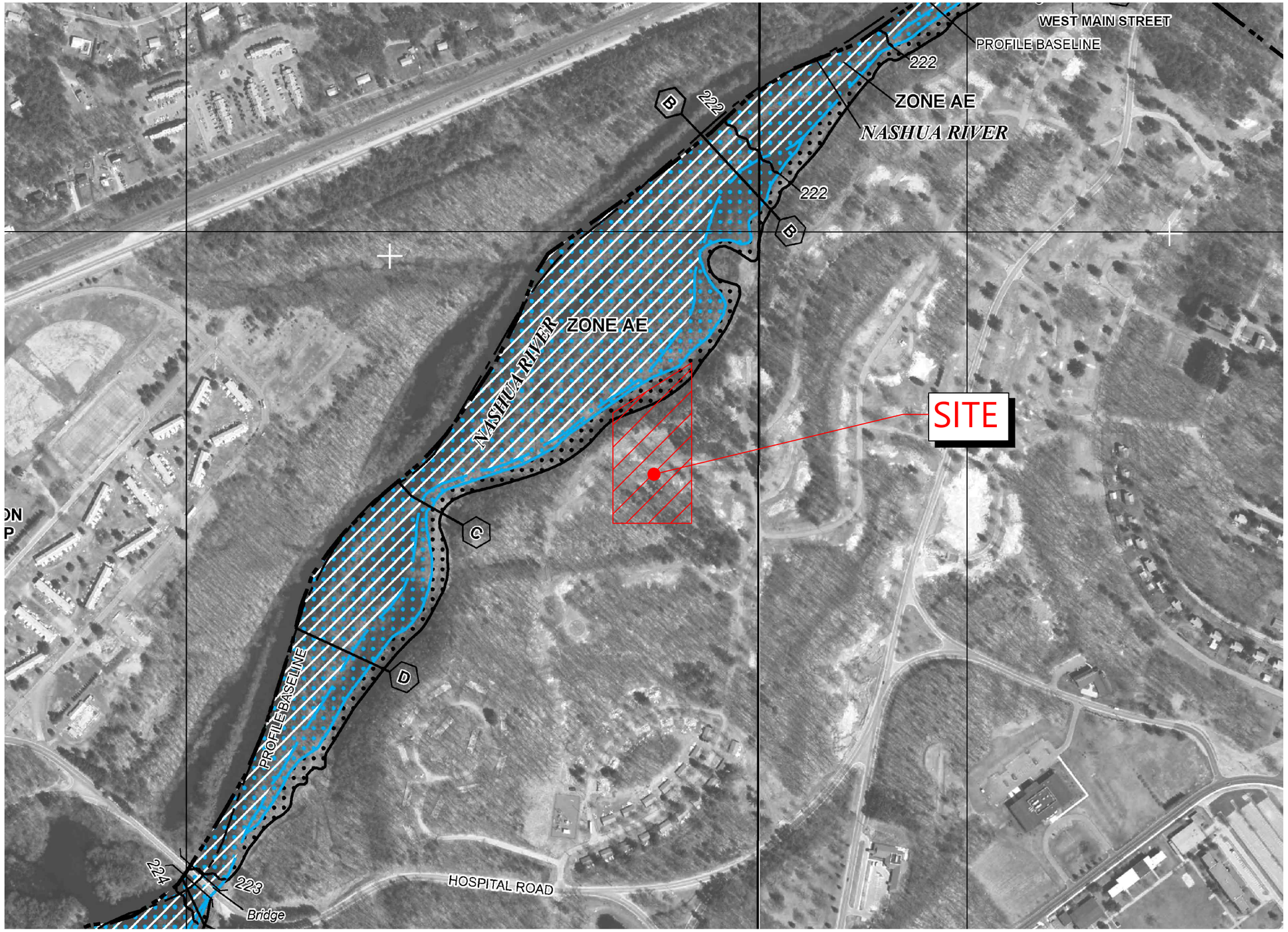



## LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

| | |
|---|---|
| ZONE A | No Base Flood Elevations determined. |
| ZONE AE | Base Flood Elevations determined. |
| ZONE AH | Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined. |
| ZONE AO | Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined. |
| ZONE AR | Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood. |
| ZONE A99 | Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined. |
| ZONE V | Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined. |
| ZONE VE | Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined. |

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

| | |
|---|---|
| ZONE X | Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood. |

OTHER AREAS

| | |
|---|---|
| ZONE X | Areas determined to be outside the 0.2% annual chance floodplain. |
| ZONE D | Areas in which flood hazards are undetermined, but possible. |

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

| | |
|---|---|
| | 1% Annual Chance Floodplain Boundary |
| | 0.2% Annual Chance Floodplain Boundary |
| | Floodway boundary |
| | Zone D boundary |
| | CBRS and OPA boundary |
| | Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities. |
| 513 | Base Flood Elevation line and value; elevation in feet* |
| (EL 987) | Base Flood Elevation value where uniform within zone; elevation in feet* |

*Referenced to the North American Vertical Datum of 1988

| | |
|---|---|
| A — A | Cross section line |
| 23 — 23 | Transect line |
| | Culvert |
| | Bridge |
| 45° 02' 08", 93° 02' 12" | Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere |
| 4989000 M | 1000-meter ticks: Massachusetts State Plane Mainland Zone (FIPS Zone 2001), Lambert Conformal Conic projection |
| 4989000m N | 1000-meter Universal Transverse Mercator grid values, zone 19N |
| DX5510 × | Bench mark (see explanation in Notes to Users section of this FIRM panel) |
| M1.5 | River Mile |

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
July 4, 2011

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

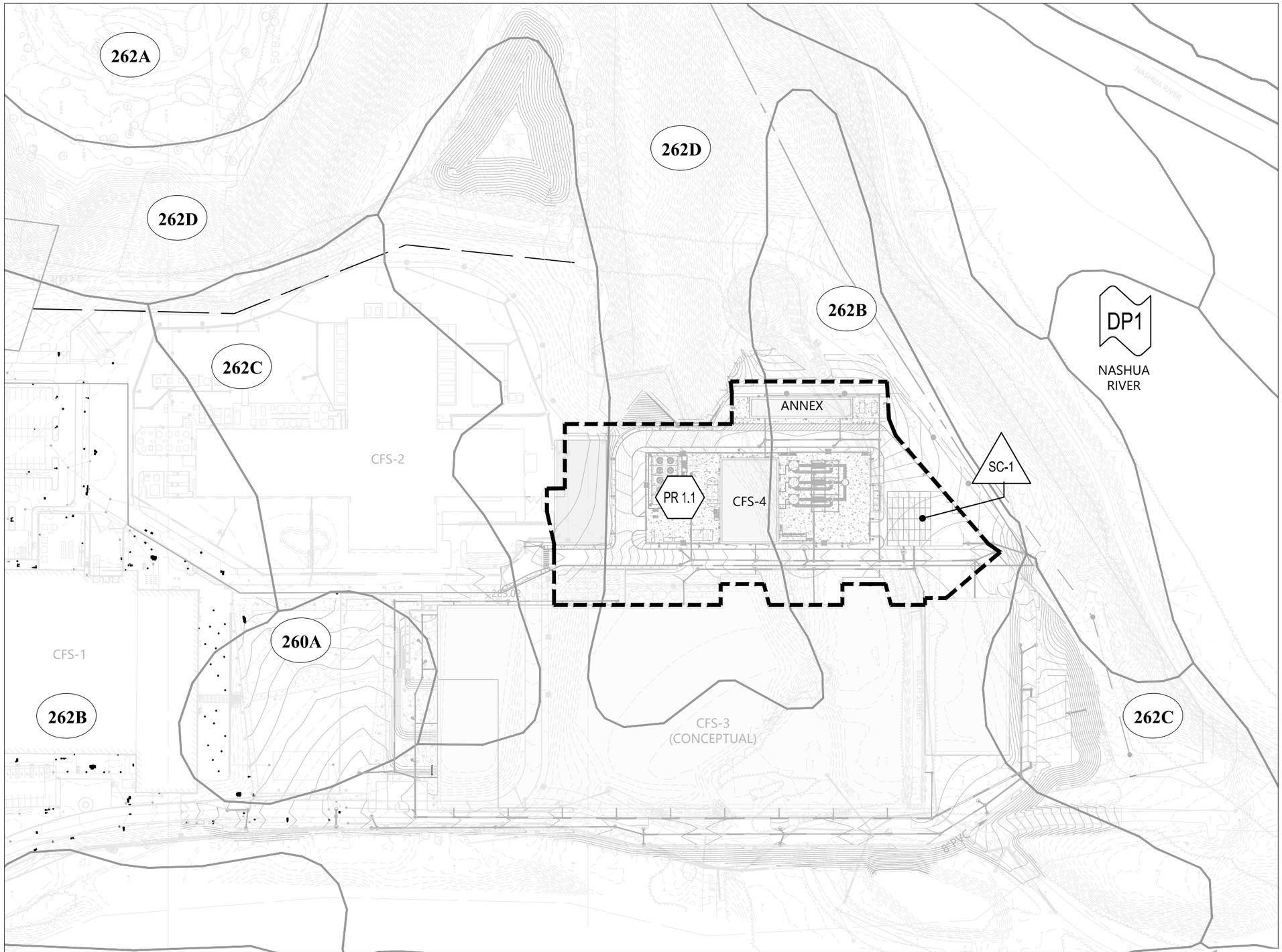
To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

0 200 400 Feet

FEMA Map
Commonwealth Fusion Systems Campus
Building 3
111 Hospital Road, Devens, MA

**Figure 2**
Sept. 2025

## Figure 3 Proposed Drainage Area




# Legend

**SYMBOLS**

- X — **DESIGN POINT**
- X — **DRAINAGE AREA DESIGNATION**
- X — **POND**

**LINETYPES**

- **DRAINAGE AREA BOUNDARY**
- **TIME OF CONCENTRATION FLOW LINE**
- **SOIL TYPE BOUNDARY**

**SCS SOIL CLASSIFICATIONS**

- 260A — **SOIL GROUP B; SUDBURY FINE SANDY LOAM, 0 TO 3 PERCENT SLOPES**
- 262A — **SOIL GROUP A; QUONSET LOAMY SAND, 0 TO 3 PERCENT SLOPES**
- 262B — **SOIL GROUP A; QUONSET LOAMY SAND, 3 TO 8 PERCENT SLOPES**
- 262C — **SOIL GROUP A; QUONSET LOAMY SAND, 8 TO 15 PERCENT SLOPES**
- 262D — **SOIL GROUP A; QUONSET LOAMY SAND, 15 TO 25 PERCENT SLOPES**

0 75 150 Feet

Proposed Drainage Conditions
CFS Campus Building 4
111 Hospital Road
Devens, MA

**Figure 3**

Nov. 2025

# Regulatory Compliance

## Massachusetts Department of Environmental Protection (DEP) – Stormwater Management Standards

As demonstrated below, the proposed Project fully complies with the DEP Stormwater Management Standards.

### Standard 1: No New Untreated Discharges or Erosion to Wetlands

The Project has been designed to comply with Standard 1.

The Best Management Practices (BMPs) included in the proposed stormwater management system have been designed in accordance with the Massachusetts Stormwater Handbook. Supporting information and computations demonstrating that no new untreated discharges will result from the Project are presented through compliance with Standards 4 through 6.

### Standard 2: Peak Rate Attenuation

The Project has been designed to comply with Standard 2.

The rainfall-runoff response of the Site under proposed conditions was analyzed for storm events with recurrence intervals of 2, 10, 25, 50 and 100 years. The stormwater management system is designed to fully capture and infiltration all storm events up to and including the 100-year storm. Therefore, there is no increase in peak discharge rates between the existing and proposed conditions.

Computations and supporting information regarding the hydrologic modeling are included in Appendix B.

### Standard 3: Stormwater Recharge

The Project has been designed to comply with Standard 3.

Recahrge of stormwater is provided in the subsurface stormwater infiltration system. The entire inflow volume of the 100-Year Storm exfiltrates from the system into the ground. Therefore, the required recharge volume is necessarily met. Since all impervious ground cover is directed to the

infiltration system, no capture area adjustment is needed. The HydroCAD analysis shows that this system is designed to drain completely within 72 hours.

Soil evaluation, computations, and supporting information are included in Appendix C.

## Standard 4: Water Quality

The Project has been designed to comply with Standard 4.

The proposed stormwater management system implements a treatment train of BMPs that has been designed to meet the requirements of the Massachusetts Stormwater Handbook by providing at least 80% TSS removal of stormwater runoff from all proposed impervious surfaces and at least 44% pretreatment prior to infiltration BMPs. Additionally, the system also achieves 80% TSS removal prior to infiltration, therefore also meeting Devens Industrial Performance Standard 974 CMR 4.08 (6)(h).

Computations and supporting information, including the Long-Term Pollution Prevention Plan, are included in Appendix D.

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

The Project is not considered a LUHPPL. However, the Site does meet the water quality and pretreatment requirements of this standard regardless.

## Standard 6: Critical Areas

The Project will infiltrate treated stormwater near the Nashua River, which is defined as a Class B inland water in 314 CMR 4.00, and is therefore considered a critical area. The Project has been designed with suitable BMPs sized to treat the 1-inch water quality volume and provide the pretreatment requirement of at least 44% TSS removal prior to infiltration.

Proposed source controls and pollution prevention measures have been identified in the Long-Term Pollution Prevention Plan included in Appendix D. Computations and supporting information regarding the sizing of BMPs is also included in Appendix D.

## Standard 7: Redevelopments and Other Projects Subject to the Standards only to the Maximum Extent Practicable

The Project has been designed to comply with all ten of the Stormwater Management Standards.

## Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Controls

The Project will disturb approximately 3.8 acres of land and is therefore required to obtain coverage under the Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES) Construction General Permit. As required under this permit, a

Stormwater Pollution Prevention Plan (SWPPP) will be developed and submitted before land disturbance begins. Recommended construction period pollution prevention and erosion and sedimentation controls to be finalized in the SWPPP are included in Appendix E.

## Standard 9: Operation and Maintenance Plan

In compliance with Standard 9, a Post Construction Stormwater Operation and Maintenance (O&M) Plan has been developed for the Project. The O&M Plan is included in Appendix D as part of the Long Term Pollution Prevention Plan.

## Standard 10: Prohibition of Illicit Discharges

Sanitary sewer and storm drainage structures remaining from previous development which are part of the redevelopment area will be removed or will be incorporated into updated sanitary sewer and separate stormwater sewer systems. The design plans submitted with this report have been designed so that the components included therein are in full compliance with current standards. No statement is made with regard to the drainage system in portions of the site not included in the redevelopment project area. The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges.

# Appendix A: Standard 1 Computations and Supporting Information

# Pipe Sizing Calculations

The closed drainage system was designed for the 25-year storm event.

Drainage pipes were sized using Manning's Equation for full-flow capacity and the Rational Method. Additionally, the performance of the system was analyzed using StormCAD, a HEC-22 based program.

# 25-Year Storm Hydraulic Pipe Analysis - Stormcad Conduit Output Table

Project: CFS-4 | Project #: 14867.07

Calculated by: EOB | Date: Sept. 2025

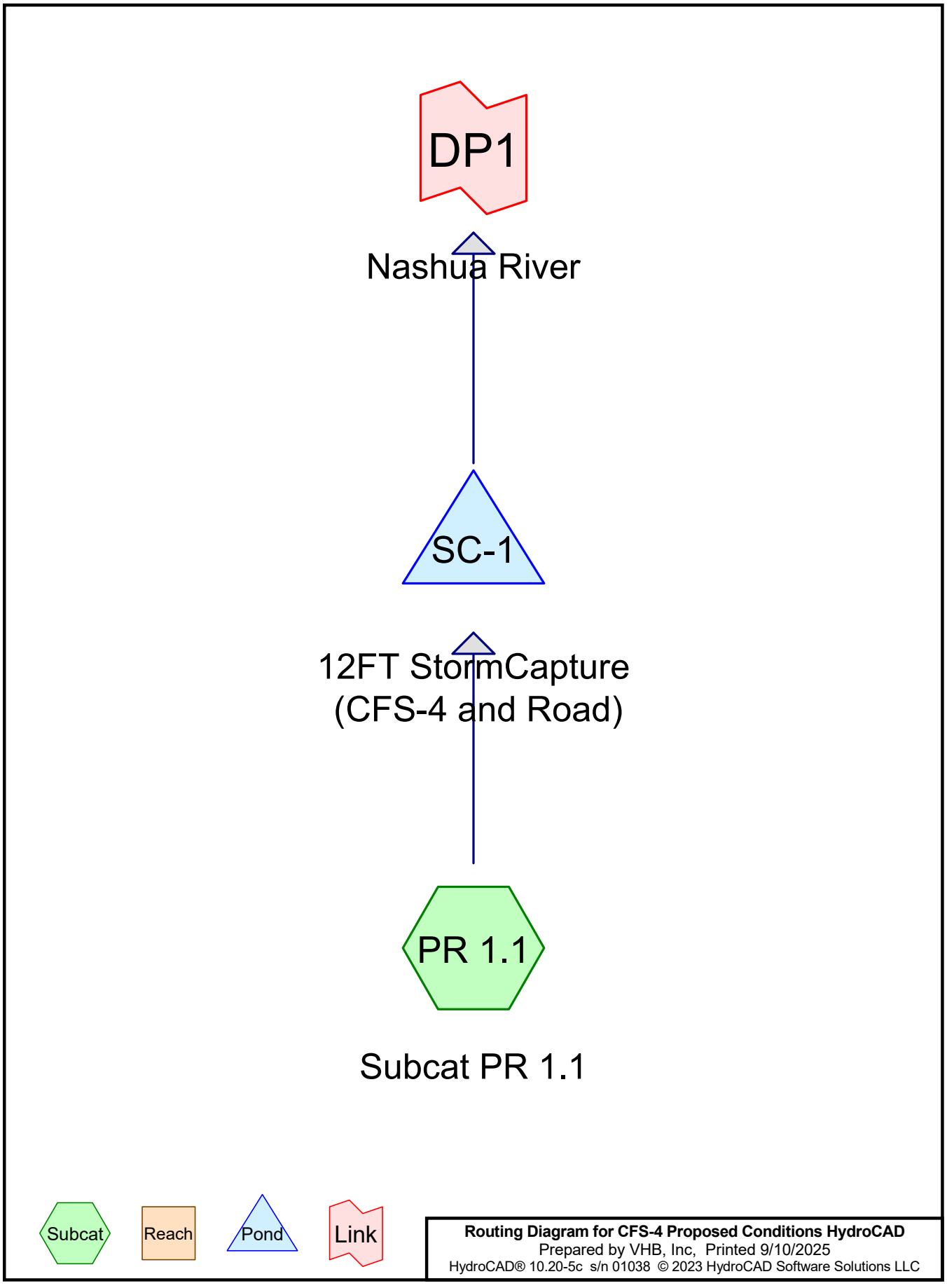
Checked by: | Date:

| Upstream Structure | Downstream Structure | Upstream Inlet Area (acres) | Upstream Inlet C | System CA | Time of Conc. (min) | Intensity (in/hr) | Pipe Diameter (in) | Material | Manning's "n" | Invert - Upper (ft) | Invert - Lower (ft) | Pipe Length (ft) | Pipe Slope (ft/ft) | Pipe Flow (cfs) | Capacity - Full Flow (cfs) | Velocity (ft/s) | Rim -Upper (ft) | Hydraulic Grade Line In (ft) | Rim - Lower (ft | Hydraulic Grade Line Out (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 101 | 103 | 0.183 | 0.58 | 0.106 | 5 | 8.13 | 12 | HDPE Pipe | 0.012 | 267.5 | 267.3 | 22.1 | 0.009 | 0.87 | 3.67 | 3.83 | 271.99 | 268.08 | 270.92 | 268.08 |
| 102 | 103 | 0.198 | 0.67 | 0.133 | 5 | 8.13 | 12 | HDPE Pipe | 0.012 | 267.5 | 267.3 | 18 | 0.011 | 1.09 | 4.07 | 4.39 | 272 | 268.06 | 270.92 | 268.08 |
| 103 | 104 | 0.341 | 0.9 | 0.546 | 5 | 8.09 | 12 | HDPE Pipe | 0.012 | 267.2 | 263.8 | 94.8 | 0.036 | 4.45 | 7.31 | 9.76 | 270.92 | 268.08 | 267.33 | 264.36 |
| 104 | 107 | 0.135 | 0.9 | 0.667 | 5 | 8.01 | 15 | HDPE Pipe | 0.012 | 263.7 | 262.7 | 76.5 | 0.013 | 5.39 | 8 | 7 | 267.33 | 264.64 | 266.65 | 263.78 |
| 105 | 107 | 0.128 | 0.66 | 0.084 | 5 | 8.13 | 12 | HDPE Pipe | 0.012 | 262.95 | 262.75 | 17.4 | 0.012 | 0.69 | 4.14 | 3.91 | 266.47 | 263.78 | 266.65 | 263.78 |
| 106 | 107 | 0.473 | 0.87 | 0.412 | 5 | 8.13 | 12 | HDPE Pipe | 0.012 | 262.95 | 262.75 | 8.6 | 0.023 | 3.37 | 5.89 | 7.75 | 266.48 | 263.74 | 266.65 | 263.78 |
| 107 | 108 | (N/A) | (N/A) | 1.163 | 0 | 7.93 | 18 | HDPE Pipe | 0.012 | 262.6 | 262.5 | 9.7 | 0.01 | 9.3 | 11.57 | 7.28 | 266.65 | 263.78 | 266.76 | 263.73 |
| 108 | 109 | 0.418 | 0.9 | 1.539 | 5 | 7.92 | 18 | HDPE Pipe | 0.012 | 262.4 | 261.25 | 97 | 0.012 | 12.29 | 12.39 | 7.99 | 266.76 | 263.73 | 267.5 | 262.69 |
| 109 | 113 | (N/A) | (N/A) | 2.315 | 0 | 7.78 | 24 | HDPE Pipe | 0.012 | 261.15 | 260.45 | 35 | 0.02 | 18.16 | 34.66 | 11.16 | 267.5 | 262.69 | 266.73 | 262.02 |
| 110 | 112 | 0.378 | 0.79 | 0.299 | 5 | 8.13 | 12 | HDPE Pipe | 0.012 | 262.05 | 261.75 | 30.2 | 0.01 | 2.45 | 3.84 | 5.19 | 265.54 | 262.72 | 265.89 | 262.45 |
| 111 | 112 | 0.201 | 0.9 | 0.181 | 5 | 8.13 | 12 | HDPE Pipe | 0.012 | 262.15 | 262 | 10.3 | 0.015 | 1.48 | 4.65 | 5.26 | 265.66 | 262.67 | 265.89 | 262.42 |
| 112 | 113 | (N/A) | (N/A) | 0.48 | 0 | 8.09 | 15 | HDPE Pipe | 0.012 | 261.65 | 260.45 | 105 | 0.011 | 3.91 | 7.48 | 6.16 | 265.89 | 262.45 | 266.73 | 262.02 |
| 113 | WQU-1 | (N/A) | (N/A) | 2.794 | 0 | 7.76 | 24 | HDPE Pipe | 0.012 | 260.35 | 260.2 | 13.2 | 0.011 | 21.86 | 26.13 | 9.31 | 266.73 | 262.02 | 266.66 | 261.72 |
| 201 | 202 | 0.694 | 0.57 | 0.396 | 5 | 8.13 | 12 | HDPE Pipe | 0.012 | 268.75 | 268.65 | 13.3 | 0.008 | 3.24 | 3.35 | 4.86 | 272.24 | 269.54 | 272.62 | 269.43 |
| 202 | 204 | 0.195 | (N/A) | 0.571 | 5 | 8.11 | 15 | HDPE Pipe | 0.012 | 268.55 | 265.9 | 110.7 | 0.024 | 4.67 | 10.83 | 8.5 | 272.62 | 269.43 | 272.66 | 266.81 |
| 203 | 204 | 0.188 | 0.8 | 0.15 | 5 | 8.13 | 12 | HDPE Pipe | 0.012 | 268.75 | 268.65 | 13.9 | 0.007 | 1.23 | 3.27 | 3.87 | 272.27 | 269.22 | 272.66 | 269.08 |
| 204 | 205 | 0.06 | 0.9 | 0.775 | 5 | 8.01 | 15 | HDPE Pipe | 0.012 | 265.8 | 264.4 | 57.7 | 0.024 | 6.26 | 10.9 | 9.19 | 272.66 | 266.81 | 272.49 | 265.1 |
| 205 | 109 | (N/A) | (N/A) | 0.775 | 0 | 7.96 | 15 | HDPE Pipe | 0.012 | 263.9 | 261.25 | 178.7 | 0.015 | 6.22 | 8.52 | 7.58 | 272.49 | 264.91 | 267.5 | 262.69 |
| WQU-1 | INF-1 | (N/A) | (N/A) | 2.794 | 0 | 7.75 | 24 | HDPE Pipe | 0.012 | 260.2 | 260.1 | 8.7 | 0.011 | 21.83 | 26.28 | 9.35 | 266.66 | 261.87 | 266.7 | 261.64 |

# Appendix B: Standard 2 Computations and Supporting Information

The rainfall-runoff response of the Site were evaluated for storm events with recurrence intervals of 2, 10, 25, 50, and 100-years. Rainfall volumes used for this analysis were based on the Natural Resources Conservation Service (NRCS) Type III, 24-hour storm and NOAA Atlas 14 precipitation depths for the site. Runoff coefficients for the pre- and post-development conditions were determined using NRCS Technical Release 55 (TR-55) methodology as provided in HydroCAD. Drainage areas used in the analyses were described in previous sections and shown on Figures 2 and 3. The HydroCAD model is based on the NRCS Technical Release 20 (TR-20) Model for Project Formulation Hydrology.

# HydroCAD Analysis: Proposed Conditions




**Routing Diagram for CFS-4 Proposed Conditions HydroCAD**
Prepared by VHB, Inc, Printed 9/10/2025
HydroCAD® 10.20-5c s/n 01038 © 2023 HydroCAD Software Solutions LLC

# 2-Year Storm Event – Proposed

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment PR 1.1: Subcat PR 1.1** Runoff Area=164,903 sf 80.04% Impervious Runoff Depth=2.32"
Tc=6.0 min CN=39/98 Runoff=9.2 cfs 31,873 cf

**Pond SC-1: 12FT StormCapture (CFS-4 and** Peak Elev=254.84' Storage=0.235 af Inflow=9.2 cfs 31,873 cf
Outflow=1.0 cfs 31,875 cf

**Link DP1: Nashua River** Inflow=0.0 cfs 0 cf
Primary=0.0 cfs 0 cf

**Total Runoff Area = 164,903 sf Runoff Volume = 31,873 cf Average Runoff Depth = 2.32"**
**19.96% Pervious = 32,912 sf 80.04% Impervious = 131,990 sf**

## Summary for Subcatchment PR 1.1: Subcat PR 1.1

Runoff = 9.2 cfs @ 12.08 hrs, Volume= 31,873 cf, Depth= 2.32"
Routed to Pond SC-1 : 12FT StormCapture (CFS-4 and Road)

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.13"

| Area (sf) | CN | Description |
|---|---|---|
| 32,911 | 39 | >75% Grass cover, Good, HSG A |
| 115,705 | 98 | Paved parking, HSG A |
| 16,286 | 98 | Roofs, HSG A |
| 2 | 30 | Woods, Good, HSG A |
| 164,903 | 86 | Weighted Average |
| 32,912 | 39 | 19.96% Pervious Area |
| 131,990 | 98 | 80.04% Impervious Area |

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

## Summary for Pond SC-1: 12FT StormCapture (CFS-4 and Road)

Inflow Area = 164,903 sf, 80.04% Impervious, Inflow Depth = 2.32" for 2-Year event
Inflow = 9.2 cfs @ 12.08 hrs, Volume= 31,873 cf
Outflow = 1.0 cfs @ 11.46 hrs, Volume= 31,875 cf, Atten= 89%, Lag= 0.0 min
Discarded = 1.0 cfs @ 11.46 hrs, Volume= 31,875 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 254.84' @ 12.77 hrs Surf.Area= 0.118 ac Storage= 0.235 af

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 67.3 min ( 824.1 - 756.9 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 252.00' | 0.000 af | **80.00'W x 64.00'L x 13.17'H Field A**<br>1.548 af Overall - 1.548 af Embedded = 0.000 af x 40.0% Voids |
| #2A | 252.00' | 1.249 af | **Oldcastle StormCapture SC2 12'** x 40 Inside #1<br>Inside= 84.0"W x 144.0"H => 86.13 sf x 16.00'L = 1,378.0 cf<br>Outside= 96.0"W x 158.0"H => 105.33 sf x 16.00'L = 1,685.3 cf<br>10 Rows adjusted for 724.0 cf perimeter wall |
| | | 1.249 af | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 252.00' | **8.270 in/hr Exfiltration over Surface area** |

**Discarded OutFlow** Max=1.0 cfs @ 11.46 hrs HW=252.58' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 1.0 cfs)

## Summary for Link DP1: Nashua River

Inflow Area = 164,903 sf, 80.04% Impervious, Inflow Depth = 0.00" for 2-Year event
Inflow = 0.0 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

## Stage-Area-Storage for Pond SC-1: 12FT StormCapture (CFS-4 and Road)

| Elevation (feet) | Surface (acres) | Storage (acre-feet) |
|---|---|---|
| 252.00 | **0.118** | 0.000 |
| 252.20 | 0.118 | 0.000 |
| 252.40 | 0.118 | 0.000 |
| 252.60 | 0.118 | 0.002 |
| 252.80 | 0.118 | 0.023 |
| 253.00 | 0.118 | 0.043 |
| 253.20 | 0.118 | 0.064 |
| 253.40 | 0.118 | 0.085 |
| 253.60 | 0.118 | 0.106 |
| 253.80 | 0.118 | 0.127 |
| 254.00 | 0.118 | 0.147 |
| 254.20 | 0.118 | 0.168 |
| 254.40 | 0.118 | 0.189 |
| 254.60 | 0.118 | 0.210 |
| 254.80 | 0.118 | 0.231 |
| 255.00 | 0.118 | 0.251 |
| 255.20 | 0.118 | 0.272 |
| 255.40 | 0.118 | 0.293 |
| 255.60 | 0.118 | 0.314 |
| 255.80 | 0.118 | 0.335 |
| 256.00 | 0.118 | 0.356 |
| 256.20 | 0.118 | 0.376 |
| 256.40 | 0.118 | 0.397 |
| 256.60 | 0.118 | 0.418 |
| 256.80 | 0.118 | 0.439 |
| 257.00 | 0.118 | 0.460 |
| 257.20 | 0.118 | 0.480 |
| 257.40 | 0.118 | 0.501 |
| 257.60 | 0.118 | 0.522 |
| 257.80 | 0.118 | 0.543 |
| 258.00 | 0.118 | 0.564 |
| 258.20 | 0.118 | 0.584 |
| 258.40 | 0.118 | 0.605 |
| 258.60 | 0.118 | 0.626 |
| 258.80 | 0.118 | 0.647 |
| 259.00 | 0.118 | 0.668 |
| 259.20 | 0.118 | 0.689 |
| 259.40 | 0.118 | 0.709 |
| 259.60 | 0.118 | 0.730 |
| 259.80 | 0.118 | 0.751 |
| 260.00 | 0.118 | 0.772 |
| 260.20 | 0.118 | 0.793 |
| 260.40 | 0.118 | 0.813 |
| 260.60 | 0.118 | 0.834 |
| 260.80 | 0.118 | 0.855 |
| 261.00 | 0.118 | 0.876 |
| 261.20 | 0.118 | 0.897 |
| 261.40 | 0.118 | 0.917 |
| 261.60 | 0.118 | 0.938 |
| 261.80 | 0.118 | 0.959 |
| 262.00 | 0.118 | 0.980 |
| 262.20 | 0.118 | 1.001 |
| 262.40 | 0.118 | 1.022 |
| 262.60 | 0.118 | 1.042 |
| 262.80 | 0.118 | 1.063 |
| 263.00 | 0.118 | 1.084 |
| 263.20 | 0.118 | 1.105 |
| 263.40 | 0.118 | 1.126 |
| 263.60 | 0.118 | 1.146 |
| 263.80 | 0.118 | 1.167 |
| 264.00 | 0.118 | 1.188 |
| 264.20 | 0.118 | 1.209 |
| 264.40 | 0.118 | 1.230 |
| 264.60 | 0.118 | 1.249 |
| 264.80 | 0.118 | 1.249 |
| 265.00 | 0.118 | **1.249** |

# 10-Year Storm Event – Proposed

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment PR 1.1: Subcat PR 1.1** Runoff Area=164,903 sf 80.04% Impervious Runoff Depth=3.68"
Tc=6.0 min CN=39/98 Runoff=14.2 cfs 50,523 cf

**Pond SC-1: 12FT StormCapture (CFS-4 and** Peak Elev=256.81' Storage=0.440 af Inflow=14.2 cfs 50,523 cf
Outflow=1.0 cfs 50,526 cf

**Link DP1: Nashua River** Inflow=0.0 cfs 0 cf
Primary=0.0 cfs 0 cf

**Total Runoff Area = 164,903 sf Runoff Volume = 50,523 cf Average Runoff Depth = 3.68"**
**19.96% Pervious = 32,912 sf 80.04% Impervious = 131,990 sf**

## Summary for Subcatchment PR 1.1: Subcat PR 1.1

Runoff = 14.2 cfs @ 12.08 hrs, Volume= 50,523 cf, Depth= 3.68"
Routed to Pond SC-1 : 12FT StormCapture (CFS-4 and Road)

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.79"

| Area (sf) | CN | Description |
|---|---|---|
| 32,911 | 39 | >75% Grass cover, Good, HSG A |
| 115,705 | 98 | Paved parking, HSG A |
| 16,286 | 98 | Roofs, HSG A |
| 2 | 30 | Woods, Good, HSG A |
| 164,903 | 86 | Weighted Average |
| 32,912 | 39 | 19.96% Pervious Area |
| 131,990 | 98 | 80.04% Impervious Area |

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

## Summary for Pond SC-1: 12FT StormCapture (CFS-4 and Road)

Inflow Area = 164,903 sf, 80.04% Impervious, Inflow Depth = 3.68" for 10-Year event
Inflow = 14.2 cfs @ 12.08 hrs, Volume= 50,523 cf
Outflow = 1.0 cfs @ 10.92 hrs, Volume= 50,526 cf, Atten= 93%, Lag= 0.0 min
Discarded = 1.0 cfs @ 10.92 hrs, Volume= 50,526 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 256.81' @ 13.38 hrs Surf.Area= 0.118 ac Storage= 0.440 af

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 145.7 min ( 896.9 - 751.1 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 252.00' | 0.000 af | **80.00'W x 64.00'L x 13.17'H Field A**<br>1.548 af Overall - 1.548 af Embedded = 0.000 af x 40.0% Voids |
| #2A | 252.00' | 1.249 af | **Oldcastle StormCapture SC2 12'** x 40 Inside #1<br>Inside= 84.0"W x 144.0"H => 86.13 sf x 16.00'L = 1,378.0 cf<br>Outside= 96.0"W x 158.0"H => 105.33 sf x 16.00'L = 1,685.3 cf<br>10 Rows adjusted for 724.0 cf perimeter wall |
| | | 1.249 af | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 252.00' | **8.270 in/hr Exfiltration over Surface area** |

**Discarded OutFlow** Max=1.0 cfs @ 10.92 hrs HW=252.58' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 1.0 cfs)

## Summary for Link DP1: Nashua River

Inflow Area = 164,903 sf, 80.04% Impervious, Inflow Depth = 0.00" for 10-Year event
Inflow = 0.0 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

# 25-Year Storm Event – Proposed

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment PR 1.1: Subcat PR 1.1** Runoff Area=164,903 sf 80.04% Impervious Runoff Depth=4.56"
Tc=6.0 min CN=39/98 Runoff=17.3 cfs 62,599 cf

**Pond SC-1: 12FT StormCapture (CFS-4 and** Peak Elev=258.32' Storage=0.597 af Inflow=17.3 cfs 62,599 cf
Outflow=1.0 cfs 62,615 cf

**Link DP1: Nashua River** Inflow=0.0 cfs 0 cf
Primary=0.0 cfs 0 cf

**Total Runoff Area = 164,903 sf Runoff Volume = 62,599 cf Average Runoff Depth = 4.56"**
**19.96% Pervious = 32,912 sf 80.04% Impervious = 131,990 sf**

## Summary for Subcatchment PR 1.1: Subcat PR 1.1

Runoff = 17.3 cfs @ 12.08 hrs, Volume= 62,599 cf, Depth= 4.56"
Routed to Pond SC-1 : 12FT StormCapture (CFS-4 and Road)

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.83"

| Area (sf) | CN | Description |
|---|---|---|
| 32,911 | 39 | >75% Grass cover, Good, HSG A |
| 115,705 | 98 | Paved parking, HSG A |
| 16,286 | 98 | Roofs, HSG A |
| 2 | 30 | Woods, Good, HSG A |
| 164,903 | 86 | Weighted Average |
| 32,912 | 39 | 19.96% Pervious Area |
| 131,990 | 98 | 80.04% Impervious Area |

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

## Summary for Pond SC-1: 12FT StormCapture (CFS-4 and Road)

Inflow Area = 164,903 sf, 80.04% Impervious, Inflow Depth = 4.56" for 25-Year event
Inflow = 17.3 cfs @ 12.08 hrs, Volume= 62,599 cf
Outflow = 1.0 cfs @ 10.40 hrs, Volume= 62,615 cf, Atten= 94%, Lag= 0.0 min
Discarded = 1.0 cfs @ 10.40 hrs, Volume= 62,615 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 258.32' @ 13.93 hrs Surf.Area= 0.118 ac Storage= 0.597 af

Plug-Flow detention time= 209.8 min calculated for 62,598 cf (100% of inflow)
Center-of-Mass det. time= 209.9 min ( 959.3 - 749.4 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 252.00' | 0.000 af | **80.00'W x 64.00'L x 13.17'H Field A**<br>1.548 af Overall - 1.548 af Embedded = 0.000 af x 40.0% Voids |
| #2A | 252.00' | 1.249 af | **Oldcastle StormCapture SC2 12'** x 40 Inside #1<br>Inside= 84.0"W x 144.0"H => 86.13 sf x 16.00'L = 1,378.0 cf<br>Outside= 96.0"W x 158.0"H => 105.33 sf x 16.00'L = 1,685.3 cf<br>10 Rows adjusted for 724.0 cf perimeter wall |
| | | 1.249 af | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 252.00' | **8.270 in/hr Exfiltration over Surface area** |

**Discarded OutFlow** Max=1.0 cfs @ 10.40 hrs HW=252.58' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 1.0 cfs)

## Summary for Link DP1: Nashua River

Inflow Area = 164,903 sf, 80.04% Impervious, Inflow Depth = 0.00" for 25-Year event
Inflow = 0.0 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

## 50-Year Storm Event – Proposed

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment PR 1.1: Subcat PR 1.1** Runoff Area=164,903 sf 80.04% Impervious Runoff Depth=5.22"
Tc=6.0 min CN=39/98 Runoff=19.7 cfs 71,698 cf

**Pond SC-1: 12FT StormCapture (CFS-4 and** Peak Elev=259.55' Storage=0.725 af Inflow=19.7 cfs 71,698 cf
Outflow=1.0 cfs 71,698 cf

**Link DP1: Nashua River** Inflow=0.0 cfs 0 cf
Primary=0.0 cfs 0 cf

**Total Runoff Area = 164,903 sf Runoff Volume = 71,698 cf Average Runoff Depth = 5.22"**
**19.96% Pervious = 32,912 sf 80.04% Impervious = 131,990 sf**

## Summary for Subcatchment PR 1.1: Subcat PR 1.1

Runoff = 19.7 cfs @ 12.08 hrs, Volume= 71,698 cf, Depth= 5.22"
Routed to Pond SC-1 : 12FT StormCapture (CFS-4 and Road)

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-Year Rainfall=6.60"

| Area (sf) | CN | Description |
|---|---|---|
| 32,911 | 39 | >75% Grass cover, Good, HSG A |
| 115,705 | 98 | Paved parking, HSG A |
| 16,286 | 98 | Roofs, HSG A |
| 2 | 30 | Woods, Good, HSG A |
| 164,903 | 86 | Weighted Average |
| 32,912 | 39 | 19.96% Pervious Area |
| 131,990 | 98 | 80.04% Impervious Area |

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

## Summary for Pond SC-1: 12FT StormCapture (CFS-4 and Road)

Inflow Area = 164,903 sf, 80.04% Impervious, Inflow Depth = 5.22" for 50-Year event
Inflow = 19.7 cfs @ 12.08 hrs, Volume= 71,698 cf
Outflow = 1.0 cfs @ 10.12 hrs, Volume= 71,698 cf, Atten= 95%, Lag= 0.0 min
Discarded = 1.0 cfs @ 10.12 hrs, Volume= 71,698 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 259.55' @ 14.36 hrs Surf.Area= 0.118 ac Storage= 0.725 af

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 261.8 min ( 1,010.3 - 748.5 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 252.00' | 0.000 af | **80.00'W x 64.00'L x 13.17'H Field A**<br>1.548 af Overall - 1.548 af Embedded = 0.000 af x 40.0% Voids |
| #2A | 252.00' | 1.249 af | **Oldcastle StormCapture SC2 12'** x 40 Inside #1<br>Inside= 84.0"W x 144.0"H => 86.13 sf x 16.00'L = 1,378.0 cf<br>Outside= 96.0"W x 158.0"H => 105.33 sf x 16.00'L = 1,685.3 cf<br>10 Rows adjusted for 724.0 cf perimeter wall |
| | | 1.249 af | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 252.00' | **8.270 in/hr Exfiltration over Surface area** |

**Discarded OutFlow** Max=1.0 cfs @ 10.12 hrs HW=252.58' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 1.0 cfs)

## Summary for Link DP1: Nashua River

Inflow Area = 164,903 sf, 80.04% Impervious, Inflow Depth = 0.00" for 50-Year event
Inflow = 0.0 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

# 100-Year Storm Event – Proposed

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment PR 1.1: Subcat PR 1.1** Runoff Area=164,903 sf 80.04% Impervious Runoff Depth=5.94"
Tc=6.0 min CN=39/98 Runoff=22.5 cfs 81,636 cf

**Pond SC-1: 12FT StormCapture (CFS-4 and** Peak Elev=260.99' Storage=0.875 af Inflow=22.5 cfs 81,636 cf
Outflow=1.0 cfs 81,640 cf

**Link DP1: Nashua River** Inflow=0.0 cfs 0 cf
Primary=0.0 cfs 0 cf

**Total Runoff Area = 164,903 sf Runoff Volume = 81,636 cf Average Runoff Depth = 5.94"**
**19.96% Pervious = 32,912 sf 80.04% Impervious = 131,990 sf**

## Summary for Subcatchment PR 1.1: Subcat PR 1.1

Runoff = 22.5 cfs @ 12.08 hrs, Volume= 81,636 cf, Depth= 5.94"
Routed to Pond SC-1 : 12FT StormCapture (CFS-4 and Road)

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.43"

| Area (sf) | CN | Description |
|---|---|---|
| 32,911 | 39 | >75% Grass cover, Good, HSG A |
| 115,705 | 98 | Paved parking, HSG A |
| 16,286 | 98 | Roofs, HSG A |
| 2 | 30 | Woods, Good, HSG A |
| 164,903 | 86 | Weighted Average |
| 32,912 | 39 | 19.96% Pervious Area |
| 131,990 | 98 | 80.04% Impervious Area |

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

## Summary for Pond SC-1: 12FT StormCapture (CFS-4 and Road)

Inflow Area = 164,903 sf, 80.04% Impervious, Inflow Depth = 5.94" for 100-Year event
Inflow = 22.5 cfs @ 12.08 hrs, Volume= 81,636 cf
Outflow = 1.0 cfs @ 9.67 hrs, Volume= 81,640 cf, Atten= 96%, Lag= 0.0 min
Discarded = 1.0 cfs @ 9.67 hrs, Volume= 81,640 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 260.99' @ 14.86 hrs Surf.Area= 0.118 ac Storage= 0.875 af

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 321.2 min ( 1,069.0 - 747.8 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 252.00' | 0.000 af | **80.00'W x 64.00'L x 13.17'H Field A**<br>1.548 af Overall - 1.548 af Embedded = 0.000 af x 40.0% Voids |
| #2A | 252.00' | 1.249 af | **Oldcastle StormCapture SC2 12'** x 40 Inside #1<br>Inside= 84.0"W x 144.0"H => 86.13 sf x 16.00'L = 1,378.0 cf<br>Outside= 96.0"W x 158.0"H => 105.33 sf x 16.00'L = 1,685.3 cf<br>10 Rows adjusted for 724.0 cf perimeter wall |
| | | 1.249 af | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 252.00' | **8.270 in/hr Exfiltration over Surface area** |

**Discarded OutFlow** Max=1.0 cfs @ 9.67 hrs HW=252.58' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 1.0 cfs)

## Summary for Link DP1: Nashua River

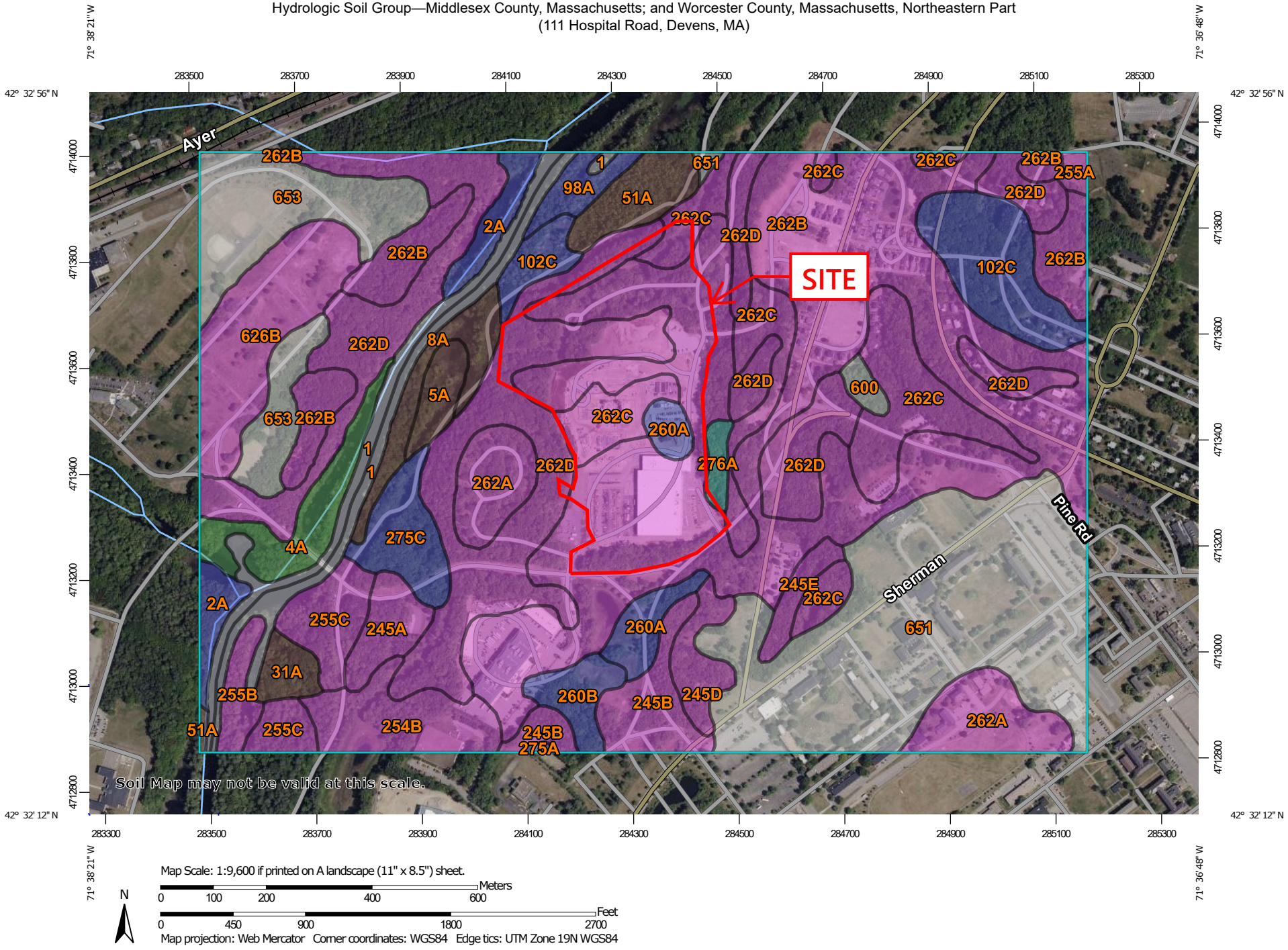
Inflow Area = 164,903 sf, 80.04% Impervious, Inflow Depth = 0.00" for 100-Year event
Inflow = 0.0 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

# Appendix C: Standard 3 Computations and Supporting Information

# Soil Evaluation and Analysis

Hydrologic Soil Group—Middlesex County, Massachusetts; and Worcester County, Massachusetts, Northeastern Part
(111 Hospital Road, Devens, MA)



## MAP LEGEND

**Area of Interest (AOI)**
- Area of Interest (AOI)

**Soils**

**Soil Rating Polygons**
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

**Soil Rating Lines**
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

**Soil Rating Points**
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

**Water Features**
- Streams and Canals

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

**Background**
- Aerial Photography

## MAP INFORMATION

The soil surveys that comprise your AOI were mapped at scales ranging from 1:20,000 to 1:24,000.

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: Middlesex County, Massachusetts
Survey Area Data: Version 24, Aug 27, 2024

Soil Survey Area: Worcester County, Massachusetts, Northeastern Part
Survey Area Data: Version 19, Aug 27, 2024

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

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

Date(s) aerial images were photographed: May 22, 2022—Jun 5, 2022

# Hydrologic Soil Group

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| 1 | Water | | 6.9 | 1.5% |
| 2A | Pootatuck fine sandy loam, 0 to 3 percent slopes, occasionally flooded | B | 6.6 | 1.4% |
| 4A | Rippowam fine sandy loam, 0 to 3 percent slopes, frequently flooded | A/D | 8.3 | 1.8% |
| 51A | Swansea muck, 0 to 1 percent slopes | B/D | 0.3 | 0.1% |
| 262B | Quonset sandy loam, 3 to 8 percent slopes | A | 9.1 | 1.9% |
| 262D | Quonset sandy loam, 15 to 25 percent slopes | A | 19.1 | 4.0% |
| 626B | Merrimac-Urban land complex, 0 to 8 percent slopes | A | 17.0 | 3.6% |
| 653 | Udorthents, sandy | | 23.1 | 4.9% |
| **Subtotals for Soil Survey Area** | | | **90.5** | **19.1%** |
| **Totals for Area of Interest** | | | **472.8** | **100.0%** |

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| 1 | Water | | 7.2 | 1.5% |
| 5A | Saco silt loam, frequently ponded, 0 to 2 percent slopes, frequently flooded | B/D | 3.4 | 0.7% |
| 8A | Limerick silt loam, 0 to 3 percent slopes, frequently flooded | B/D | 6.3 | 1.3% |
| 31A | Walpole sandy loam, 0 to 3 percent slopes | B/D | 3.0 | 0.6% |
| 51A | Swansea muck, 0 to 1 percent slopes | B/D | 6.0 | 1.3% |
| 98A | Winooski very fine sandy loam, 0 to 3 percent slopes, occasionally flooded | B | 3.2 | 0.7% |
| 102C | Chatfield-Hollis-Rock outcrop complex, 0 to 15 percent slopes | B | 16.2 | 3.4% |
| 245A | Hinckley loamy sand, 0 to 3 percent slopes | A | 4.9 | 1.0% |

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| 245B | Hinckley loamy sand, 3 to 8 percent slopes | A | 9.2 | 1.9% |
| 245D | Hinckley loamy sand, 15 to 25 percent slopes | A | 4.6 | 1.0% |
| 245E | Hinckley loamy sand, 25 to 35 percent slopes | A | 2.7 | 0.6% |
| 254B | Merrimac fine sandy loam, 3 to 8 percent slopes | A | 10.3 | 2.2% |
| 255A | Windsor loamy sand, 0 to 3 percent slopes | A | 0.9 | 0.2% |
| 255B | Windsor loamy sand, 3 to 8 percent slopes | A | 3.3 | 0.7% |
| 255C | Windsor loamy sand, 8 to 15 percent slopes | A | 9.0 | 1.9% |
| 260A | Sudbury fine sandy loam, 0 to 3 percent slopes | B | 5.8 | 1.2% |
| 260B | Sudbury fine sandy loam, 3 to 8 percent slopes | B | 4.4 | 0.9% |
| 262A | Quonset loamy sand, 0 to 3 percent slopes | A | 15.1 | 3.2% |
| 262B | Quonset loamy sand, 3 to 8 percent slopes | A | 114.9 | 24.3% |
| 262C | Quonset loamy sand, 8 to 15 percent slopes | A | 30.6 | 6.5% |
| 262D | Quonset loamy sand, 15 to 25 percent slopes | A | 49.5 | 10.5% |
| 275A | Agawam fine sandy loam, 0 to 3 percent slopes | B | 0.2 | 0.0% |
| 275C | Agawam fine sandy loam, 8 to 15 percent slopes | B | 7.3 | 1.5% |
| 276A | Ninigret fine sandy loam, 0 to 3 percent slopes | C | 1.7 | 0.3% |
| 600 | Pits, gravel | | 1.4 | 0.3% |
| 651 | Udorthents, smoothed | | 61.2 | 12.9% |
| **Subtotals for Soil Survey Area** | | | **382.3** | **80.8%** |
| **Totals for Area of Interest** | | | **472.8** | **100.0%** |

## Description

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

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

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

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

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

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

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

## Rating Options

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff: None Specified*

*Tie-break Rule:* Higher

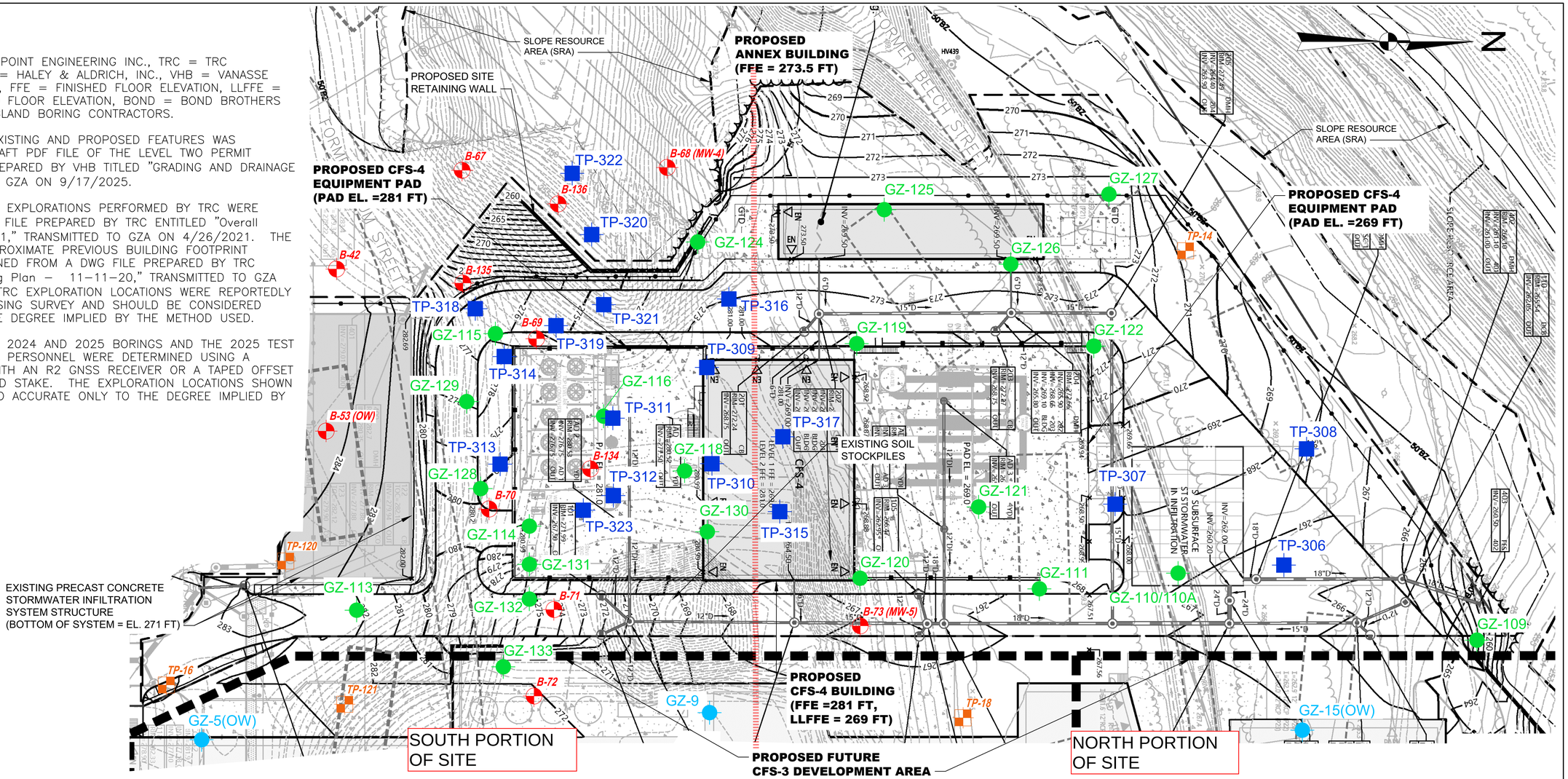
## GENERAL NOTES

1. ACRONYMS: HEI = HIGHPOINT ENGINEERING INC., TRC = TRC COMPANIES, INC., H&A = HALEY & ALDRICH, INC., VHB = VANASSE HANGEN BRUSTLIN, INC., FFE = FINISHED FLOOR ELEVATION, LLFFE = LOWEST LEVEL FINISHED FLOOR ELEVATION, BOND = BOND BROTHERS INC., NEBC = NEW ENGLAND BORING CONTRACTORS.

2. BASE MAP DEPICTING EXISTING AND PROPOSED FEATURES WAS DEVELOPED FROM A DRAFT PDF FILE OF THE LEVEL TWO PERMIT DRAWING NO. C4.01 PREPARED BY VHB TITLED "GRADING AND DRAINAGE PLAN," TRANSMITTED TO GZA ON 9/17/2025.

3. THE LOCATIONS OF THE EXPLORATIONS PERFORMED BY TRC WERE OBTAINED FROM A DWG FILE PREPARED BY TRC ENTITLED "Overall Boring Plan – 4–8–21," TRANSMITTED TO GZA ON 4/26/2021. THE LOCATIONS OF THE APPROXIMATE PREVIOUS BUILDING FOOTPRINT LOCATIONS WERE OBTAINED FROM A DWG FILE PREPARED BY TRC ENTITLED "Overall Boring Plan – 11–11–20," TRANSMITTED TO GZA ON 11/19/2020. THE TRC EXPLORATION LOCATIONS WERE REPORTEDLY LOCATED BY OTHERS USING SURVEY AND SHOULD BE CONSIDERED ACCURATE ONLY TO THE DEGREE IMPLIED BY THE METHOD USED.

4. THE LOCATIONS OF THE 2024 AND 2025 BORINGS AND THE 2025 TEST PITS OBSERVED BY GZA PERSONNEL WERE DETERMINED USING A TRIMBLE GPS DEVICE WITH AN R2 GNSS RECEIVER OR A TAPED OFFSET FROM THE GPS–LOCATED STAKE. THE EXPLORATION LOCATIONS SHOWN SHOULD BE CONSIDERED ACCURATE ONLY TO THE DEGREE IMPLIED BY THE METHOD USED.




## LEGEND

PREVIOUS U.S. ARMY BUILDING FOOTPRINT (APPROX.)

***B-1 to B-136 (OW or MW-1)***

BORINGS PERFORMED BY TRC COMPANIES, INC. OF WINDSOR, CONNECTICUT BETWEEN AUGUST 2020 AND NOVEMBER 2020 (PRIOR TO THE CFS–2 DEVELOPMENT). OBSERVED AND LOGGED BY TRC AND/OR H&A.

INDICATES MONITORING OR OBSERVATION WELL INSTALLED IN BOREHOLE

***TP-9***

TEST PITS PERFORMED BY W.G. MCCLELLAN AND SON OF FALLENTIMBER, PENNSYLVANIA ON BEHALF OF TRC FROM AUGUST 13 TO SEPTEMBER 4, 2020 (PRIOR TO THE CFS–2 DEVELOPMENT). OBSERVED AND LOGGED BY TRC.

GZ-5 (OW)

TEST BORING PERFORMED BY NEW ENGLAND BORING CONTRACTORS OF DERRY, NEW HAMPSHIRE FROM OCTOBER 28, 2024 TO NOVEMBER 6, 2024 (CFS–2 DEVELOPMENT WORK ALREADY SUBSTANTIALLY COMPLETED). OBSERVED AND LOGGED BY GZA PERSONNEL.

INDICATES OBSERVATION WELL INSTALLED IN BOREHOLE

TP-301

TEST PIT PERFORMED BY CRYAN LANDSCAPE CONTRACTORS, INC. OF NORTH ATTLEBOROUGH, MASSACHUSETTS FROM AUGUST 4 TO 7, 2025. OBSERVED AND LOGGED BY GZA PERSONNEL.

GZ-101

TEST BORING PERFORMED BY NEW ENGLAND BORING CONTRACTORS OF DERRY, NEW HAMPSHIRE FROM AUGUST 18 TO SEPTEMBER 5, 2025. OBSERVED AND LOGGED BY GZA PERSONNEL.

0 15 30 60
SCALE IN FEET

UNLESS SPECIFICALLY STATED BY WRITTEN AGREEMENT, THIS DRAWING IS THE SOLE PROPERTY OF GZA GEOENVIRONMENTAL, INC. (GZA). THE INFORMATION SHOWN ON THE DRAWING IS SOLELY FOR USE BY GZA'S CLIENT OR THE CLIENT'S DESIGNATED REPRESENTATIVE FOR THE SPECIFIC PROJECT AND LOCATION IDENTIFIED ON THE DRAWING. THE DRAWING SHALL NOT BE TRANSFERRED, REUSED, COPIED, OR ALTERED IN ANY MANNER FOR USE AT ANY OTHER LOCATION OR FOR ANY OTHER PURPOSE WITHOUT THE PRIOR WRITTEN CONSENT OF GZA. ANY TRANSFER, REUSE, OR MODIFICATION TO THE DRAWING BY THE CLIENT OR OTHERS, WITHOUT THE PRIOR WRITTEN EXPRESS CONSENT OF GZA, WILL BE AT THE USER'S SOLE RISK AND WITHOUT ANY RISK OR LIABILITY TO GZA.

GEOTECHNICAL EVALUATION
PROPOSED CFS-4 DEVELOPMENT
HOSPITAL ROAD, DEVENS, MASSACHUSETTS

**EXPLORATION LOCATION PLAN**

| PREPARED BY: | | | PREPARED FOR: | |
|---|---|---|---|---|
| GZA GeoEnvironmental, Inc. Engineers and Scientists www.gza.com | | | COMMONWEALTH FUSION SYSTEMS | |
| PROJ MGR: MJO | REVIEWED BY: MAR | CHECKED BY: TMK | | FIGURE |
| DESIGNED BY: MJO | DRAWN BY: MJO | SCALE: AS SHOWN | | 2 |
| DATE: OCTOBER, 2025 | PROJECT NO. 01.0174955.30 | REVISION NO. 0 | | |

©2025 – GZA GeoEnvironmental, Inc. G:\01\170,000–179,999\174955\174955-30\WORK\FIGURES\CADD\DWG\Fig 2 – 174955.30_CFS4 EXPL LOC Plan_DRAFT_2025-09-16.dwg [Fig2_CFS-4 Expl] October 01, 2025 – 5:39pm michael.catrowski

# TEST PIT LOG

GZA GeoEnvironmental, Inc.
*Engineers/Scientists*

Pivotal Devens, LLC
Proposed CFS-3 Development
Hospital Road
Devens, Massachusetts

**TEST PIT NO.:** TP-306
**SHEET:** 1 of 1
**PROJECT NO:** 01.0178186.00
**REVIEWED BY:** MJO

**GZA Rep.** Kyran Peters
**Weather** 70's, Overcast

**Contractor** Cryan Landscaping Contractors, Inc.
**Operator** Hassler Lopez
**Make** CAT **Model** 311FLRR
**Capacity** 1/3 CY **Reach** 14 ft.

**Date** 8/5/2025
**Ground Elev.** 267
**Time Started** 0945
**Time Completed** 1020

| Depth (ft) | Soil Description (Stratum Description-USDA Field Determination) | Sample No. | Field Test Data | Excav. Effort | Boulders: Count/ Class | Note No. |
|---|---|---|---|---|---|---|
| 1 | Light brown, fine to coarse SAND, some fine to coarse Gravel, little Silt, trace Roots, dry. (TOPSOIL - USDA LOAMY SAND) | GS-1 | ND | E | 0 | 1, 2 |
| 2 | | | | M | 0 | |
| 3 | Brown, fine to coarse SAND and fine to coarse Gravel, trace Silt, dry. (SAND/GRAVEL or Possible FILL - USDA LOAMY SAND) | GS-2 | ND | D | 1B | |
| 4 | | | | D | 1A | |
| 5 | Brown, fine to coarse SAND, some fine to coarse Gravel, trace (-) Silt, moist. (SAND/GRAVEL - USDA SAND) | | | M | 0 | |
| 6 | | | | M | 0 | |
| 7 | | | | M | 0 | |
| 8 | | | | M | 0 | |
| 9 | | | | E | 0 | |
| 10 | | | | E | 0 | |
| 11 | | | | E | 0 | |
| 12 | | | | E | 0 | |
| 13 | | | | E | 0 | 3,4 |
| 14 | Bottom of Test Pit 13' | | | | | |
| 15 | | | | | | |
| 16 | | | | | | |

**Notes:**

1. Ground surface elevation estimated from topography depicted on an AutoCAD file prepared by VHB titled "CFS Composite Existing Surface -polylines," transmitted to GZA on September 16, 2024.
2. Field testing results represent total organic vapor levels, referenced to a benzene standard, measured in the headspace of sealed soil sample jars using a Ion Science Phocheck Tiger organic vapor meter equipped with a photoionization detector (PID) and 10.6eV lamp. Results in parts per million by volume (ppmv). ND indicates nothing detected (<0.1 ppmv).
3. Test pit terminated at 13 feet bgs due to cave ins.
4. Test pit backfilled with excavated spoils placed in approximately 1-foot-thich lifts each tamped with the excavator bucket.

**Test Pit Plan**

11
4
NORTH

Volume = 11 cu. yd.

**Boulder Class**

| Letter Designation | Size Range Classification |
|---|---|
| A | 6" - 17" |
| B | 18" - 36" |
| C | 36" and Larger |

**Proportions Used**

| | |
|---|---|
| TRACE (TR.) | 0 - 10% |
| LITTLE (LI.) | 10 - 20% |
| SOME (SO.) | 20 - 35% |
| AND | 35 - 50% |

**Excavation Effort**

E - Easy M - Moderate D - Difficult

**Abbreviations**

F = Fine
M = Medium
C = Coarse
V = Very
F/M = Fine to medium
F/C = Fine to coarse
GR = Gray
BN = Brown
YEL = Yellow

**Groundwater**

( ) Encountered
(x) Not Encountered

| Elapsed Time to Reading (Hours) | Depth to Ground water |
|---|---|
| | |
| | |

Stratification lines represent approximate boundaries between soil types, transitions may be gradual. Water level readings have been made at times and under conditions

# TEST PIT LOG

GZA GeoEnvironmental, Inc.
*Engineers/Scientists*

Pivotal Devens, LLC
Proposed CFS-3 Development
Hospital Road
Devens, Massachusetts

**TEST PIT NO.:** TP-307
**SHEET:** 1 of 1
**PROJECT NO:** 01.0178186.00
**REVIEWED BY:** MJO

**GZA Rep.** Kyran Peters
**Weather** 70's, Overcast

**Contractor** Cryan Landscaping Contractors, Inc.
**Operator** Hassler Lopez
**Make** CAT **Model** 311FLRR
**Capacity** 1/3 CY **Reach** 14 ft.

**Date** 8/6/2025
**Ground Elev.** 269
**Time Started** 1310
**Time Completed** 1385

| Depth (ft) | Soil Description (Stratum Description-USDA Field Determination) | Sample No. | Field Test Data | Excav. Effort | Boulders: Count/ Class | Note No. |
|---|---|---|---|---|---|---|
| 0.5 / 1 | Dark brown, fine to coarse SAND,some fine to coarse Gravel, little (+) Silt, trace Roots, dry. (TOPSOIL - USDA SANDY LOAM) | GS-1 | ND | E | 0 | 1, 2 |
| 2 | Light brown, fine to coarse SAND, little fine to coarse Gravel, trace (-) Silt, trace Roots, dry. (SAND - USDA SAND) | GS-2 | ND | E | 0 | |
| 3 | Brown, fine to coarse GRAVEL and fine to coarse SAND, trace (-) Silt, dry. (SAND/GRAVEL - USDA SAND) | GS-3 | ND | E | 0 | |
| 4 | | | | E | 0 | |
| 5 | | | | E | 0 | |
| 6 | | | | E | 0 | |
| 7 | Brown, fine to coarse SAND and fine to coarse GRAVEL, trace (-) Silt, dry. (SAND/GRAVEL - USDA SAND) | | | E | 0 | |
| 8 | | GS-4 | ND | E | 0 | 3,4 |
| 9 | Bottom of Test Pit 8' | | | | | |
| 10 | | | | | | |
| 11 | | | | | | |
| 12 | | | | | | |
| 13 | | | | | | |
| 14 | | | | | | |
| 15 | | | | | | |
| 16 | | | | | | |

**Notes:**

1. Ground surface elevation estimated from topography depicted on an AutoCAD file prepared by VHB titled "CFS Composite Existing Surface -polylines," transmitted to GZA on September 16, 2024.
2. Field testing results represent total organic vapor levels, referenced to a benzene standard, measured in the headspace of sealed soil sample jars using a Ion Science Phocheck Tiger organic vapor meter equipped with a photoionization detector (PID) and 10.6eV lamp. Results in parts per million by volume (ppmv). ND indicates nothing detected (<0.1 ppmv).
3. Test pit terminated at 8 feet bgs due to cave ins.
4. Test pit backfilled with excavated spoils placed in approximately 1-foot-thich lifts each tamped with the excavator bucket.

**Test Pit Plan**

11
4
NORTH

Volume = 7 cu. yd.

**Boulder Class**

| Letter Designation | Size Range Classification |
|---|---|
| A | 6" - 17" |
| B | 18" - 36" |
| C | 36" and Larger |

**Proportions Used**

| | |
|---|---|
| TRACE (TR.) | 0 - 10% |
| LITTLE (LI.) | 10 - 20% |
| SOME (SO.) | 20 - 35% |
| AND | 35 - 50% |

**Excavation Effort**

E - Easy M - Moderate D - Difficult

**Abbreviations**

F = Fine
M = Medium
C = Coarse
V = Very
F/M = Fine to medium
F/C = Fine to coarse
GR = Gray
BN = Brown
YEL = Yellow

**Groundwater**

( ) Encountered
(x) Not Encountered

| Elapsed Time to Reading (Hours) | Depth to Ground water |
|---|---|
| | |
| | |

Stratification lines represent approximate boundaries between soil types, transitions may be gradual. Water level readings have been made at times and under conditions

# TEST BORING LOG

**GZA GeoEnvironmental, Inc.**
*Engineers and Scientists*

**Pivotal Devens, LLC**
**Proposed CFS-3 Development**
**Hospital Road**
**Devens, MA**

**BORING NO.:** GZ-110
**SHEET:** 1 of 1
**PROJECT NO:** 01.0178186.00
**REVIEWED BY:** MJO

| | | | |
|---|---|---|---|
| **Drilling Co.:** New England Boring Contractors | **Type of Rig:** ATV | **Boring Location:** See Plan | **H. Datum:** See Plan |
| **Foreman:** Manlea Thompson | **Rig Model:** Diedrich D-70 Turbo | **Ground Surface Elev. (ft.):** 271 | |
| **Logged By:** Kyran Peters | **Drilling Method:** HSA | **Final Boring Depth (ft.):** 26 | **V. Datum:** See Plan |
| | | **Date Start - Finish:** 8/27/2025 - 8/27/2025 | |

| | | |
|---|---|---|
| **Auger/Casing Type:** HSA | **Sampler Type:** Split Spoon | |
| **I.D/O.D.(in):** 3.25/6-5/8 | **I.D./O.D. (in.):** 1.375/2 | |
| **Hammer Weight (lb.):** | **Sampler Hmr Wt (lb):** 140 lbs | |
| **Hammer Fall (in.):** | **Sampler Hmr Fall (in):** 30" | |
| **Other:** | **Other:** Autohammer | |

**Groundwater Depth (ft.)**

| Date | Time | Water Depth | Casing | Stab. Time |
|---|---|---|---|---|
| 8/27/25 | 1140 | Dry (26') | 24 | 15 min |
| | | | | |
| | | | | |

| Depth (ft) | Casing Blows/ Core Rate | Sample No. | Sample Depth (ft.) | Sample Pen. (in) | Sample Rec. (in) | Sample Blows (per 6 in.) | Sample SPT Value | Sample Description and Identification (Modified Burmister Procedure) | Remark | Field Test Data | Stratum Depth (ft.) | Stratum Description | Stratum Elev. (ft.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | S-1 | 0-2 | 24 | 9 | 5 5<br>6 5 | 11 | S-1: Medium dense, dark brown, fine to coarse SAND, some Gravel, little Silt, trace Wood, damp. | 1 | 4.4 | | TOPSOIL | |
| | | S-2 | 2-4 | 24 | 11 | 4 3<br>3 65 | 6 | S-2: (Top 4"): Loose, brown, fine to coarse SAND and GRAVEL, little Silt, trace Roots, damp. | 2 | 5.5 | 2' | | 269.0' |
| | | | | | | | | (Bottom 7"): Bituminous ASPHALT pavement. | 3 | | 2.3' | FILL | 268.7' |
| 5 | | S-3 | 4-6 | 24 | 19 | 29 29<br>24 24 | 53 | S-3: Very dense, brown to gray, GRAVEL and fine to coarse SAND, trace Silt, dry. | | 5.5 | 2.9' | BURIED ASPHALT PAVEMENT | 268.1' |
| | | S-4 | 6-8 | 24 | 21 | 19 19<br>18 15 | 37 | S-4: (Top 11"): Dense, light brown to gray, GRAVEL and fine to coarse SAND, trace Silt, dry. | | 5.4 | | FILL | |
| | | S-5 | 8-10 | 24 | 15 | 6 7<br>9 9 | 16 | (Bottom (10"): Dense, light brown, fine to coarse SAND, trace Gravel, trace Silt, damp. | | 2.8 | 6.9' | | 264.1' |
| 10 | | | | | | | | S-5: Medium dense, light brown, fine to coarse SAND, some Gravel, trace Silt, Iron oxide staining 9 to 10 inches from top of recovery, dry. | | | | SAND/GRAVEL | |
| | | | | | | | | | | | 11.5' | | 259.5' |
| | | S-6 | 13-15 | 24 | 17 | 4 4<br>5 5 | 9 | S-6: Loose, light brown, fine to medium SAND, trace Silt, damp. | | 0.1 | | | |
| 15 | | S-7 | 15-17 | 24 | 9 | 5 6<br>7 8 | 13 | S-7: Medium dense, light brown, fine to medium SAND, trace Silt. | | ND | | | |
| | | S-8 | 18-20 | 24 | 14 | 3 6<br>11 13 | 17 | S-8: Medium dense, light brown, fine to medium SAND, trace (-) Silt. (USDA Field Determination: SAND) | | 1.1 | | SAND | |
| 20 | | S-9 | 20-22 | 24 | 22 | 8 8<br>8 9 | 16 | S-9: Medium dense, light brown, fine SAND, trace (+) Silt, Iron oxide coloring bottom 9 inches, moist. (USDA Gradation Determination: SAND) | | 1.3 | | | |
| | | S-10 | 22-24 | 24 | 24 | 12 13<br>13 14 | 26 | S-10: Medium dense, light brown, fine SAND, some Silt, Iron oxide staining 6-10 inches, 13 to 15 inches from top of recovery, damp. | | 4.0 | | | |
| 25 | | S-11 | 24-26 | 24 | 21 | 10 11<br>13 13 | 24 | Occasional 1/2- to 3-inch-thick silt seam. (USDA Gradation Determination: LOAMY SAND) | | 3.8 | | | |
| | | | | | | | | S-11: Medium dense, light brown to gray, fine to medium SAND, trace Silt, iron oxide staining observed top 11 inches of recovery. Occasional 1/2- to 1-inch-thick silt seam within top 11-inches of recovery. (USDA Field Determination: LOAMY SAND) | 4 | | 26' | | 245.0' |
| 30 | | | | | | | | Bottom of boring at 26 feet. | | | | | |

**REMARKS**

1. Ground surface elevation estimated from topography depicted on an AutoCAD file prepared by VHB titled "CFS Composite Existing Surface -polylines," transmitted to GZA on September 16, 2024.
2. Field testing results represent total organic vapor levels, referenced to a benzene standard, measured in the headspace of sealed soil sample jars using a Honeywell MiniRAE3000+ organic vapor meter equipped with a photoionization detector (PID) and 10.6eV lamp. Results in parts per million by volume (ppmv). ND indicates nothing detected (<0.1 ppmv).
3. Water added into augers prior to sampling S-7 and S-8.
4. Boring terminated at 26 feet below ground surface after reaching target depth. Upon completion, the borehole was backfilled with soil cuttings to the ground surface.

See Log Key for explanation of sample description and identification procedures. Stratification lines represent approximate boundaries between soil and bedrock types. Actual transitions may be gradual. Water level readings have been made at the times and under the conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the times the measurements were made.

**Boring No.: GZ-110**

178186.00 PIVOTAL DEVENS, LLC - PROP CFS-3 DEV.GPJ; STRATUM ONLY NORWOOD; 9/22/2025

# Required and Provided Recharge Volumes

## Summary for Subcatchment PR 1.1: Subcat PR 1.1

Runoff = 22.5 cfs @ 12.08 hrs, Volume= 81,636 cf, Depth= 5.94"
Routed to Pond SC-1 : 12FT StormCapture (CFS-4 and Road)

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.43"

| Area (sf) | CN | Description |
|---|---|---|
| 32,911 | 39 | >75% Grass cover, Good, HSG A |
| 115,705 | 98 | Paved parking, HSG A |
| 16,286 | 98 | Roofs, HSG A |
| 2 | 30 | Woods, Good, HSG A |
| 164,903 | 86 | Weighted Average |
| 32,912 | 39 | 19.96% Pervious Area |
| 131,990 | 98 | 80.04% Impervious Area |

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

The entire inflow volume of the 100-Year Storm exfiltrates from the system into the ground. Therefore, the required recharge volume is met. Since all impervious ground cover is directed to the infiltration system, no capture area adjustment is needed.

## Summary for Pond SC-1: 12FT StormCapture (CFS-4 and Road)

Inflow Area = 164,903 sf, 80.04% Impervious, Inflow Depth = 5.94" for 100-Year event
Inflow = 22.5 cfs @ 12.08 hrs, Volume= 81,636 cf
Outflow = 1.0 cfs @ 9.67 hrs, Volume= 81,640 cf, Atten= 96%, Lag= 0.0 min
Discarded = 1.0 cfs @ 9.67 hrs, Volume= 81,640 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 260.99' @ 14.86 hrs Surf.Area= 0.118 ac Storage= 0.875 af

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 321.2 min ( 1,069.0 - 747.8 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 252.00' | 0.000 af | **80.00'W x 64.00'L x 13.17'H Field A**<br>1.548 af Overall - 1.548 af Embedded = 0.000 af x 40.0% Voids |
| #2A | 252.00' | 1.249 af | **Oldcastle StormCapture SC2 12'** x 40 Inside #1<br>Inside= 84.0"W x 144.0"H => 86.13 sf x 16.00'L = 1,378.0 cf<br>Outside= 96.0"W x 158.0"H => 105.33 sf x 16.00'L = 1,685.3 cf<br>10 Rows adjusted for 724.0 cf perimeter wall |
| | | 1.249 af | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 252.00' | **8.270 in/hr Exfiltration over Surface area** |

**Discarded OutFlow** Max=1.0 cfs @ 9.67 hrs HW=252.58' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 1.0 cfs)

# 72-Hour Drawdown Analysis

## Summary for Subcatchment PR 1.1: Subcat PR 1.1

Runoff = 22.5 cfs @ 12.08 hrs, Volume= 81,636 cf, Depth= 5.94"
Routed to Pond SC-1 : 12FT StormCapture (CFS-4 and Road)

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.43"

| Area (sf) | CN | Description |
|---|---|---|
| 32,911 | 39 | >75% Grass cover, Good, HSG A |
| 115,705 | 98 | Paved parking, HSG A |
| 16,286 | 98 | Roofs, HSG A |
| 2 | 30 | Woods, Good, HSG A |
| 164,903 | 86 | Weighted Average |
| 32,912 | 39 | 19.96% Pervious Area |
| 131,990 | 98 | 80.04% Impervious Area |

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

The entire inflow volume for the 100-Year Storm exfiltrates from the system into the ground within a 72-hour timespan. Therefore, the drawdown requirement is met.

## Summary for Pond SC-1: 12FT StormCapture (CFS-4 and Road)

Inflow Area = 164,903 sf, 80.04% Impervious, Inflow Depth = 5.94" for 100-Year event
Inflow = 22.5 cfs @ 12.08 hrs, Volume= 81,636 cf
Outflow = 1.0 cfs @ 9.67 hrs, Volume= 81,640 cf, Atten= 96%, Lag= 0.0 min
Discarded = 1.0 cfs @ 9.67 hrs, Volume= 81,640 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 260.99' @ 14.86 hrs Surf.Area= 0.118 ac Storage= 0.875 af

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 321.2 min ( 1,069.0 - 747.8 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 252.00' | 0.000 af | **80.00'W x 64.00'L x 13.17'H Field A**<br>1.548 af Overall - 1.548 af Embedded = 0.000 af x 40.0% Voids |
| #2A | 252.00' | 1.249 af | **Oldcastle StormCapture SC2 12'** x 40 Inside #1<br>Inside= 84.0"W x 144.0"H => 86.13 sf x 16.00'L = 1,378.0 cf<br>Outside= 96.0"W x 158.0"H => 105.33 sf x 16.00'L = 1,685.3 cf<br>10 Rows adjusted for 724.0 cf perimeter wall |
| | | 1.249 af | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 252.00' | **8.270 in/hr Exfiltration over Surface area** |

**Discarded OutFlow** Max=1.0 cfs @ 9.67 hrs HW=252.58' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 1.0 cfs)

# Appendix D: Standard 4 Computations and Supporting Information

# Operations and Maintenance Plan

# Commonwealth Fusion Systems Campus – Building 4

## 111 Hospital Road
## Devens, Massachusetts

PREPARED FOR

Commonwealth Fusion Systems
148 Sidney Street
Cambridge, Massachusetts
509.942.4255

PREPARED BY

1 Cedar Street, Suite 400
Providence, Rhode Island 02903
401.272.8100

September 2025

# Table of Contents

# Project Information

## Site

111 Hospital Road
Devens, Massachusetts 01434

## Developer

Commonwealth Fusion Systems
148 Sidney Street
Cambridge, Massachusetts
509.942.4255

## Site Supervisor

TBD

## Site Contact

Name: _____

Telephone: _____

Cell phone: _____

Email: _____

# Section A: Source Control

# A Source Control

A comprehensive source control program will be implemented at the Site, which includes the following components:

- Regular pavement sweeping
- Catch basin cleaning
- Clearing litter from the pavement area and perimeter landscape areas
- Enclosure and regular maintenance of all dumpsters
- Spill Prevention training

# Section B: Spill Prevention

# B Spill Prevention

Spill prevention equipment and training will be provided by the Commonwealth Fusion Systems (CSF)..

## B.1 Initial Notification

In the event of a spill the facility and/or construction manager or supervisor will be notified immediately.

| | |
|---|---|
| Facility Manager (name): | TBD |
| Facility Manager (phone): | |
| Construction Manager (name) : | TBD |
| Construction Manager (phone): | |

The supervisor will first contact the Fire Department and then notify the Police Department, the Public Health Commission and the Conservation Commission. The Fire Department is ultimately responsible for matters of public health and safety and should be notified immediately.

## B.2 Further Notification

Based on the assessment from the Fire Chief, additional notification to a cleanup contractor may be made. The Massachusetts Department of Environmental Protection (MassDEP) and the EPA may be notified depending upon the nature and severity of the spill. The Fire Chief will be responsible for determining the level of cleanup and notification required. The attached list of emergency phone numbers shall be posted in the main construction/facility office and readily accessible to all employees. A hazardous waste spill report shall be completed as necessary using the attached form.

## Emergency Notification Phone Numbers

**1. FACILITY MANAGER**

Name: TBD — Phone: ____
Beeper/Cell: ____
Home Phone: ____

Alternate Contact: ____ — Phone: ____
Beeper/Cell: ____
Home Phone: ____

**2. FIRE & POLICE DEPARTMENT** — Emergency: 911

**3. CLEANUP CONTRACTOR**

Address: ____ — Phone: ____

**4. MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION (MassDEP)** — Emergency: (508) 792-7650

**5. NATIONAL RESPONSE CENTER** — Phone: (800) 424-8802

Alternate: U.S. Environmental Protection Agency — Phone: (888) 372-7341

**6. DEVENS ENTERPRISE COMMISSION** — Phone: (978) 772-8831

Contact: Neil Angus

## Hazardous Waste & Oil Spill Report

**Date:** _____ **Time:** _____ **AM / PM**

**Exact location (Transformer #):** _____

**Type of equipment:** _____ **Make:** _____ **Size:** _____

**S / N:** _____ **Weather Conditions:** _____

**On or near water?** ☐ Yes ☐ No **If yes, name of body of water:** _____

**Type of chemical / oil spilled:** _____

**Amount of chemical / oil spilled:** _____

**Cause of spill:** _____

**Measures taken to contain or clean up spill:** _____

**Amount of chemical / oil recovered:** _____ **Method:** _____

**Material collected as a result of cleanup:**

_____ drums containing _____

_____ drums containing _____

_____ drums containing _____

**Location and method of debris disposal:** _____

**Name and address of any person, firm, or corporation suffering charges:** _____

**Procedures, method, and precautions instituted to prevent a similar occurrence from recurring:** _____

**Spill reported by General Office by:** _____ **Time:** _____ **AM / PM**

**Spill reported to DEP / National Response Center by:** _____

**DEP Date:** _____ **Time:** _____ **AM / PM** **Inspector:** _____

**NRC Date:** _____ **Time:** _____ **AM / PM** **Inspector:** _____

**Additional comments:** _____

## B.3 Assessment – Initial Containment

The supervisor or manager will assess the incident and initiate containment control measures with the appropriate spill containment equipment included in the spill kit kept on-site. A list of recommended spill equipment to be kept on site is included on the following page.

**Fire / Police Department:** 911

**Devens Enterprise Commission:** (978) 772-8831

### Emergency Response Equipment

The following equipment and materials shall be maintained at all times and stored in a secure area for long-term emergency response need.

| Supplies | Quantity | Recommended Suppliers |
|---|---|---|
| › Sorbent Pillows/"Pigs" | 2 | http://www.newpig.com<br>Item # KIT276 — mobile container with two pigs |
| › Sorbent Boom/Sock | 25 feet | http://www.forestry-suppliers.com |
| › Sorbent Pads | 50 | |
| › Lite-Dri® Absorbent | 5 pounds | |
| › Shovel | 1 | Item # 33934 — Shovel (or equivalent) |
| › Pry Bar | 1 | Item # 43210 — Manhole cover pick (or equivalent) |
| › Goggles | 1 pair | Item # 23334 — Goggles (or equivalent) |
| › Gloves – Heavy | 1 pair | Item # 90926 — Gloves (or equivalent) |

# Section C: Snow Management

# C Snow Management

Snow storage areas are shown on the attached Map.

- Snow storage areas will be managed to prevent blockage of storm drain catch basins and stormwater drainage swales. Snow combined with sand and debris may block a storm drainage system, diminishing the infiltration capacity of the system and causing localized flooding.
- Sand and debris deposited on vegetated or paved areas shall be cleared from the site and properly disposed of at the end of the snow season, no later than May 15.
- Snow shall not be dumped into any waterbody, pond, or wetland resource area.

# Section D: Maintenance of Stormwater Management Systems

# D Maintenance of Stormwater Management Systems

## D.1 Pavement Systems

### D.1.1 Standard Asphalt Pavement

- Sweep or vacuum standard asphalt pavement areas at least two times per year and properly dispose of removed material.
- Recommended sweeping schedule:
- Oct/Nov
- Mar/Apr
- More frequent sweeping of paved surfaces will result in less accumulation in catch basins, less cleaning of subsurface structures, and less disposal costs.
- Check loading docks and dumpster areas frequently for spillage and/or pavement staining and clean as necessary.

## D.2 Structural Stormwater Management Devices

### D.2.1 Catch Basins and Area Drains

The proper removal of sediments and associated pollutants and trash occurs only when catch basin inlets and sumps are cleaned out regularly. The more frequent the cleaning, the less likely sediments will be re-suspended and subsequently discharged. In addition, frequent cleaning also results in more volume available for future deposition and enhances the overall performance. As noted in the pavement Operation and Maintenance (O&M) section, more frequent sweeping of paved surfaces will result in less accumulation in catch basins, less cleaning of subsurface structures, and less disposal costs.

These catch basins are constructed with sumps (minimum 4 feet) and hooded outlets to trap debris, sediments, and floating contaminants. Disposal of all sediments must be in accordance with applicable local, state, and federal guidelines. A map of the catch basin locations is included in Section E.5 Maintenance Checklists and Device Location Maps.

accordance with applicable local, state, and federal guidelines. A map of the catch basin locations is included in Section E.5 Maintenance Checklists and Device Location Maps.

### Inspections and Cleaning

- All catch basins shall be inspected at least four times per year and cleaned a minimum of at least once per year.
- Sediment (if more than six inches deep) and/or floatable pollutants shall be pumped from the basin and disposed of at an approved offsite facility in accordance with all applicable regulations.
- Any structural damage or other indication of malfunction will be reported to the site manager and repaired as necessary
- During colder periods, the catch basin grates must be kept free of snow and ice.
- During warmer periods, the catch basin grates must be kept free of leaves, litter, sand, and debris.

## D.2.2 Structural Water Quality Unit

The stormwater drainage system includes one HydroInternational First Defense Unit , which efficiently remove sediment and hydrocarbons from stormwater runoff. This unit is a pretreatment device located upstream of the subsurface infiltration system.

A map showing the location of the unit is included in the Operations and Maintenance Location Map. An Operations and Maintenance Manual for this unit is attached to this report.

## D.2.3 Subsurface Infiltration Basins

The stormwater drainage system includes one subsurface stormwater infiltration structure composed of Oldcastle StormCapture SC2 units. The subsurface infiltration basin is used to detain and infiltrate roadway and rooftop runoff.. This basin has a water quality pre-treatment device (described above) to protect the infiltration bed from clogging.

A map of the infiltration basin location is included in the Operations and Maintenance Location Map. An Operations and Maintenance Manual for this unit is attached to this report

## D.2.4 Stormwater Outfalls

The stormwater drainage system has one outfall location. This outfall is an emergency overflow for the subsurface infiltration system and will not see use during all storm events up to and including the 100-year storm. As a method of confirming that the subsurface infiltration system is functioning as intended, a regular maintenance schedule is included despite the fact that this outfall is unlikely to ever receive stormwater discharge.

A map showing its locations is included in the Operations and Maintenance Location Map.

- Inspect outfall locations monthly for the first three months after construction for any signs of erosion or washout. If there are indicators of stormwater discharge from this outlet, it is an indicator that the upstream stormwater infiltration system is not functioning properly.
- Inspect outfalls annually after initial three-month period.
- Annual inspections should be supplemented after large storms.
- Maintain vegetation around outfalls to prevent blockages at the outfall.
- Remove and dispose of any trash or debris at the outfall.

### D.2.5 Roof Drain Leader

Roof runoff from buildings is directed to the subsurface infiltration system via closed drainage system.

- Perform routine roof inspections quarterly.
- Keep roofs clean and free of debris.
- Keep roof drainage systems clear.
- Keep roof access limited to authorized personnel.
- Clean inlets twice per year or as necessary.

# Section E: Operations and Maintenance Plan Summary

# E Operations and Maintenance Plan Summary

This Operation and Maintenance Plan specifies operational practices and drainage system maintenance requirements for the project. Requirements should be adjusted by the site manager as necessary to ensure successful functioning of system components.

## E.1 Routine Maintenance Checklists

Routine required maintenance is described in Sections A – D. The following checklists are to be used by the property manager to implement and document the required maintenance and inspection tasks.

## E.2 Reporting and Documentation

The site supervisor shall be responsible for ensuring that the scheduled tasks as described in this plan are appropriately completed and recorded in the Maintenance Log. Accurate records of all inspections, routine maintenance and repairs shall be documented and these records shall be available for inspection by members of the Devens Enterprise Commission, or their designated agent, upon request.

The Maintenance Log shall:

- Document the completion of required maintenance tasks.
- Identify the person responsible for the completion of tasks.
- Identify any outstanding problems, malfunctions or inconsistencies identified during the course of routine maintenance.
- Document specific repairs or replacements.

## E.3 Long-term Maintenance/Evaluation Checklist

### CFS-4 (Devens, Massachusetts)

| Best Management Practice | Minimum Maintenance and Key Items to Check | Inspection Frequency | Date Inspected | Inspector Initials | Cleaning Frequency | Cleaning or Repair Needed ☐Yes/No | Date of Cleaning or Repair | Performed by: |
|---|---|---|---|---|---|---|---|---|
| Street Sweeping | Vacuum sweeper | 2X per year | | | 2X per year* minimum | | | |
| Outfall Structures | Remove debris and excess vegetation. Inspect for signs of erosion. | 1X per year | | | 1X per year | | | |
| Deep Sump Hooded Catch Basins and Area Drains | Remove sediment 1X per year or if >6 inches | 4X per year | | | 1X per year or as necessary | | | |
| Water Quality Unit | Oil and floatables removal, sediment removal | 2X per year | | | 1X per year or as necessary | | | |
| Subsurface Infiltration System | Remove trash, debris, and sediment. | 2X per year | | | 1X per year or as necessary | | | |
| Roof Drains | Remove debris, clean inlets draining to subsurface bed | 4x per year roof inspection | | | 2x per year inlet cleaning, roof debris as necessary | | | |

* Recommend sweeping Oct/Nov, Mar/Apr

Stormwater Control Manager: _____

## E.4 Maintenance Checklists and Device Location Maps

These checklists are provided for the maintenance crew to photocopy and use when conducting inspections and cleaning activities to the stormwater management systems.

# Maintenance Checklists

### Catch Basins – Inspect 4 times per year, clean when sediment depth >6 inches or at least once per year.

| Catch Basin | Inspected (Y/N) | Sediment Depth (inches) | Cleaning needed (Y/N) | Date Cleaned | Comments (Trash, Oil, Pet waste, Lawn Debris, Damage) |
|---|---|---|---|---|---|
| | | | | / / | |
| | | | | / / | |
| | | | | / / | |
| | | | | / / | |
| | | | | / / | |
| | | | | / / | |
| | | | | / / | |
| | | | | / / | |

### Outfall – Inspect 4 times per year, replace any dislodged rip-rap, remove excess vegetation, remove any debris.

| Outfall | Inspected (Y/N) | Sediment Depth (inches) | Cleaning needed (Y/N) | Date Cleaned | Comments (Trash, Oil, Pet waste, Lawn Debris, Damage) |
|---|---|---|---|---|---|
| | | | | / / | |

### Water Quality Units – Inspect two times per year, clean per manufacturer's recommendations.

| Water Quality Unit | Inspected (Y/N) | Sediment Depth (inches) | Cleaning needed (Y/N) | Date Cleaned | Comments (Trash, Oil, Pet waste, Lawn Debris, Damage) |
|---|---|---|---|---|---|
| | | | | / / | |

### Subsurface Infiltration System – Inspect two times per year, clean per manufacturer's recommendations.

| System | Inspected (Y/N) | Sediment Depth (inches) | Cleaning needed (Y/N) | Date Cleaned | Comments (Trash, Oil, Pet waste, Lawn Debris, Damage) |
|---|---|---|---|---|---|
| | | | | / / | |

### Roof Drain Leaders – Inspect roof drains monthly, clean inlets draining to the subsurface bed twice per year.

| Bldg # | Inspected (Y/N) | Sediment Depth (inches) | Cleaning needed (Y/N) | Date Cleaned | Comments (Trash, Oil, Pet waste, Lawn Debris, Damage) |
|---|---|---|---|---|---|
| | | | | / / | |
| | | | | / / | |
| | | | | / / | |
| | | | | / / | |
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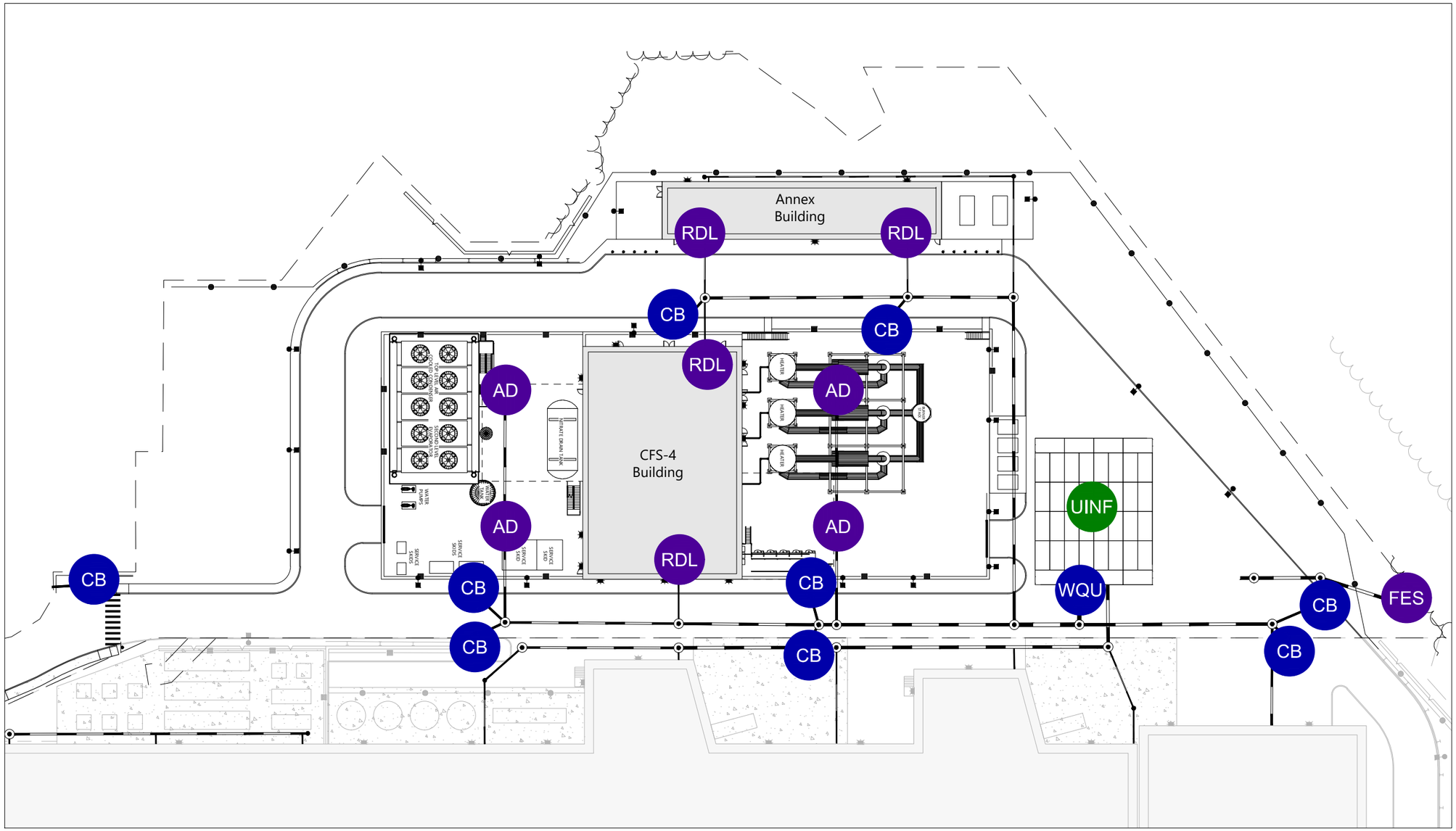
| | | | | / / | |
| | | | | / / | |
| | | | | / / | |

# Device Location Map




## Legend

| | |
|---|---|
| CB | CATCH BASIN |
| WQU | WATER QUALITY UNIT |
| UINF | UNDERGROUND INFILTRATION BASIN |
| AD | AREA DRAIN |
| FES | FLARED END SECTION |
| RDL | ROOF DRAIN LEADER |

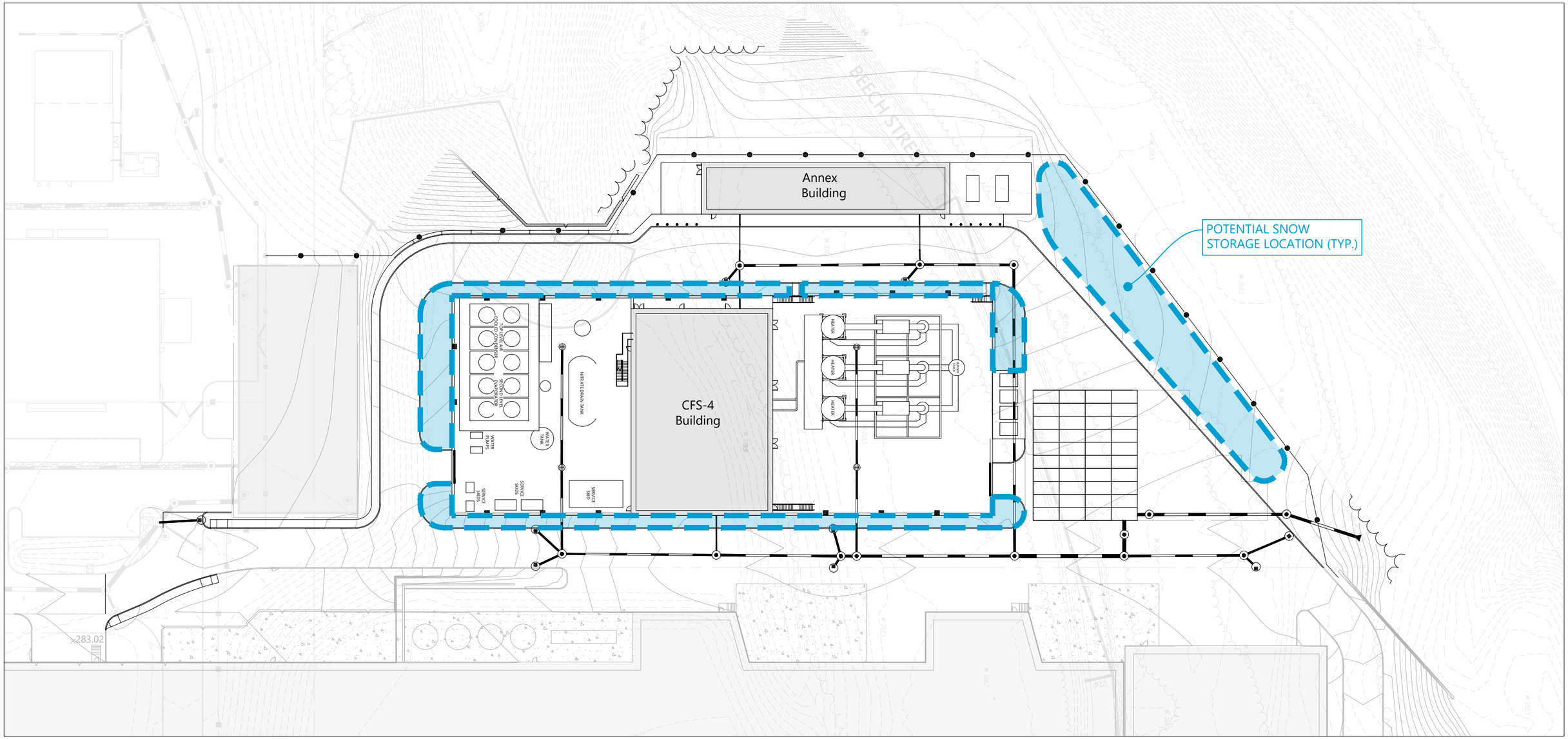
0 30 60 Feet

Operations and Maintenance
Location Plan
CFS Campus Building 4
111 Hospital Road, Devens, MA

**O&M**

Nov. 2025

# Snow Storage Areas Map




0 30 60 Feet

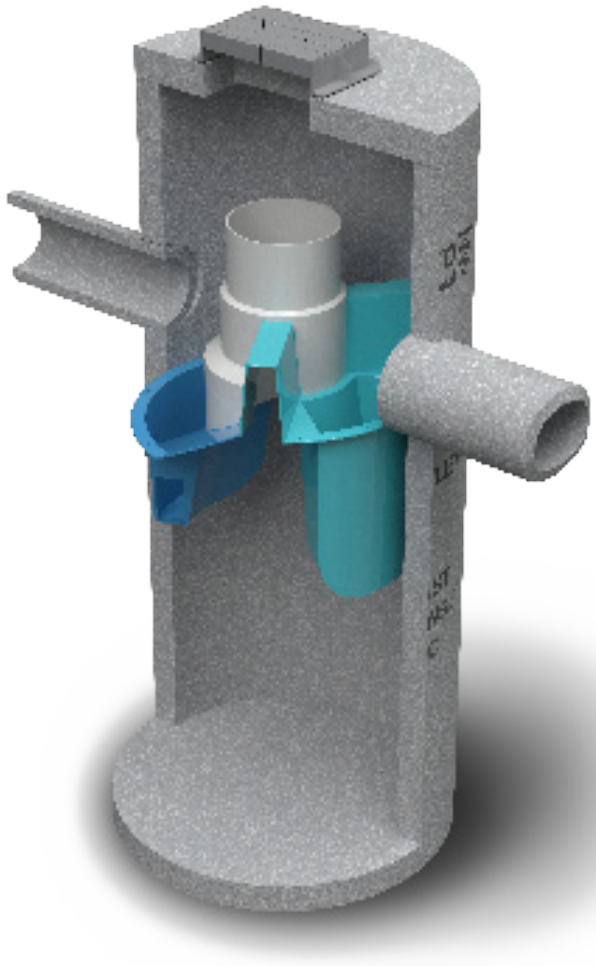
Snow Storage
Location Plan
CFS Campus Building 4
111 Hospital Road, Devens, MA

**SNOW**

Sept. 2025

# Section F: Product Literature

Hydro International



# Operation and Maintenance Manual

## First Defense® High Capacity and First Defense®Optimum

Vortex Separator for Stormwater Treatment

# Table of Contents



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**DISCLAIMER:** Information and data contained in this manual is exclusively for the purpose of assisting in the operation and maintenance of Hydro International plc's First Defense®. No warranty is given nor can liability be accepted for use of this information for any other purpose. Hydro International plc has a policy of continuous product development and reserves the right to amend specifications without notice.

**Hydro International** (Stormwater), 94 Hutchins Drive, Portland ME 04102
Tel: (207) 756-6200 Fax: (207) 756-6212 Web: www.hydro-int.com

# I. First Defense® by Hydro International

## Introduction

The First Defense® is an enhanced vortex separator that combines an effective and economical stormwater treatment chamber with an integral peak flow bypass. It efficiently removes total suspended solids (TSS), trash and hydrocarbons from stormwater runoff without washing out previously captured pollutants. The First Defense® is available in several model configurations to accommodate a wide range of pipe sizes, peak flows and depth constraints.

The two product models described in this guide are the First Defense® High Capacity and the First Defense® Optimum; they are inspected and maintained identically.

### Operation

The First Defense® operates on simple fluid hydraulics. It is self-activating, has no moving parts, no external power requirement and is fabricated with durable non-corrosive components. No manual procedures are required to operate the unit and maintenance is limited to monitoring accumulations of stored pollutants and periodic clean-outs. The First Defense® has been designed to allow for easy and safe access for inspection, monitoring and clean-out procedures. Neither entry into the unit nor removal of the internal components is necessary for maintenance, thus safety concerns related to confined-space-entry are avoided.

### Pollutant Capture and Retention

The internal components of the First Defense® have been designed to optimize pollutant capture. Sediment is captured and retained in the base of the unit, while oil and floatables are stored on the water surface in the inner volume (Fig.1).

The pollutant storage volumes are isolated from the built-in bypass chamber to prevent washout during high-flow storm events. The sump of the First Defense® retains a standing water level between storm events. This ensures a quiescent flow regime at the onset of a storm, preventing resuspension and washout of pollutants captured during previous events.

Accessories such as oil absorbent pads are available for enhanced oil removal and storage. Due to the separation of the oil and floatable storage volume from the outlet, the potential for washout of stored pollutants between clean-outs is minimized.

### Applications

- Stormwater treatment at the point of entry into the drainage line
- Sites constrained by space, topography or drainage profiles with limited slope and depth of cover
- Retrofit installations where stormwater treatment is placed on or tied into an existing storm drain line
- Pretreatment for filters, infiltration and storage

### Advantages

- Inlet options include surface grate or multiple inlet pipes
- Integral high capacity bypass conveys large peak flows without the need for “offline” arrangements using separate junction manholes
- Long flow path through the device ensures a long residence time within the treatment chamber, enhancing pollutant settling
- Delivered to site pre-assembled and ready for installation

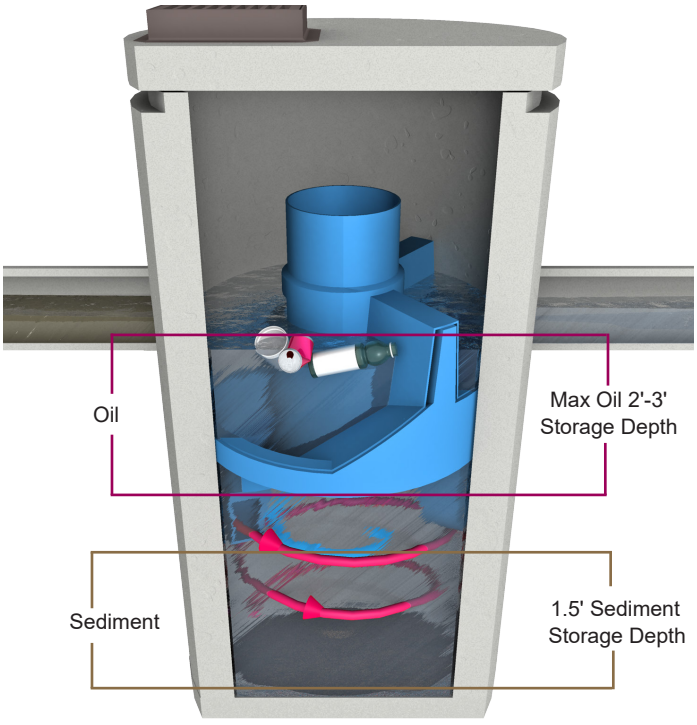


*Fig.1 Pollutant storage volumes in the First Defense®.*

# II. Model Sizes & Configurations

The First Defense® inlet and internal bypass arrangements are available in several model sizes and configurations. The components have modified geometries allowing greater design flexibility to accommodate various site constraints.

All First Defense® models include the internal components that are designed to remove and retain total suspended solids (TSS), gross solids, floatable trash and hydrocarbons (Fig.2). First Defense® model sizes (diameter) are shown in Table 1.

# III. Maintenance

## First Defense® Components

1. **Built-In Bypass**
2. **Inlet Pipe**
3. **Inlet Chute**
4. **Floatables Draw-off Port**
5. **Outlet Pipe**
6. **Floatables Storage**
7. **Sediment Storage**
8. **Inlet Grate or Cover**

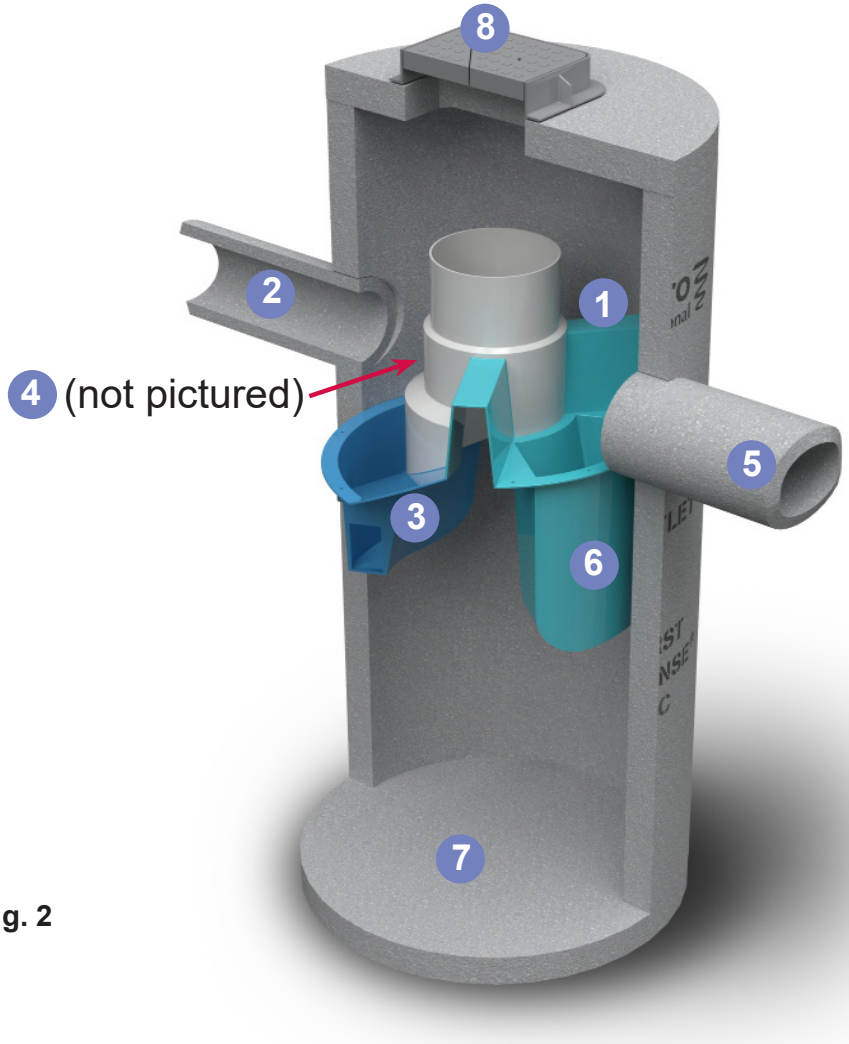


**Fig. 2**

**Table 1**

| First Defense® Model Sizes |
|---|
| (ft / m) diameter |
| 3 / 0.9 |
| 4 / 1.2 |
| 5 / 1.5 |
| 6 / 1.8 |
| 7 / 2.1 |
| 8 / 2.4 |
| 10 / 3.0 |

## Overview

The First Defense® protects the environment by removing a wide range of pollutants from stormwater runoff. Periodic removal of these captured pollutants is essential to the continuous, long-term functioning of the First Defense®. The First Defense® will capture and retain sediment and oil until the sediment and oil storage volumes are full to capacity. When sediment and oil storage capacities are reached, the First Defense® will no longer be able to store removed sediment and oil.

The First Defense® allows for easy and safe inspection, monitoring and clean-out procedures. A commercially or municipally owned sump-vac is used to remove captured sediment and floatables. Access ports are located in the top of the manhole.

Maintenance events may include Inspection, Oil & Floatables Removal, and Sediment Removal. Maintenance events do not require entry into the First Defense®, nor do they require the internal components of the First Defense® to be removed. In the case of inspection and floatables removal, a vactor truck is not required. However, a vactor truck is required if the maintenance event is to include oil removal and/or sediment removal.

## Maintenance Equipment Considerations

The internal components of the First Defense® have a centrally located circular shaft through which the sediment storage sump can be accessed with a sump vac hose. The open diameter of this access shaft is 15 inches in diameter (Fig.3). Therefore, the nozzle fitting of any vactor hose used for maintenance should be less than 15 inches in diameter.

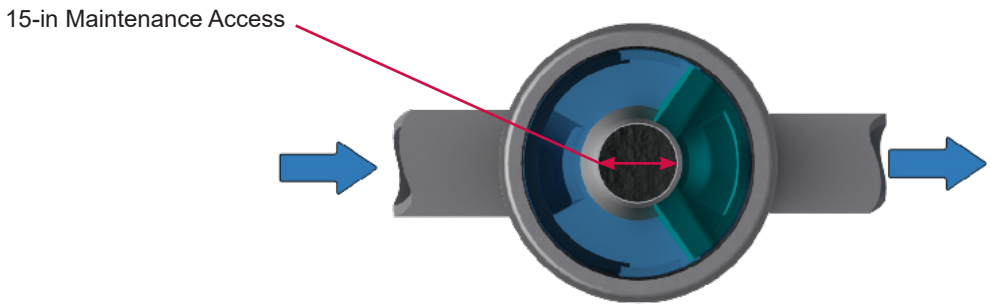


*Fig.3 The central opening to the sump of the First Defense®is 15 inches in diameter.*

## Determining Your Maintenance Schedule

The frequency of clean out is determined in the field after installation. During the first year of operation, the unit should be inspected every six months to determine the rate of sediment and floatables accumulation. A simple probe such as a Sludge-Judge® can be used to determine the level of accumulated solids stored in the sump. This information can be recorded in the maintenance log (see page 9) to establish a routine maintenance schedule.

The vactor procedure, including both sediment and oil / flotables removal, for First Defense® typically takes less than 30 minutes and removes a combined water/oil volume of about 765 gallons.

*Inspection Procedures*

1. Set up any necessary safety equipment around the access port or grate of the First Defense® as stipulated by local ordinances. Safety equipment should notify passing pedestrian and road traffic that work is being done.

2. Remove the grate or lid to the manhole.

3. Without entering the vessel, look down into the chamber to inspect the inside. Make note of any irregularities. Fig.4 shows the standing water level that should be observed.

4. Without entering the vessel, use the pole with the skimmer net to remove floatables and loose debris from the components and water surface.

5. Using a sediment probe such as a Sludge Judge®, measure the depth of sediment that has collected in the sump of the vessel.

6. On the Maintenance Log (see page 9), record the date, unit location, estimated volume of floatables and gross debris removed, and the depth of sediment measured. Also note any apparent irregularities such as damaged components or blockages.

7. Securely replace the grate or lid.

8. Take down safety equipment.

9. Notify Hydro International of any irregularities noted during inspection.

## Floatables and Sediment Clean Out

Floatables clean out is typically done in conjunction with sediment removal. A commercially or municipally owned sump-vac is used to remove captured sediment and floatables (Fig.4).

Floatables and loose debris can also be netted with a skimmer and pole. The access port located at the top of the manhole provides unobstructed access for a vactor hose to be lowered to the base of the sump.

*Scheduling*

- Floatables and sump clean out are typically conducted once a year during any season.

- Floatables and sump clean out should occur as soon as possible following a spill in the contributing drainage area.

*Fig.4 Floatables are removed with a vactor hose*

*Recommended Equipment*

- Safety Equipment (traffic cones, etc)
- Crow bar or other tool to remove grate or lid
- Pole with skimmer or net (if only floatables are being removed)
- Sediment probe (such as a Sludge Judge®)
- Vactor truck (flexible hose recommended)
- First Defense® Maintenance Log

*Floatables and Sediment Clean Out Procedures*

1. Set up any necessary safety equipment around the access port or grate of the First Defense® as stipulated by local ordinances. Safety equipment should notify passing pedestrian and road traffic that work is being done.

2. Remove the grate or lid to the manhole.

3. Without entering the vessel, look down into the chamber to inspect the inside. Make note of any irregularities.

4. Remove oil and floatables stored on the surface of the water with the vactor hose or with the skimmer or net

5. Using a sediment probe such as a Sludge Judge®, measure the depth of sediment that has collected in the sump of the vessel and record it in the Maintenance Log (page 9).

6. Once all floatables have been removed, drop the vactor hose to the base of the sump. Vactor out the sediment and gross debris off the sump floor

7. Retract the vactor hose from the vessel.

8. On the Maintenance Log provided by Hydro International, record the date, unit location, estimated volume of floatables and gross debris removed, and the depth of sediment measured. Also note any apparent irregularities such as damaged components, blockages, or irregularly high or low water levels.

9. Securely replace the grate or lid.

# Maintenance at a Glance

| | |
|---|---|
| Inspection | - Regularly during first year of installation<br>- Every 6 months after the first year of installation |
| Oil and Floatables Removal | - Once per year, with sediment removal<br>- Following a spill in the drainage area |
| Sediment Removal | - Once per year or as needed<br>- Following a spill in the drainage area |
| NOTE: For most clean outs the entire volume of liquid does not need to be removed from the manhole. Only remove the first few inches of oils and floatables from the water surface to reduce the total volume of liquid removed during a clean out. | |

# First Defense® Installation Log

| | |
|---|---|
| HYDRO INTERNATIONAL REFERENCE NUMBER: | |
| SITE NAME: | |
| SITE LOCATION: | |
| OWNER: | CONTRACTOR: |
| CONTACT NAME: | CONTACT NAME: |
| COMPANY NAME: | COMPANY NAME: |
| ADDRESS: | ADDRESS: |
| TELEPHONE: | TELEPHONE: |
| FAX: | FAX: |

**INSTALLATION DATE:** / /

**MODEL SIZE (CIRCLE ONE):** [3-FT] [4-FT] [5-FT] [6-FT] [7-FT] [8-FT] [10-FT]

**INLET (CIRCLE ALL THAT APPLY):** GRATED INLET (CATCH BASIN) INLET PIPE (FLOW THROUGH)

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# First Defense® Inspection and Maintenance Log

| Date | Initials | Depth of Floatables and Oils | Sediment Depth Measured | Volume of Sediment Removed | Site Activity and Comments |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
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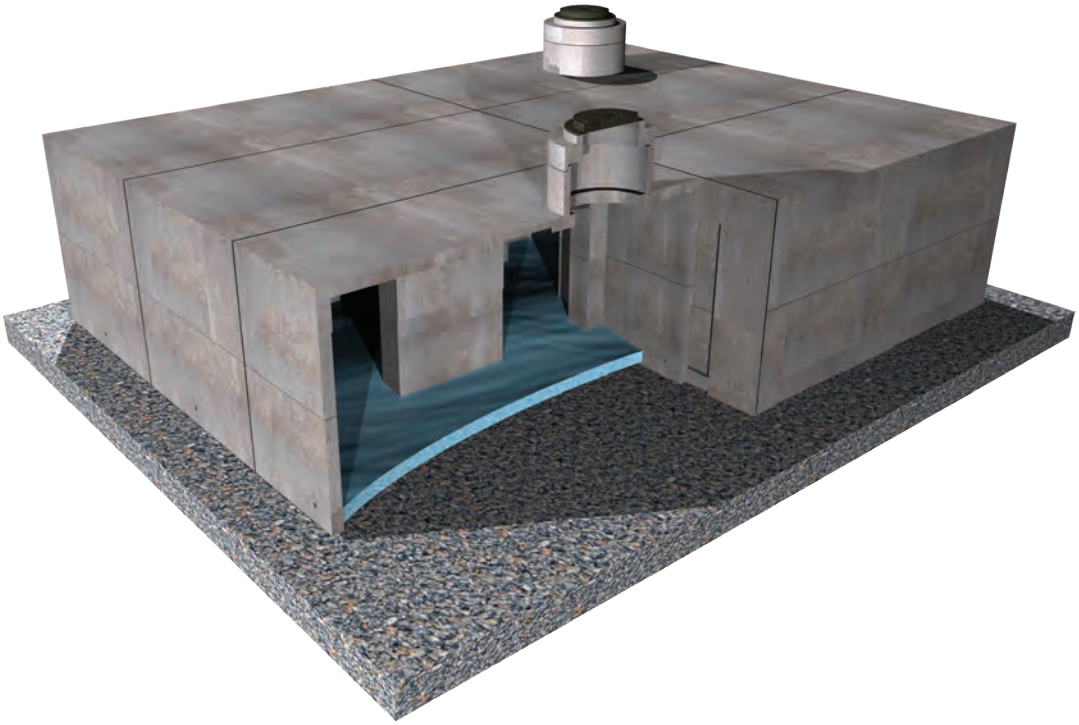
**Hydro International** (Stormwater), 94 Hutchins Drive, Portland ME 04102
Tel: (207) 756-6200 Fax: (207) 756-6212 Web: www.hydro-int.com

Oldcastle Infrastructure™
A CRH COMPANY

# STORMCAPTURE®

## Inspection and Maintenance Guide



Water

## Description

The StormCapture® system is an underground, modular, structural precast concrete storage system for stormwater detention, retention, infiltration, harvesting and reuse, and water quality volume storage. The system's modular design utilizes multiple standard precast concrete units with inside dimensions of 7 feet by 15 feet (outside dimensions of 8 feet by 16 feet) to form an underground storage system. The inside height of the StormCapture system can range from 2 feet to 14 feet. This modular design provides limitless configuration options for site-specific layouts.

StormCapture components can be provided as either open-bottom modules to promote infiltration or closed-bottom modules for detention. In some cases, StormCapture modules can be placed in a checkerboard configuration for an even more efficient design. A Link Slab, with a footprint of 9 feet by 17 feet, is then used to bridge each space without a module.

The standard StormCapture design incorporates lateral and longitudinal passageways between modules to accommodate internal stormwater conveyance throughout the system. These passageways may be classified as either a "window configuration" with standard 12-inch tall sediment baffles extending up from the floor of the module to the bottom of the window, or a "doorway configuration" without the sediment baffles. The function and drainage rate of a StormCapture system depends on site-specific conditions and requirements.

Stormwater typically enters the StormCapture system through an inlet pipe. Grated inlets can also be used for direct discharge into the system. The StormCapture system is rated for H-20 traffic loading with limited cover. Higher load requirements can also be accommodated. In addition, StormCapture systems are typically equipped with a limited number of maintenance modules that provide access to the system for ongoing inspection and maintenance.

## Function

The StormCapture system is primarily used to manage water quantity by temporarily storing stormwater runoff from impervious surfaces to prevent flooding, slow down the rate at which stormwater leaves the site, and reduce receiving stream erosion. In addition, the StormCapture system can be used to capture stormwater runoff for water quality treatment. Regardless of how the StormCapture system is used, some sedimentation may occur in the modules during the time water is stored.

## Configurations

The configuration of the StormCapture systems may vary, depending on the water quality and/or quantity requirements of the site. StormCapture configurations for detention, retention/infiltration, and retention/harvesting are described below.

## Detention

StormCapture Detention systems are designed with a closed bottom to detain stormwater runoff for controlled discharge from the site. This design may incorporate a dead storage sump and a permanent pool of water if the outlet pipe is higher than the floor elevation. Discharge from the system is typically controlled by an outlet orifice and/or outlet weir to regulate the rate of stormwater leaving the system. StormCapture Detention systems are typically designed with silt-tight joints, however when conditions exist that require a StormCapture system to be watertight, the system may be wrapped in a continuous, impermeable geomembrane liner. If the StormCapture Detention system includes Link Slabs, a liner must be used to detain water since the chambers under each Link Slab have no floor slab. In this case, care must be taken by maintenance personnel not to damage the exposed liner beneath each Link Slab.

## Retention/Infiltration

StormCapture Retention/Infiltration systems are designed with an open bottom to allow for the retention of stormwater onsite through infiltration into the base rock and surrounding soils. For infiltration systems, the configuration of the base of the StormCapture system may vary, depending on the needs of the site and the height of the system. Some systems may use modules that have fully open bottoms with no concrete floor, while other systems may use modules that incorporate floor openings in the base of each module. These are typically 24-inch by 24-inch openings. For open-bottom systems, concrete splash pads may be installed below inlet grate openings and pipe inlets to prevent erosion of base rock. A StormCapture Infiltration system may have an elevated discharge pipe for peak overflow.

## Retention/Harvesting

StormCapture Retention/Harvesting systems are similar to detention systems using closed-bottom modules, but stormwater is typically retained onsite for an extended period of time and later reused for non-potable applications or irrigation. For rainwater harvesting systems, an impermeable geomembrane liner is typically installed around the modules to provide a water-tight system.

## Inspection and Maintenance Overview

State and local regulations typically require all stormwater management systems to be inspected on a regular basis and maintained as necessary to ensure performance and protect downstream receiving waters. Inspections should be used to evaluate the conditions of the system. Based on these inspections, maintenance needs can be determined. Maintenance needs vary by site and system. Using this Inspection & Maintenance Guide, qualified maintenance personnel should be able to provide a recommendation for maintenance needs. Requirements may range from minor activities such as removing trash, debris or pipe blockages to more substantial activities such as vacuuming and removal of sediment and/or non-draining water. Long-term maintenance is important to the operation of the system since it prevents excessive pollutant buildup that may limit system performance by reducing the operating capacity and increasing the potential for scouring of pollutants during periods of high flow.

Only authorized personnel shall inspect and/or enter a StormCapture system. Personnel must be properly trained and equipped before entering any underground or confined space structure. Training includes familiarity with and adherence to any and all local, state and federal regulations governing confined space access and the operation, inspection, and maintenance of underground structures.

## Inspection and Maintenance Frequency

The StormCapture system should be inspected on a regular basis, typically twice per year, and maintained as required. The maintenance frequency will be driven by the amount of runoff and pollutant loading encountered by a given system. Local jurisdictions may also dictate inspection and maintenance frequencies.

## Inspection Equipment

The following equipment is helpful when conducting StormCapture inspections:

- Recording device (pen and paper form, voice recorder, iPad, etc.)
- Suitable clothing (appropriate footwear, gloves, hardhat, safety glasses, etc.)
- Traffic control equipment (cones, barricades, signage, flagging, etc.)
- Manhole hook or pry bar
- Confined space entry equipment, if needed
- Flashlight
- Tape measure
- Measuring stick or sludge sampler
- Long-handled net (optional)

## Inspection Procedures

A typical StormCapture system provides strategically placed access points that may be used for inspection. StormCapture inspections are usually conducted visually from the ground surface, without entering the unit. This typically limits inspection to the assessment of sediment depth, water drain down, and general condition of the modules and components, but a more detailed assessment of structural condition may be conducted during a maintenance event.

To complete an inspection, safety measures including traffic control should be deployed before the access covers are removed. Once the covers have been removed, the following items should be inspected and recorded (see form provided at the end of this document) to determine whether maintenance is required:

- Observe inlet and outlet pipe penetrations for blockage or obstruction.
- If possible, observe internal components like baffles, flow control weirs or orifices, and steps or ladders to determine whether they are broken, missing, or possibly obstructed.
- Observe, quantify, and record the sediment depths within the modules.
- Retrieve as much floating trash as possible with a long-handled net. If a significant amount of trash remains, make a note in the Inspection & Maintenance Log.
- For infiltration systems, local regulations may require monitoring of the system to ensure drain down is occurring within the required permit time period (typically 24 to 72 hours). If this is the case, refer to local regulations for proper inspection procedure.

## Maintenance Indicators

Maintenance should be scheduled if any of the following conditions are identified during the inspection:

- Inlet or outlet piping is blocked or obstructed.
- Internal components are broken, missing, or obstructed.
- Accumulation of more than six inches of sediment on the system floor or in the sump, if applicable.
- Significant accumulation of floating trash and debris that cannot be retrieved with a net.
- The system has not drained completely after it hasn't rained for one to three days, or the drain down does not meet permit requirements.
- Any hazardous material is observed or reported.

## Maintenance Equipment

The following equipment is helpful when conducting StormCapture maintenance:

- Suitable clothing (appropriate footwear, gloves, hardhat, safety glasses, etc.)
- Traffic control equipment (cones, barricades, signage, flagging, etc.)
- Manhole hook or pry bar
- Confined space entry equipment, if needed
- Flashlight
- Tape measure
- Vacuum truck

## Maintenance Procedures

Maintenance should be conducted during dry weather when no flow is entering the system. Confined space entry is usually required to maintain the StormCapture. Only personnel that are OSHA Confined Space Entry trained and certified may enter underground structures. Once safety measures such as traffic control have been deployed, the access covers may be removed and the following activities may be conducted to complete maintenance:

- Remove trash and debris using an extension on the end of the boom hose of the vacuum truck. Continue using the vacuum truck to completely remove accumulated sediment. Some jetting may be necessary to fully evacuate sediment from the system floor or sump. Jetting is acceptable in systems with solid concrete floors or base slabs (referred to as closed-bottom systems). However, jetting is not recommended for open-bottom systems with a gravel foundation since it may cause bedding displacement, undermining of the foundation, or internal disturbance.
- All material removed from the system during maintenance must be disposed of in accordance with local regulations. In most cases, the material may be handled in the same manner as disposal of material removed from sumped catch basins or manholes.
- Inspect inlet and outlet pipe penetrations for cracking and other signs of movement that may cause leakage.
- Inspect the concrete splash pads (applicable for open-bottom systems only) for proper function and placement.
- Inspect the system for movement of modules. There should be less than 3/4-inch spacing between modules.
- Inspect the general interior condition of modules for concrete cracking or deterioration. If the system consists of horizontal joints as part of the modules, inspect those joints for leakage, displacement or deterioration.

Be sure to securely replace all access covers, as appropriate, following inspection and/or maintenance. If the StormCapture modules or any of the system components show significant signs of cracking, spalling, or deterioration or if there is evidence of excessive differential settlement between modules, contact Oldcastle Infrastructure at **800-579-8819.**

# StormCapture
# Inspection & Maintenance Log

Refer to as-built records for details about system size and location onsite

Location _____

**System Configuration:**

Inspection Date _____

☐ Detention ☐ Infiltration ☐ Retention/Harvesting

***Inlet or Outlet Blockage or Obstruction***

**Notes:**

☐ Yes ☐ No

***Condition of Internal Components***

**Notes:**

☐ Good ☐ Damaged ☐ Missing

***Sediment Depth Observed***

**Notes:**

☐ Inches of Sediment: _____

***Trash and Debris Accumulation***

**Notes:**

☐ Significant ☐ Not Significant

***Drain Down Observations***

**Notes:**

☐ Appropriate Time Frame ☐ Inappropriate Time Frame

***Maintenance Requirements***

☐ **Yes - Schedule Maintenance** ☐ **No - Inspect Again in _____ Months**

# Water Quality Volume Calculations

## Summary for Subcatchment PR 1.1: Subcat PR 1.1

Runoff = 22.5 cfs @ 12.08 hrs, Volume= 81,636 cf, Depth= 5.94"
Routed to Pond SC-1 : 12FT StormCapture (CFS-4 and Road)

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.43"

| Area (sf) | CN | Description |
|---|---|---|
| 32,911 | 39 | >75% Grass cover, Good, HSG A |
| 115,705 | 98 | Paved parking, HSG A |
| 16,286 | 98 | Roofs, HSG A |
| 2 | 30 | Woods, Good, HSG A |
| 164,903 | 86 | Weighted Average |
| 32,912 | 39 | 19.96% Pervious Area |
| 131,990 | 98 | 80.04% Impervious Area |

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

## Summary for Pond SC-1: 12FT StormCapture (CFS-4 and Road)

Inflow Area = 164,903 sf, 80.04% Impervious, Inflow Depth = 5.94" for 100-Year event
Inflow = 22.5 cfs @ 12.08 hrs, Volume= 81,636 cf
Outflow = 1.0 cfs @ 9.67 hrs, Volume= 81,640 cf, Atten= 96%, Lag= 0.0 min
Discarded = 1.0 cfs @ 9.67 hrs, Volume= 81,640 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 260.99' @ 14.86 hrs Surf.Area= 0.118 ac Storage= 0.875 af

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 321.2 min ( 1,069.0 - 747.8 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 252.00' | 0.000 af | **80.00'W x 64.00'L x 13.17'H Field A**<br>1.548 af Overall - 1.548 af Embedded = 0.000 af x 40.0% Voids |
| #2A | 252.00' | 1.249 af | **Oldcastle StormCapture SC2 12'** x 40 Inside #1<br>Inside= 84.0"W x 144.0"H => 86.13 sf x 16.00'L = 1,378.0 cf<br>Outside= 96.0"W x 158.0"H => 105.33 sf x 16.00'L = 1,685.3 cf<br>10 Rows adjusted for 724.0 cf perimeter wall |
| | | 1.249 af | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 252.00' | **8.270 in/hr Exfiltration over Surface area** |

**Discarded OutFlow** Max=1.0 cfs @ 9.67 hrs HW=252.58' (Free Discharge)
↳**1=Exfiltration** (Exfiltration Controls 1.0 cfs)

The entire inflow volume for the 100-Year Storm exfiltrates from the system into the ground. Therefore, the required water quality volume is met.

# TSS Removal Worksheets

Hydro International

# First Defense® High Capacity

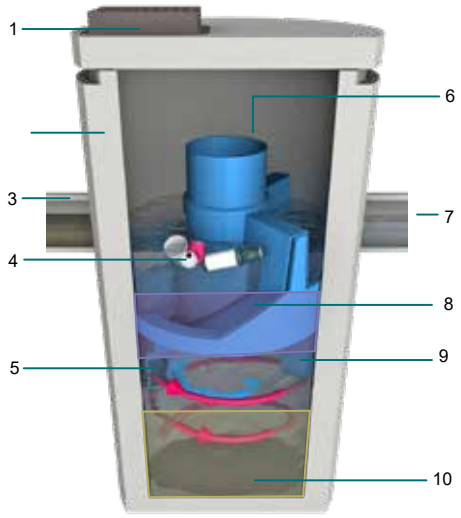
## Advanced Hydrodynamic Separator

## Product Summary

**A Simple Solution for your Trickiest Sites**

First Defense® High Capacity is a versatile stormwater separator with some of the highest approved flow rates in the United States, enabling engineers and contractors to save site space and projects costs by using the smallest possible footprint. It also works with single and multiple inlet pipes and inlet grates has an internal bypass to convey infrequent peak flows directly to the outlet.

**Fig.1** The First Defense® High Capacity has internal components designed to efficiently capture pollutants and prevent washout at




## Product Profile

1. Inlet Grate (optional)
2. Precast chamber
3. Inlet Pipe (optional)
4. Floatables Draw Off Slot (not pictured)
5. Inlet Chute
6. Internal Bypass
7. Outlet pipe
8. Oil and Floatables Storage
9. Outlet chute
10. Sediment Storage Sump

## Applications

- Areas requiring a minimum of 50% TSS removal
- Stormwater treatment at the point of entry into the drainage line
- Sites constrained by space, topography or drainage profiles with limited slope and depth of cover
- Highways, car parks, industrial areas and urban developments
- Pre-treatment to ponds, storage systems, green infrastructure

## How it Works

**Highest Flow through the Smallest Footprint**

Contaminated stormwater runoff enters the inlet chute from a surface grate and/or inlet pipe. The inlet chute introduces flow into the chamber tangentially to create a low energy vortex flow regime (magenta arrow) that directs sediment into the sump while oils, floating trash and debris rise to the surface.

Treated stormwater exits through a submerged outlet chute located opposite to the direction of the rotating flow (blue arrow). Enhanced vortex separation is provided by forcing the rotating flow within the vessel to follow the longest path possible rather than directly from inlet to outlet.

Higher flows bypass the treatment chamber to prevent turbulence and washout of captured pollutants. An internal bypass conveys infrequent peak flows directly to the outlet eliminating the need for, and expense of, external bypass control structures. A floatables draw off slot functions to convey floatables into the treatment chamber prior to bypass.

## Benefits

### Small & Simple

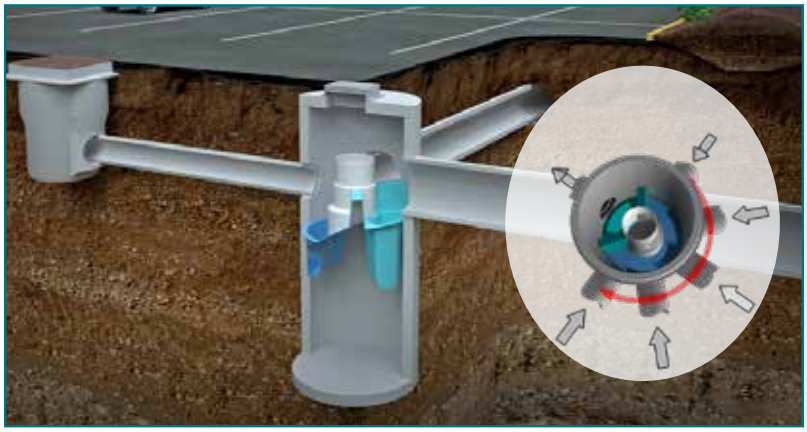
- Cut footprint size, cut costs: First Defense® provides space-saving, easy-to-install surface water treatment in standard sized chambers/ manholes.
- Adapt to site limitations: Variable configuratoins will help you effectively slip First Defense® into a tight spot. It also works well with large pipes, multiple inlet pipes and inlet grates.
- Save installation time: Every First Defense® unit is delivered to site pre-assembled and ready for installation – so installation is as easy as fitting any chamber/manhole.

**Stormwater Solutions**

→ hydro-int.com/firstdefense

## Sizing & Design

This adaptable online treatment system works easily with large pipes, multiple inlet pipes, inlet grates and now, contains a high capacity bypass for the conveyance of large peak flows. Designed with site flexibility in mind, the First Defense® High Capacity allows engineers to maximize available site space without compromising treatment level.



### Free Sizing Tool

This simple online tool will recommend the best separator, model size and online/offline arrangement based on site-specific data entered by the user.

Go to hydro-int.com/sizing to access the tool.

| First Defense® High Capacity Model Number | Diameter | Typical TSS Treatment Flow Rates | | Peak Online Flow Rate | Maximum Pipe Diameter[1] | Oil Storage Capacity | Typical Sediment Storage Capacity[2] | Minimum Distance from Outlet Invert to Top of Rim[3] | Standard Distance from Outlet Invert to Sump Floor |
|---|---|---|---|---|---|---|---|---|---|
| | | NJDEP Certified | 110µm | | | | | | |
| | (ft / m) | (cfs / L/s) | (cfs / L/s) | (cfs / L/s) | (in / mm) | (gal / L) | ($yd^3$ / $m^3$) | (ft / m) | (ft / m) |
| FD-3HC | 3 / 0.9 | 0.84 / 23.7 | 1.06 / 30.0 | 15 / 424 | 18 / 450 | 125 / 473 | 0.4 / 0.3 | 2.0 - 3.5 / 0.6 - 1.0 | 3.71 / 1.13 |
| FD-4HC | 4 / 1.2 | 1.50 / 42.4 | 1.88 / 53.2 | 18 / 510 | 24 / 600 | 191 / 723 | 0.7 / 0.5 | 2.3 - 3.9 / 0.7 - 1.2 | 4.97 / 1.5 |
| FD-5HC | 5 / 1.5 | 2.35 / 66.2 | 2.94 / 83.2 | 20 / 566 | 24 / 600 | 300 / 1135 | 1.1 / .84 | 2.5 - 4.5 / 0.7 - 1.3 | 5.19 / 1.5 |
| FD-6HC | 6 / 1.8 | 3.38 / 95.7 | 4.23 / 119.8 | 32 / 906 | 30 / 750 | 496 / 1,878 | 1.6 / 1.2 | 3.0 - 5.1 / 0.9 - 1.6 | 5.97 / 1.8 |
| FD-8HC | 8 / 2.4 | 6.00 / 169.9 | 7.52 / 212.9 | 50 / 1415 | 48 / 1200 | 1120 / 4239 | 2.8 / 2.1 | 3.0 - 6.0 / 0.9 -1.8 | 7.40 / 2.2 |
| FD-10HC | 10 / 3.0 | 9.38 / 265.6 | 11.75 / 332.7 | 50 / 1415 | 48 / 1200 | 1742 / 6594 | 4.4 / 3.3 | 6.5 -8.0 / 2.0 - 2.4 | 10.25 / 3.12 |

[1]Contact Hydro International when larger pipe sizes are required.
[2]Contact Hydro International when custom sediment storage capacity is required.
[3]Minimum distance for models depends on pipe diameter.

## Maintenance

Easy vactor hose access through the center shaft of the system makes for quick, simple sump cleanout while trash and floatables can be fished out from the surface with a net.

Nobody maintains our systems better than we do. To ensure optimal, ongoing device performance, be sure to recommend Hydro International as a preferred service and maintenance provider to your clients.

Hydro International

Hydro International, 94 Hutchins Drive, Portland, ME 04102
**Tel**: (207) 756-6200
**Email**: stormwaterinquiry@hydro-int.com
**Web**: www.hydro-int.com/firstdefense

FD_SS_B_2105

**Download Drawings!**

→ hydro-int.com/fddrawings

**Access the Operation & Maintenance Manual**

→ hydro-int.com/fd-om

# Technical Abstract
# First Defense® - High Capacity

## NJCAT Verified 80% TSS Removal for 50 to 150 µm Particle Size Range

### Introduction

Hydro International has a state-of-the-art hydraulics and test facility that is used both to develop products and to evaluate performance. Through controlled testing using industry standard test protocols, Hydro's treatment products are evaluated under varying hydraulic and sediment load conditions. With a known drainage area or water quality flow rate, these test results are used to benchmark treatment objectives and to select the correct model size.

A common stormwater treatment goal for manufactured treatment devices is to reduce the Total Suspended Solids (TSS) concentration by at least 80%. To comply with this goal, a silica-based test sand with known particle size gradation (PSD) and density is injected into the treatment system at different flow rates. With known TSS concentrations and particle sizes before and after treatment, efficiency curves are plotted and used to predict TSS reductions for a range of particle sizes.

### OK110 Silica Test Sand

U.S. Silica OK110 is a common test sand that has been used by the industry but is no longer available. However, its PSD can be modelled from a blend of silica sands having a wide range of particle sizes. This abstract summarizes test results based on a particle size range similar to OK110 for the First Defense® High Capacity (FDHC). All test protocols and results have been independently verified by the New Jersey Corporation for Advanced Technology (NJCAT). The full report can be viewed at: FDHC_PSD_Removal_Verification_Report_9-16.pdf

### First Defense High Capacity (FDHC)

The FDHC (Figure 1) has patented flow modifying internal components that create a gentle swirling flow path within the Vortex Chamber. The rotating flow creates low energy vortex forces that supplement gravitational settling forces to enhance separation of pollutants.

The internal components are fit into precast manholes to collect runoff as part of typical drainage network system. During rain events, flow enters either from a surface inlet grate or inlet pipe. As flow enters the manhole, components divert flow and pollutants into a Vortex Chamber beneath a separation module, that includes both Inlet\Outlet Chutes and Bypass Weirs. The internal Bypass Weirs divert peak flows over the separation module and away from the Vortex Chamber where pollutants are collecting. This prevents high velocities from re-suspending captured pollutants during infrequent but large storm events.

Capable of providing high pollutant removals for a wide range of flow rates and pipe sizes, the FDHC can be installed ether online or offline depending on pipes and peak flows. Its efficiency and simplicity make it economical to install and maintain.

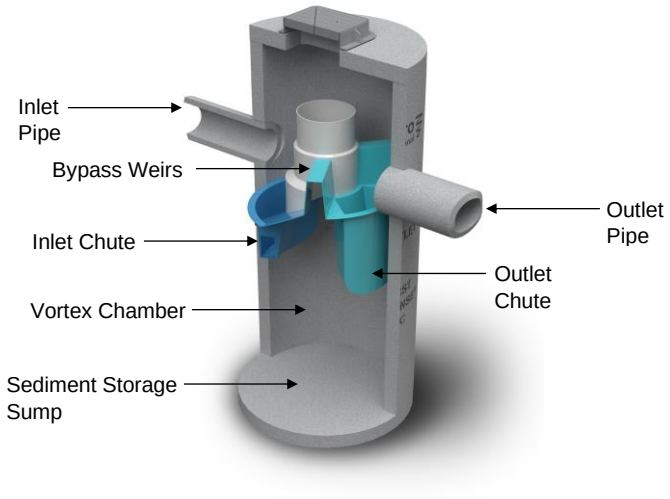



**Figure 1 - First Defense High Capacity**

### Laboratory Testing Arrangement

The laboratory setup (Figure 2) consisted of a recirculating closed loop system with an 8-inch (200 mm) submersible Flygt pump that conveyed water from a 23,000 gal (87,064 L) reservoir through a PVC pipe network to the 4-ft (1.2m) FDHC. The flow rate of the pump was controlled by a GE Fuji Electric AF-300 P11 Adjustable Frequency Drive and measured by an EMCO Flow Systems 4411e Electromagnetic Flow Transmitter. Test sand was injected into the incoming flow stream using a volumetric screw feeder situated 10-ft prior to entering the test unit.

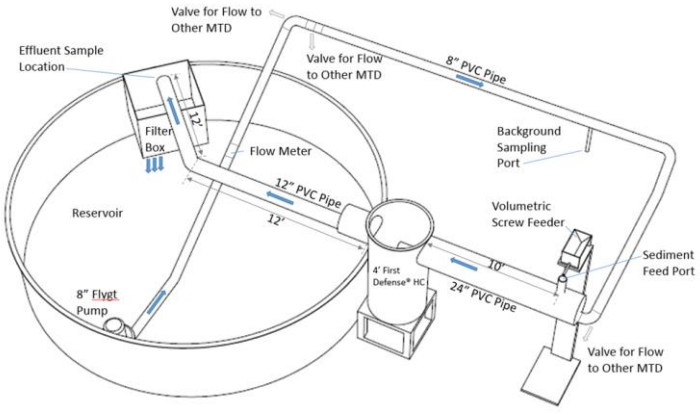



**Figure 2 - Set-up of the Portland, Maine hydraulic testing facility**

### Test Sediment

The feed sediment injected into the inlet during removal efficiency testing was a blend of commercially available silica sands ranging from 2 µm to 1,000 µm. The PSD of the test sediment was analyzed by an independent laboratory in accordance with ASTM D 422-63.

# First Defense® - High Capacity

To evaluate the performance consistent with OK110 test sand, results were analyzed from the particle sizes range of 50 µm to 150 µm ($D_{50}$=108µm). A comparison between the 50 – 150 µm range and OK110 gradation is shown in Figure 3. The 50 – 150 µm test sand gradation is overall finer than OK110 between 50 µm and 100 µm. For example, the test sand had 15% finer than 75 µm compared to the OK110 PSD that had only 3% less than 75 microns. Given that finer particles are more difficult to remove, performance results for 50 to 150 µm PSD is considered conservative.

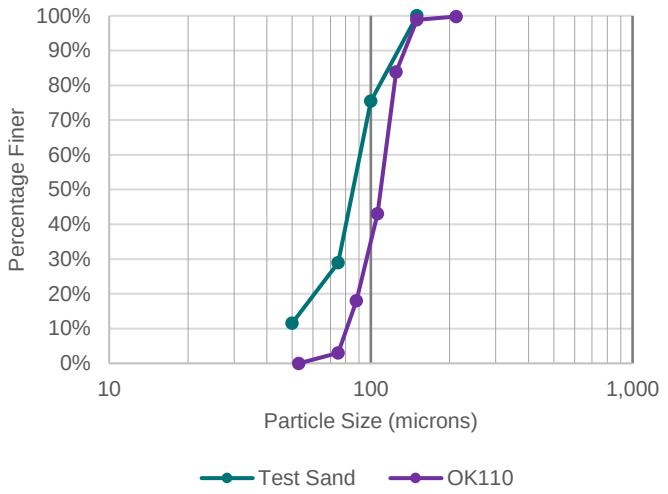



**Figure 3 - Particle Size Distribution Comparison**

## Removal Efficiency Testing

Removal efficiency testing with the feed sediment was conducted in accordance with Section 5 of the NJDEP Laboratory Protocol for Manufactured Treatment Devices. Five flow rates ranging from 0.38 cfs to 1.88 cfs were tested to assess the performance trend.

The test sediment was fed into the flow stream at a rate that was equivalent to 200 mg/L. The average influent TSS concentration was calculated using the total sediment mass and volume of water added during dosing. The influent concentration for each particle size band was calculated using the percentage of particles in each particle size band and known average inlet concentration. Three time-spaced effluent grab samples were composited and analyzed using laser diffraction (ISO 13320) to evaluate the effluent particle sizes.

**Table 1 – 50 – 150 µm Particle Size Range Test Results**

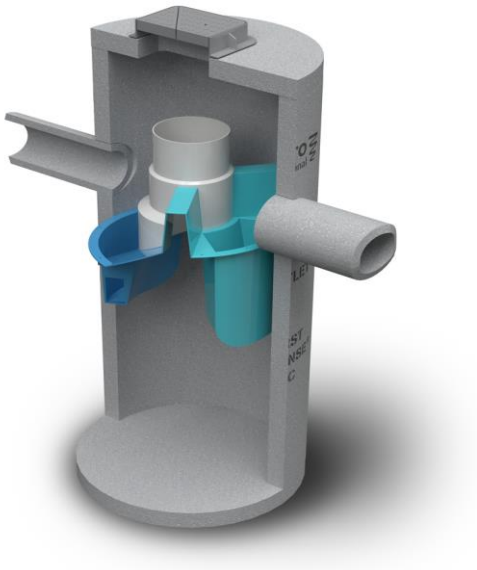
| Flow | Inlet Mass | Outlet Mass | Removal |
|---|---|---|---|
| cfs (L/s) | grams | grams | % |
| 0.38 (10.8) | 1,554.6 | 107.1 | 93.1 |
| 0.75 (21.2) | 1,761.0 | 150.8 | 91.4 |
| 1.13 (32.0) | 1,872.8 | 127.2 | 93.2 |
| 1.5 (42.5) | 2,203.2 | 226.7 | 89.7 |
| 1.88 (53.2) | 2,366.6 | 303.8 | 87.2 |

The average effluent sediment concentration of the three composited samples was also measured for each flow rate in accordance with ASTM D3977-97. The effluent concentration for each particle size band was then calculated using the average effluent composite concentration and percentage of particles in each particle size band.

Percent removed at each of the five tested flow rates is shown in Table 1. Inlet concentrations of the OK110 particle size range varied from 79-84 mg/L compared to 4-8.5 mg/L at the outlet. As expected, the highest concentration measured at the outlet was at the highest tested flow rate of 1.88 cfs (53.2 L/s). In general, the 4-ft FDHC removed greater than 85% of the OK110 particle size range for all tested flow rates. Table 2 provides "Treatment Flow Rates" for the available models.

**Table 2 – FDHC Treatment Flow Rate for > 85% OK110**

| Model: | FD-3HC | FD-4HC | FD-5HC | FD-6HC | FD-8HC | FD-10HC |
|---|---|---|---|---|---|---|
| Size: | 3 ft (0.9 m) | 4 ft (1.2 m) | 5 ft (1.5 m) | 6 ft (1.8 m) | 8 ft (2.4 m) | 10 ft (3.0 m) |
| cfs: | 1.06 | 1.88 | 2.94 | 4.23 | 7.52 | 11.75 |
| L/s: | 30.02 | 53.2 | 83.3 | 119.8 | 212.9 | 332.6 |



For design purposes the selected model's Treatment Flow Rate must be equal or greater to the site's required Water Quality Flow Rate. The peak flow rate and maximum pipe size must be considered to determine whether an online or offline configuration is appropriate. Full removal curves are available on request.

Refer First Defense product information brochure or visit www.hydro-int.com/us for more information

Hydro International. 94 Hutchins Drive. Portland. ME 04102
Tel: 207.756.6200 Fax: 207.756.6212
Email: stormwaterinquiry@hydro-int.com Web: www.hydro-int.com

Stormwater Solutions

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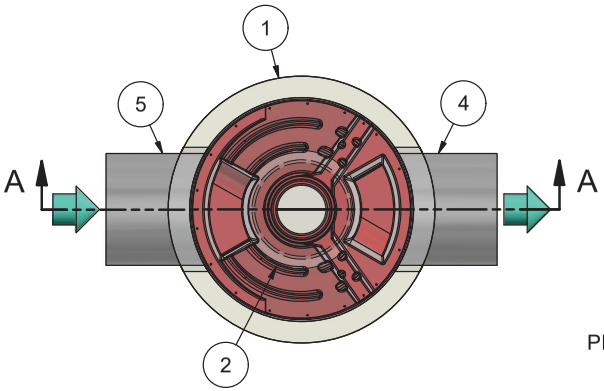
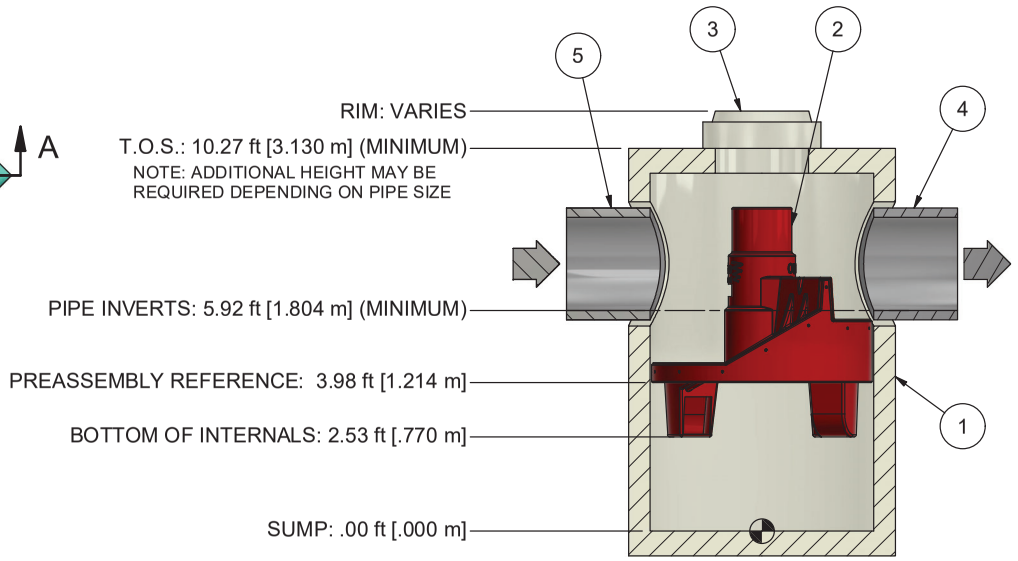



PLAN VIEW

HYDRO FRAME AND COVER (INCLUDED)

GRADE RINGS BY OTHERS AS REQUIRED




SECTION A-A
SCALE 1:40

1. MANHOLE WALL AND SLAB THICKNESSES ARE NOT TO SCALE.

2. CONTACT HYDRO INTERNATIONAL FOR A BOTTOM OF STRUCTURE ELEVATION PRIOR TO SETTING FIRST DEFENSE MANHOLE.

3. CONTRACTOR TO CONFIRM RIM, PIPE INVERTS, PIPE DIA. AND PIPE ORIENTATION PRIOR TO RELEASE OF UNIT TO FABRICATION.

PRODUCT SPECIFICATION:

1. Peak Hydraulic Flow: 32.0 cfs (906 l/s)
2. Min Sediment Storage Capacity: 1.6 cu. yd. (1.2 cu. m.)
3. Maximum Inlet/Outlet Pipe Diameters: 30 in. (750 mm)
4. The treatment system shall use an induced vortex to separate pollutants from stormwater runoff.
5. For more product information including regulatory acceptances, please visit https://hydro-int.com/en/products/first-defense

GENERAL NOTES:
1. General Arrangement drawings only. Contact Hydro International for site specific drawings.
2. The diameter of the inlet and outlet pipes may be no more than 30".
3. Multiple inlet pipes possible (refer to project plan).
4. Inlet/outlet pipe angle can vary to align with drainage network (refer to project plans).
5. Peak flow rate and minimum height limited by available cover and pipe diameter.
6. Larger sediment storage capacity may be provided with a deeper sump depth.

PARTS LIST

| ITEM | QTY | SIZE (in) | SIZE (mm) | DESCRIPTION |
|---|---|---|---|---|
| 1 | 1 | 72 | 1800 | I.D. PRECAST MANHOLE |
| 2 | 1 | | | INTERNAL COMPONENTS (PRE-INSTALLED) |
| 3 | 1 | 30 | 750 | FRAME AND COVER (ROUND) |
| 4 | 1 | 30 (MAX) | 750 (MAX) | OUTLET PIPE (BY OTHERS) |
| 5 | 1 | 30 (MAX) | 750 (MAX) | INLET PIPE (BY OTHERS) |

PROJECTION

IF IN DOUBT ASK

| DATE: | SCALE: |
|---|---|
| 11/2/2021 | 1:40 |

| DRAWN BY: | CHECKED BY: | APPROVED BY |
|---|---|---|
| ER | MRJ | |

Title
6-ft DIAMETER
FIRST DEFENSE

GENERAL ARRANGEMENT

Hydro International
hydro-int.com
HYDRO INTERNATIONAL

| WEIGHT: | MATERIAL: |
|---|---|
| | |

STOCK NUMBER: 1

DRAWING NO.: FD GA-6

| SHEET SIZE: | SHEET: | Rev: |
|---|---|---|
| B | 1 OF 1 | - |

**Calculation of Required Water Quality Flow for Sizing of Stormwater Treatment System**

9/10/2025

Based on Massachusetts DEP document:
"Standard Method to Convert Required Water Quality Volume to a Discharge Rate for Sizing Flow Based Manufactured Proprietary Stormwater Treatment Practices"

Stormwater Standard No. 4 requires that the full WQV be captured and treated to remove 80% of the average annual post-construction TSS load.
Since manufactured proprietary separators are sized using discharge rates and not volume, MassDEP is requiring this standard method be used to convert the required WQV to a discharge rate (WQF) to be treated.

Project Site: **Commonwealth Fusion CFS-4**
Project Location: **Devens, MA**

Runoff Depth, Q: **1** " (0.5" or 1")

**Table 1.**

| Structure Name | Area (acres) | % Impervious | Impervious A ($miles^2$) | $t_c$ (min.) | $t_c$ (hrs.) |
|---|---|---|---|---|---|
| **WQU-1** | **3.72** | **80.10%** | 0.004656 | **5.00** | 0.083 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

Because only runoff from impervious surfaces is used in calculation of WQV, area is considered 100% impervious
Therefore, CN = 98

Enter Ia/P Ratio for CN=98:
Ia/P = **0.034** (0.058 for Q=0.5" / 0.034 for Q=1")

Enter unit peak discharge, qu (csm/in) for Type III rainfall distribution, Ia/P, and tc:
From Figure 2 (Q=0.5") or Figure 4 (Q=1")

**Table 2.**

| Structure Name | tc (hours) | qu (csm/in) |
|---|---|---|
| **WQU-1** | **0.083** | **795** |
| | | |
| | | |
| | | |
| | | |

WQF in cfs = (qu)(A)(Q), where:

WQF = water quality flow (cfs)
$q_u$ = unit peak discharge (csm/in) — From Table 2 above
A = drainage area ($mi^2$) — From Table 1 above
Q = runoff depth (watershed inches) — Based on Area Type, from above

**Table 3.**

| **Structure Name** | **$q_u$ (csm/in)** | **Impervious A ($miles^2$)** | **Q (in)** | **WQF (cfs)** | **Proposed Device[1]** |
|---|---|---|---|---|---|
| WQU-1 | 795 | 0.004656 | 1 | **3.70** | **FD-6HC** |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

[1]Proposed Device is sized so that the required site WQF is less than the treatment flow at which the device achieves at least 80% of 110 microns, as documented by enclosed test data.

# TSS Removal Calculation Worksheet

101 Walnut Street
Post Office Box 9151
Watertown, MA 02471
P 617.924.1770

| | | | |
|---|---|---|---|
| Project Name: | **CFS-4** | Sheet: | **1 of 1** |
| Project Number: | **14867.07** | Date: | **Sept. 2025** |
| Location: | **Devens, MA** | Computed by: | **EOB** |
| Discharge Point: | **DP1** | Checked by: | |
| Drainage Area(s): | **All** | | |

## 1. Pre-Treatment prior to Infiltration

| BMP* | TSS Removal Rate* | Starting TSS Load** | Amount Removed (C*D) | Remaining Load (D-E) |
|---|---|---|---|---|
| **Deep Sump and Hooded Catch Basin** | **25%** | **100%** | **25%** | **75%** |
| **WQU-1** | **80%** | **75%** | **60%** | **15%** |
| | **0%** | **15%** | **0%** | **15%** |

**Pre-Treatment TSS Removal =** **85%**

## 2. Total TSS Removal including Pretreatment 1.

| BMP* | TSS Removal Rate* | Starting TSS Load** | Amount Removed (C*D) | Remaining Load (D-E) |
|---|---|---|---|---|
| **Deep Sump and Hooded Catch Basin** | **25%** | **100%** | **25%** | **75%** |
| **WQU-1** | **80%** | **75%** | **60%** | **15%** |
| **Subsurface Infiltration Structure** | **80%** | **15%** | **12%** | **3%** |
| | **0%** | **3%** | **0%** | **3%** |

* BMP and TSS Removal Rate Values from the MassDEP Stormwater Handbook Vol. 1. Removal rates for proprietary devices are from approved studies and/or manufacturer data (attach study or data source, or remove this sentence if not applicable).

** Equals remaining load from previous BMP (E)

*** Stormceptor sizing calculation gives a TSS removal rate of 87%. To be conservative, 80% removal is used for this calculation (Change name of device and the claimed removal rate shown on the calc. sheet. Remove this sentence if

**Treatment Train TSS Removal =** **97%**

# Total Phosphorus (TP) Removal

# BMP Performance Tables for Soil Infiltration Rate: Infiltration Basin

| | | Cumulative Load Reduction | | | | |
|---|---|---|---|---|---|---|
| Infiltration Rate (in/hr) | Depth of Runoff from Impervious Area (inches) | TSS | Phosphorus | Nitrogen | Zinc | Runoff Volume |
| 1.02 | 0.1 | 67% | 41% | 59% | 78% | 25% |
| | 0.2 | 94% | 60% | 77% | 92% | 42% |
| | 0.4 | 96% | 81% | 92% | 99% | 66% |
| | 0.6 | 99% | 90% | 96% | 100% | 79% |
| | 0.8 | 100% | 94% | 98% | 100% | 87% |
| | 1.0 | 100% | 97% | 100% | 100% | 91% |
| | 1.5 | 100% | 99% | 100% | 100% | 96% |
| | 2.0 | 100% | 100% | 100% | 100% | 98% |
| | | | | | | |
| 2.41 | 0.1 | 70% | 46% | 64% | 82% | 33% |
| | 0.2 | 88% | 67% | 82% | 95% | 54% |
| | 0.4 | 98% | 87% | 95% | 100% | 78% |
| | 0.6 | 100% | 94% | 98% | 100% | 88% |
| | 0.8 | 100% | 97% | 99% | 100% | 93% |
| | 1.0 | 100% | 98% | 100% | 100% | 96% |
| | 1.5 | 100% | 100% | 100% | 100% | 99% |
| | 2.0 | 100% | 100% | 100% | 100% | 100% |
| | | | | | | |
| 8.27 | 0.1 | 79% | 59% | 75% | 91% | 55% |
| | 0.2 | 95% | 81% | 92% | 99% | 77% |
| | 0.4 | 100% | 96% | 99% | 100% | 93% |
| | 0.6 | 100% | 99% | 100% | 100% | 98% |
| | 0.8 | 100% | 100% | 100% | 100% | 99% |
| | 1.0 | 100% | 100% | 100% | 100% | 100% |
| | 1.5 | 100% | 100% | 100% | 100% | 100% |
| | 2.0 | 100% | 100% | 100% | 100% | 100% |

Performance Curve Chart taken from the University of New Hampshire Stormwater Center SCM Performance Fact Sheet which was developed in conjunction with EPA Region 1.

# Appendix E: Standard 8 Supporting Information

# Recommended Construction Period Pollution Prevention and Erosion and Sedimentation Controls

# Appendix F: Erosion and Sedimentation Control Measures

# Erosion and Sedimentation Control Measures

The following erosion and sedimentation controls are for use during the earthwork and construction phases of the project. The following controls are provided as recommendations for the site contractor and do not constitute or replace the plans required by the Construction General Permit (CGP). As part of the Notice of Intent process, an erosion and sedimentation control plan will be developed and included in the project plan set, which will include measures such as those described below.

## Compost Filter Socks (Silt Socks)

Compost socks will be placed to trap sediment transported by runoff before it reaches the drainage system or leaves the construction site. These barriers shall be staked at manufacturer's recommended intervals and be placed in solid contact with the ground to prevent undercutting of runoff.

## Silt Fencing

In areas where high runoff velocities or high sediment loads are expected, or adjacent to environmentally sensitive areas, compost sock barriers will be backed up with silt fencing. This semi-permeable barrier made of a synthetic porous fabric will provide additional protection. The silt fences and compost sock barriers will be replaced as determined by periodic field inspections.

## Catch Basin/Area Drain Protection

Newly constructed and existing catch basins and area drains will be protected with compost filter sock (where appropriate) or silt sacks throughout construction.

## Stabilized Construction Entrance/Exit

A temporary crushed-stone construction entrance/exit will be constructed. A cross slope will be placed in the entrance to direct runoff to a protected catch basin inlet or settling area. If

deemed necessary after construction begins, a wash pad may be included to wash off vehicle wheels before leaving the project site.

## Diversion Channels

Diversion channels may be used to collect runoff from construction areas and discharge to either sedimentation basins or protected catch basin inlets.

## Temporary Sediment Basins

Temporary sediment basins will be designed either as excavations or bermed stormwater detention structures (depending on grading) that will retain runoff for a sufficient period of time to allow suspended soil particles to settle out prior to discharge. These temporary basins will be located based on construction needs as determined by the contractor and outlet devices will be designed to control velocity and sediment. Points of discharge from sediment basins will be stabilized to minimize erosion.

## Vegetative Slope Stabilization

Stabilization of open soil surfaces will be implemented within 14 days after grading or construction activities have temporarily or permanently ceased, unless there is sufficient snow cover to prohibit implementation. Vegetative slope stabilization will be used to minimize erosion on slopes of 3:1 or flatter. Annual grasses, such as annual rye, will be used to ensure rapid germination and production of root mass. Permanent stabilization will be completed with the planting of perennial grasses or legumes. Establishment of temporary and permanent vegetative cover may be established by hydro-seeding or sodding. A suitable topsoil, good seedbed preparation, and adequate lime, fertilizer and water will be provided for effective establishment of these vegetative stabilization methods. Mulch will also be used after permanent seeding to protect soil from the impact of falling rain and to increase the capacity of the soil to absorb water.

## Maintenance

- The contractor or subcontractor will be responsible for implementing each control shown on the Sedimentation and Erosion Control Plan. In accordance with the CGP, the contractor must sign a copy of a certification to verify that a plan has been prepared and that permit regulations are understood.
- The on-site contractor will inspect all sediment and erosion control structures periodically and after each rainfall event. Records of the inspections will be prepared and maintained on-site by the contractor.
- Silt shall be removed from behind barriers if greater than 6-inches deep or as needed.
- Damaged or deteriorated items will be repaired immediately after identification.
- The underside of compost filter socks should be kept in close contact with the earth and reset as necessary.

- Sediment that is collected in structures shall be disposed of properly and covered if stored on-site.
- Erosion control structures shall remain in place until all disturbed earth has been securely stabilized. After removal of structures, disturbed areas shall be regraded and stabilized as necessary.

# Construction Practices Maintenance/ Evaluation Checklist

## CFS-4 (Devens, Massachusetts)

Stormwater Control Manager: _____

| Best Management Practice | Inspection Frequency | Date Inspected | Inspector Initials | Minimum Maintenance and Key Items to Check | Cleaning or Repair Needed ☐Yes/No (List Items) | Date of Cleaning or Repair | Performed by: |
|---|---|---|---|---|---|---|---|
| Stabilized Construction Entrance/Exit | Weekly and after any rainfall | | | Filled voids, erosion, breakout, runoff/sediments into street. Inspect for breakdown of crushed stone. Reapply stone as necessary to depths specified in construction documentation. | | | |
| Catch Basin/Area Drain Protection | Weekly and after any rainfall | | | Inspect for proper operation. Inspect for accumulated sediment within silt sacks. If clogged, dispose of sediment. Inspect for rips or torn silt sacks. | | | |
| Diversion Channels | Weekly and after any rainfall | | | Inspect for proper function; correct as necessary. Maintained and moved as necessary to correct locations. Check for erosion or breakout. | | | |
| Temporary Sedimentation Basins | Weekly and after any rainfall | | | Inspect for cracking, erosion, breakout, sediment buildup, contaminants. | | | |
| Vegetated Slope Stabilization | Weekly and after any rainfall | | | Inspect for erosion and correct if necessary. | | | |
| Materials Storage Areas | Weekly and after any rainfall | | | Maintain and inspect for spills and breakout. | | | |
| Silt Sock Erosion Control Barriers | Weekly and after any rainfall | | | Inspect for deterioration, damage, flow around or under barrier, excessive sag, sediment buildup, and/or separation of silt socks or silt fences with earth and each other. | | | |