Stormwater Analysis

for

Merrimack Valley Transit

265 Highland Avenue

Somerville, Massachusetts

Prepared for:

RGB Architects
Project Architects

Merrimack Valley Transit

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By:

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Table of Contents:

Introduction

Excerpt from MADEP Stormwater Management Standards Chapter 1:

> *In 1996, the Massachusetts Department of Environmental Protection (the "Department" or "MassDEP") issued the Stormwater Policy that established Stormwater Management Standards aimed at encouraging recharge and preventing stormwater discharges from causing or contributing to the pollution of the surface waters and groundwaters of the Commonwealth. In 1997, MassDEP published the Massachusetts Stormwater Handbook as guidance on the Stormwater Policy. MassDEP has revised the Stormwater Management Standards and Massachusetts Stormwater Handbook to promote increased stormwater recharge, the treatment of more runoff from polluting land uses, low impact development (LID) techniques, pollution prevention, the removal of illicit discharges to stormwater management systems, and improved operation and maintenance of stormwater best management practices (BMPs). MassDEP applies the Stormwater Management Standards pursuant to its authority under the Wetlands Protection Act, M.G.L. c. 131, § 40, and the Massachusetts Clean Waters Act, M.G.L .c. 21, §§ 26-53. The revised Stormwater Management Standards have been incorporated in the Wetlands Protection Act Regulations, 310 CMR 10.05(6)(k) and the Water Quality Certification Regulations, 314 CMR 9.06(6)(a).*
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> *Stormwater runoff results from rainfall and snow melt and represents the single largest source responsible for water quality impairments in the Commonwealth's rivers, lakes, ponds, and marine waters. New and existing development typically adds impervious surfaces and, if not properly managed, may alter natural drainage features, increase peak discharge rates and volumes, reduce recharge to wetlands and streams, and increase the discharge of pollutants to wetlands and water bodies.*
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> *The Stormwater Management Standards address water quality (pollutants) and water quantity (flooding, low base flow and recharge) by establishing standards that require the implementation of a wide variety of stormwater management strategies. These strategies include environmentally sensitive site design and LID techniques to minimize impervious surface and land disturbance, source control and pollution prevention, structural BMPs, construction period erosion and sedimentation control, and the long-term operation and maintenance of stormwater management systems.*

Executive Summary

The Merrimack Valley Transit (MeVa) is the Regional Transit Authority serving sixteen cities and towns in the northeast corner of Massachusetts including Haverhill. The site is currently developed and contains five (5) buildings operating together as the MeVa Headquarters Complex including: offices, employee parking, storage, bus parking, fueling and maintenance of vehicles. There is a shared access drive that enters through the MBTA property to the south of the site.

The wetland resource areas on site are Bank, Bordering Land Subject to Flooding(BLSF), and Riverfront Area all associated with the Merrimack River. The 100-year floodplain (BLSF) is shown on the FEMA FIRM Map Number 25009C0089H, effective date July 8, 2025, at an elevation of 23.1 feet. All work will be in an area of the site that is currently developed. No new impacts to wetland resource areas are proposed.

MeVa wishes to replace an aging subsurface fuel storage tank with a modern above-ground tank. The new tank will provide many benefits to the site.

- The above ground tank will be located further from the wetland resource areas in an already developed area;
- Water quality will be improved by installing a Stormceptor hydrodynamic separator water quality unit and a Cultec isolator row in the detention system. The area near the fuel tank will be graded so that any small spills during fuel deliveries will drain to the water quality unit and can be captured and held until they can be disposed of off-site with the closure of a valve. Other paved areas will be directed to the detention system for water quality treatment via the separator row of chambers.
- The new fuel tank will meet modern standards, including a double walled tank and interstitial monitoring and will be easier to inspect. The area around the fuel tank is graded to drain to a single catch basin equipped with a shutoff valve to contain any potential spill prior to entering the existing piped drainage system that discharges to the Merrimack River.

The design includes erosion and sedimentation control plans during construction and operation and maintenance plans for the site and proposed BMPs. The proposed development provides an upgraded fuel tank system, a more efficient access to the fuel tank, and utilizes stormwater BMPs to improve water quality treatment and the protection of the wetland resource areas and the Merrimack River.

Narrative – Existing Conditions

The existing site is located southeast of the Merrimack River and northwest of Front Street and the MBTA Haverhill Line Commuter Rail. The site is approximately 7.65 acres and generally slopes south to north from a high elevation of approximately 37 feet to the Merrimack River. The site is in two Zoning Districts that split the parcel in half, Business Park in the northeast and Residential High Density in the southwest of the site. The site is currently developed and contains five (5) buildings operating together as the Merrimack Valley Transit (MeVa) Headquarters Complex including: offices, employee parking, storage, bus parking, fueling and maintenance of vehicles.

On site soils are listed as 602 Urban Land; 230B Unadilla very fine sandy loam, 3 to 8 percent slopes; 651 Udorthents, smoothed; 406D Charlton fine sandy loam, 15 to 25 percent slopes, very stony; and 230B Most of the proposed development takes place in 602 Urban Land soils with a small portion in the 230B Unadilla soils to the west. The complete USDA NRCS soil report is in the Appendices.

Under existing conditions, the stormwater runoff near the proposed limit of work is collected in a piped system or flows overland and outlets to the Merrimack River.

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Soil Map—Essex County, Massachusetts, Northern Part MEVA

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1	Water	0.1	2.8%
230B	Unadilla very fine sandy loam, 3 to 8 percent slopes	0.6	12.0%
602	Urban land	2.7	54.1%
651	Udorthents, smoothed	1.5	31.0%
Totals for Area of Interest		4.9	100.0%

Natural Resources Conservation Service
Web Soil Survey
National Cooperative Soil Survey

The wetland resource areas on site are Bank, Bordering Land Subject to Flooding(BLSF), and Riverfront Area all associated with the Merrimack River. The 100-year floodplain (BLSF) is shown on the FEMA FIRM Map Number 25009C0089H, effective date July 8, 2025, at an elevation of 23.1 feet.

The most up to date Priority and Estimated Habitats maps (15th Natural Heritage Atlas, August 1, 2021) published by the Natural Heritage and Endangered Species Program (NHESP) maps were reviewed online using Massmapper. There are NHESP Estimated Habitats of Rare Wildlife and Priority Habitats of Rare Species on-site. The proposed work is entirely outside the mapped Priority and Estimated habitats in a previously developed area and will not impact the habitats.

Narrative – Proposed Conditions

MeVa proposes replacing an aging 20,000-gallon underground fuel tank with a modern above-ground 20,000 gallon tank and paved access drive. The new tank provides modern safety features and will be easier to inspect. The access drive is designed to accommodate fuel truck delivery to the tank while not impeding the bus traffic. A new eleven (11) space paved employee parking area is proposed near to the proposed fuel tank.

The new fuel tank construction will provide many benefits to the site and wetland resource areas.

- The new fuel tank will meet modern standards, including a double walled tank and interstitial monitoring and will be easier to inspect. The area around the fuel tank is graded to drain to a single catch basin equipped with a shutoff valve to contain any potential spill prior to entering the existing piped drainage system that discharges to the Merrimack River.
- The above ground tank will be located further from the wetland resource areas in an already developed area;
- Access to the new tank will not interrupt bus circulation and will allow the use of a tanker, reducing the frequency of deliveries.
- Water quality will be improved by installing a Stormceptor hydrodynamic separator water quality unit and a Cultec isolator row in the detention system. The area near the fuel tank will be graded so that any small spills during fuel deliveries will drain to the water quality unit and be captured and held until they can be disposed of off-site. Other paved areas will be directed to the detention system for water quality treatment.

The driveway to the tank was designed for delivery tankers to efficiently access tank without impeding the bus traffic at the site. The access drive will also provide needed employee parking. The location of the access drive and parking is in an area that is mostly concrete pads, broken concrete and steep grassed areas that are regularly mowed. Existing site grading makes a retaining wall necessary along the southern property line abutting the MBTA property to the south. The entire area is outside the Natural Heritage Estimated habitats of Rare Wildlife and Species and provides insignificant beneficial habitat.

To mitigate stormwater runoff generated due to the increase in impervious area, a subsurface stormwater chamber system with an isolator row is proposed to collect, treat, and detain stormwater runoff from the expanded parking area. Due to on-site ledge, infiltration is not feasible. A hydrodynamic water quality treatment unit is proposed to treat the stormwater runoff entering the detention system. All proposed work within the wetland resource areas (riverfront) takes place in previously impacted locations.

The proposed development incorporates stormwater management Best Management Practices (BMPs) that did not previously exist at the site and provides a higher level of stormwater runoff water quality treatment.

Stormwater Management

A stormwater management system has been designed to control the net peak discharge of stormwater flowing from the site at or below the existing rates and to meet MassDEP Stormwater Management Policy Standards. A hydrologic analysis was performed, using the HydroCAD computer program to assess the existing conditions and to design mitigation measures and improvements to the site under proposed conditions. An overall catchment was designed to investigate the impacts downgradient of the proposed development. The existing and proposed catchment was divided into subcatchments to model areas that drained to different parts of the site. An analysis point was set to combine these subcatchments to provide a comparative evaluation of the net peak discharge rates.

Existing Conditions

The area of the site impacted by construction is modelled as three (3) subcatchments.

Subcatchment 1E is the westernmost area of the catchment. It contains some of the paved driveway ramp from the MBTA property, rooftop, paved area on-site, a portion of an on-site concrete pad and grass areas. Stormwater runoff from Subcatchment 1E flows overland towards the Merrimack River.

Subcatchment 2E is the area south of the existing service building. It contains some of the paved driveway ramp from the MBTA property, rooftop, paved area on-site, a portion of an on-site concrete pad and grass areas. Subcatchment 2E flows to catch basin 5B and then travels via a piped system to the Merrimack River.

Subcatchment 3E is the easternmost area of the catchment. It contains paved areas on-site, rooftop, the concrete pad over the existing fuel tank and grass areas. Stormwater runoff from Subcatchment 3E flows overland towards the Merrimack River

Reach 1R is the same analysis point used in the existing conditions model that combines the subcatchment flows to provide a net peak discharge to be used in a comparative analysis of the pre- and post-development net peak discharge rates.

Proposed Conditions

The area of the site impacted by construction is modelled as four (4) subcatchments. A subsurface chamber detention system was modelled as 1P. Existing catch basin 5B is converted to a manhole and is modelled as CB2P.

Subcatchment 1S is the westernmost area of the catchment. It contains some of the paved driveway ramp from the MBTA property, rooftop, paved area on-site, and grassed areas. Stormwater runoff from Subcatchment 1S flows overland towards the Merrimack River.

Subcatchment 2S is an area south of the existing service building. It contains rooftop, paved parking, and landscape areas. Subcatchment 2S flows to a new catch basin, is directed to a hydrodynamic water quality unit, then travels via the existing piped system to the Merrimack River.

Subcatchment 2B is an area south of the existing service building. It contains rooftop, paved parking, and landscape areas. Subcatchment 2B flows to the converted DMH(CB5) and then travels via the existing piped system to the Merrimack River.

Subcatchment 3S is the easternmost area of the catchment. It contains rooftop, paved areas on-site, and landscaped areas on-site. Stormwater runoff from Subcatchment 3S flows overland towards the Merrimack River. Some of the runoff enters the existing piped drainage system.

Pond 1P is the proposed subsurface detention chamber system in the HydroCAD model. The detention system comprises twenty-two (22) chambers surrounded by stone. The chamber system includes an "isolator row" that provides total suspended solid removal. The detention system discharges to an outlet control structure that is a manhole structure with a weir wall designed with an orifice and an overflow to detain runoff and control the outlet flow rate from the system.

Pond 2P is the catch basin converted to a manhole in the HydroCAD model.

Reach 1R is the analysis point that combines the subcatchment flows to provide a net peak discharge to be used in a comparative analysis of the pre- and post-development net peak discharge rates.

This design complies with the MassDEP stormwater management standards and incorporates BMPs consistent with low impact development (LID) and concepts emphasized in LID design.

BMP's and LID concepts utilized:

- Stormwater Detention Chambers collecting rooftop runoff and overflow from pavement.
- Cultec Isolator Row for Pre-treatment to the detention system

Documenting Compliance

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

No new untreated outfalls are proposed.

Standard 2 - Stormwater management systems shall be designed so that the post-development peak discharge rates do not exceed pre-development peak discharge rates…To prevent storm damage and downstream and off-site flooding, Standard 2 requires that the post-development peak discharge rate is equal to or less than the pre-development rate from the 2-year and the 10-year 24-hour storms…Proponents must also evaluate the impact of peak discharges from the 100-year 24-hour storm. If this evaluation shows that increased off-site flooding will result from peak discharges from the 100-year 24-hour storms, BMPs must also be provided to attenuate these discharges.

The Massachusetts Stormwater Handbook states this Standard may be waived for discharges to land subject to coastal storm flowage as defined in 310 CMR 10.04 (below).

> *Land Subject to Coastal Storm Flowage means land subject to any inundation caused by coastal storms up to and including that caused by the 100-year storm, surge of record or storm of record, whichever is greater.*

The Merrimack River abutting the site is subject to coastal flooding. On-site Land Subject to Coastal Storm Flowage is shown on the plans as the 100-Year Flood Line at elevation 23.1. The site discharges to Land Subject to Coastal Storm Flowage. While this Standard could be waived, a subsurface detention system has been designed to mitigate the net peak discharge rates below the pre-development rates for the design storms.

A hydrologic analysis was performed, using the HydroCAD computer program, in accordance with MassDEP standards to assess the existing net peak discharges and to size the infiltration system. The rainfall events used in the analysis were obtained from The NOAA Atlas 14 Point Precipitation Frequency Estimates for Groveland, Massachusetts, Station ID 19-3276. The NOAA Atlas 14 data is provided in the Appendices. The project meets the MassDEP Stormwater Standards that require the 2- and 10-year net peak discharges not be increased, and the 100-year storm event to not cause off-site flooding.

The table below show the HydroCAD analysis results, indicating no increase in the 1-yr 6-hour and , 2-, , 10-, 25-, and 100-yr 24-hour storm events.

Analysis Point 1R

Storm Recurrence	**Storm Depth Inches**	**Existing Peak Discharge(cfs)**	**Proposed Peak Discharge (cfs)**
2-year 24-hour	3.19	2.76	2.46
10-year 24-hour	5.05	4.65	4.13
25-year 24-hour	6.21	5.81	5.15
100-year 24-hour	7.99	7.59	6.70

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

For purposes of Standards 3 and 4, impervious surfaces include roads, rooftops, parking lots, and sidewalks, when they are paved with concrete, asphalt, or brick pavers. (Volume 3, Chapter 1, Page 15)

Ledge was encountered on-site in the area of the proposed work. Installation of the subsurface detention system will require removal of ledge. Infiltration is not feasible in the area of the proposed work.

Standard 4 - Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS).

For purposes of Standards 3 and 4, impervious surfaces include roads, rooftops, parking lots, and sidewalks, when they are paved with concrete, asphalt, or brick pavers. (Volume 3, Chapter 1, Page 15)

BMP Water Quality Volume Sizing:

The Required Water Quality Volume for the SWMP is calculated using 1" over the impervious area on the site. A - 1-inch calculation is used because the site can be considered a Land Use with Higher Potential Pollutant Loads.

The site is an existing developed site with existing water quality treatment that includes vegetative buffers to the Merrimack River, deep sump catch basins and ongoing maintenance of the parking areas. The proposed work has been sited to maximize the distance from the Merrimack River and its associated wetland resource areas, including the FEMA 100-year floodplain. It is not practical to provide additional treatment outside the proposed limit of work. There is limited land on-site outside the FEMA 100-year floodplain. Additional treatment measures would likely cause additional impacts to the Riverfront Area and be closer to the Merrimack River.

Some of the impervious area included in the drainage analysis flows to the site from the abutter's property to the south.

The total existing on-site impervious area modelled = 23,323 sq. ft.
The total proposed on-site impervious area modelled = 24,241 sq. ft.
The net increase in impervious area within the limit of work is 918 sq. ft.

Required Water Quality Volume (WQV)
Recharge WQV = 1.0-inch x 24,241 sq.ft. impervious
Required Recharge WQV = 24,241 sq.ft. x 1.0 inches x 1ft/12in = 2,020 cubic feet required

The HydroCAD analysis 2-year storm event was reviewed to confirm the water quality volume was achieved during smaller storm events. The HydroCAD output file indicates x cubic feet are treated by the isolator row and Stormceptor water quality unit. The results are shown in the table below.

WQV Treatment Volume

Treatment BMP	**Contributing Subcatchment**	**Runoff Volume Generated (CF)**
Stormceptor	2S	2,246
Isolator Row	2B	1,468
Total Treated VolumeVolume		**3,714**

The total WQV provided = 3,714 c.f. provided is greater than the 2,020 c.f. required.

TSS Removal

The site is an existing developed site with no apparent water quality treatment besides deep sump catch basins and ongoing maintenance of the parking areas.

TSS Removal for the project is addressed by providing a Cultec Isolator Row to treat the runoff from the parking area that is collected in the detention basin and a Stormceptor Water Quality Unit that treats the runoff collected in the new catch basin. Both these BMPs provide 80% TSS removal. Documentation of the Cultec Isolator Row and Stormceptor TSS removal rates is attached in the Appendices. Additional treatment outside the proposed limit of work is not practical

Detention Chambers:

	BMP Utilized	Removal Rate	Remains
Treatment	Detention Chambers with Cultec Separator Row Pre-treatment	80%	20%
Final Rate		**80% Total Removed**	

New Catch Basin:

	BMP Utilized	Removal Rate	Remains
Treatment	Stormceptor Water Quality Unit	80%	20%
Final Rate		**80% Total Removed**	

80% TSS Removal is achieved for the proposed work.

The proposed stormwater management system meets SWMP Standard 4 requirement for to provide a 1" infiltration storage volume for impervious areas under proposed conditions within the limits of work.

Standard 5 - For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable. If through source control and/or pollution prevention all land uses with higher potential pollutant loads cannot be completely protected from exposure to rain, snow, snow melt, and stormwater runoff, the proponent shall use the specific structural stormwater BMPs determined by the Department to be suitable for such uses as provided in the Massachusetts Stormwater Handbook. Stormwater discharges from land uses with higher potential pollutant loads shall also comply with the requirements of the Massachusetts Clean Waters Act, M.G.L. c. 21, §§ 26-53 and the regulations promulgated thereunder at 314 CMR 3.00, 314 CMR 4.00 and 314 CMR 5.00.

The project qualifies as a LUHPPL. Additional treatment measures for water quality treatment have been incorporated into the site design including a Stormceptor Hydrodynamic Separator and Cultec Isolator Row.

Standard 6 - Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply, and stormwater discharges near or to any other critical area, require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook. A discharge is near a critical area if there is a strong likelihood of a significant impact occurring to said area, taking into account site-specific factors. Stormwater discharges to Outstanding Resource Waters and Special Resource Waters shall be removed and set back from the receiving water or wetland and receive the highest and best practical method of treatment. A "storm water discharge" as defined in 314 CMR 3.04(2)(a)1 or (b) to an Outstanding Resource Water or Special Resource Water shall comply with 314 CMR 3.00 and 314 CMR 4.00. Stormwater discharges to a Zone I or Zone A are prohibited unless essential to the operation of a public water supply.

This site does not discharge within a Zone II, IWPA, or near to any critical area.

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

The project does not qualify as a Redevelopment Project. The increase in impervious area of 918 sq. ft. is not significant and water quality and discharge rates comply with the SWM Standards for the work proposed. This is an improvement over the existing conditions, which do not address the SWM Standards to the extent that is proposed.

Standard 8 - A plan to control construction-related impacts including erosion, sedimentation and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) shall be developed and implemented.

See site plans attached with this application that include measures to control erosion, sediment and other pollutants during construction. The proposed work disturbs less than an acre, therefore an EPA Construction General Permit is not required.

Standard 9 - A long-term operation and maintenance plan shall be developed and implemented to ensure that stormwater management systems function as designed.

See the Operation and Maintenance Plan included in this document.

Standard 10 - *All illicit discharges to the stormwater management system are prohibited*.

Illicit Discharge Compliance Statement

To the best of my knowledge no illicit discharges currently exist on the site and no future illicit discharge will be allowed, including wastewater discharges and discharges of stormwater contaminated by contact with process waste, raw materials, toxic pollutants, hazardous substances, oil, or grease.

_____

Signature of Owner Date

To be completed and submitted prior to the start of construction.

Stormwater Operation and Maintenance Plan - Long Term Pollution Prevention

Ongoing maintenance is required for the proper function of the stormwater management system allowing the system to prevent pollution for the long term. This document provides a guideline for this work and allows for record keeping.

Stormwater Management System Owner: Merrimack Valley Transit _____
Signature/date

Party Responsible for Maintenance: Merrimack Valley Transit _____
Signature/date

Snow Removal

Snow removal from parking areas will be the responsibility of the property owner.

Site Specific BMP Maintenance Plans

(Reference MADEP Volume 2, Chapter – Structural BMP Specifications for the Massachusetts Stormwater Handbook)

Detention Chambers

Follow manufacturer's recommended Inspection and maintenance program (see attached manufacturer's information). Inspect detention chambers at least once per year to ensure that the basins are operating as intended. Inspect detention chambers during and after major storms to determine if the chambers are meeting the expected detention times. Examine the outlet structure for evidence of clogging or outflow release velocities that are greater than design flow. Potential problems that should be checked include: subsidence, erosion, cracking, or tree growth on or near the chambers; sediment accumulation around the outlet; inadequacy of the inlet/outlet channel erosion control measures; and erosion or sedimentation at the inlets. Make any necessary repairs immediately. During inspections, note any changes to the detention chambers or the contributing watershed, because these could affect chamber performance. Also remove trash and debris at this time. Remove sediment from the chambers as necessary, but at least once every 5 years. See attached Cultec Separator Row Operation and Maintenance Guide.

Stormceptor

See attached Stormceptor Inspection and Maintenance Information.

Gate Valve Shut Off

The gate valve should remain in the "open" position under normal conditions. Inspect Gate Valve twice a year.

- Exercise the valve: Open the valve fully open and then fully closed a few times to prevent it from sticking or seizing, which can happen from disuse.
- Clean sediment that may impede the closing of the valve.
- Clean the valve stem and apply a spray lubricant (like silicon grease) to the valve stem.

Stormwater BMP Inspection and Maintenance Log

(print a log for each BMP and maintain a log book for the project)

BMP:_____

Date	Inspector	Issues Observed	Corrective Action Taken	Notes

Stormceptor® STC
Inspection and Maintenance Information

Stormceptor® Inspection and Maintenance

Regular inspection and maintenance is a proven, cost-effective way to maximize water resource protection for all stormwater pollution control practices, and are required to insure proper functioning of the Stormceptor System. Both inspection and maintenance of the Stormceptor system is easily performed from the surface. Stormceptor's patented technology has no moving parts, simplifying the inspection and maintenance process.

Please refer to the following information and guidelines before conducting inspection and maintenance activities.

When is inspection needed?

- Post-construction inspection is required prior to putting the Stormceptor System into service.
- Routine inspections are recommended during the first year of operation to accurately assess the sediment accumulation.
- Specifically for New Jersey installations, regulations require all BMPs to be inspected a minimum four times per year and after every storm with greater than one inch of rainfall.
- Inspection frequency in subsequent years is based on the maintenance plan developed in the first year.
- Inspections should also be performed immediately after an oil, fuel or other chemical spill.

When is maintenance cleaning needed?

- For optimum performance, the unit should be cleaned out once the sediment depth reaches 15% of the unit's total storage capacity (see Table 1). Generally, the minimum cleaning frequency is once annually, although the frequency can be based on historical inspection results.
- The unit should be cleaned out immediately after an oil, fuel or chemical spill.

Table 1

Sediment Maintenance Depth* and Oil Capacity		
STC Model	**Sediment Depth*** (inches)	**Oil Capacity** (gallons)
450i	8	86
900	8	251
1200	10	251
1800	15	251
2400	12	840

3600	17	840
4800	15	909
6000	18	909
7200	15	1059
11000	17	2797
13000	20	2797
16000	17	3055
* based on 15% of the lower chamber volume		

What conditions can compromise the Stormceptor System performance?

- If the system is not maintained regularly and fills with sediment and debris beyond the capacity indicated in Table 1, sediment removal efficiency may be reduced.
- If an oil spill(s) exceeds the oil capacity of the system, subsequent spills may not be captured.
- If debris clogs the inlet of the system, removal efficiency of sediment and hydrocarbons may be reduced.
- If a downstream blockage occurs, a backwater condition may occur in the system and removal efficiency of sediment and hydrocarbons may be reduced.

What training is required?

The Stormceptor System is inspected and maintained by professional vacuum cleaning service providers with experience in the maintenance of underground tanks, sewers and catch basins. For typical inspection and maintenance activities, no specific supplemental training is required for the Stormceptor System. Information provided in this document or the Stormceptor Operation and Maintenance Manual (provided to the system owner) contains sufficient guidance to maintain the system properly.

In unusual circumstances, such as if a damaged component needs replacement or some other condition requires manned entry into the vessel, confined space entry procedures must be followed. Only professional maintenance service providers trained in these procedures should enter the vessel. Service provider companies typically have personnel who are trained and certified in confined space entry procedures according to local, state, and federal standards.

What equipment is typically required for inspection?

- Manhole access cover lifting tool
- Oil dipstick
- Sediment probe
- Flashlight
- Camera
- Data log
- Safety cones and caution tape
- Hard hat, safety shoes, safety glasses, and chemical-resistant gloves

How is the Stormceptor System inspected?

- The Stormceptor System can be inspected through a standard surface manhole

access cover.

- Sediment and oil depth inspections are performed with a sediment probe and oil dipstick. Oil depth is measured through the oil inspection port. Sediment depth can be measured through the oil inspection port or exit riser pipe.
- Inspections also involve a visual inspection of the internal components of the system.

What equipment is typically required for maintenance?

- Vacuum truck equipped with water hose and jet nozzle
- Small pump and tubing for oil removal
- Manhole access cover lifting tool
- Oil dipstick
- Sediment probe
- Flashlight
- Camera
- Data log
- Safety cones and caution tape
- Hard hats, safety shoes, safety glasses, chemical-resistant gloves, and hearing protection for service providers
- Gas analyzer, respiratory gear, and safety harness for specially trained personnel if confined space entry is required

How is the Stormceptor System maintained?

- The Stormceptor System can be maintained through a standard surface manhole access cover.
- Insert the oil dipstick into the oil inspection port. If oil is present, pump off the oil layer into separate containment using a small pump and tubing.
- Maintenance cleaning of accumulated sediment is performed with a vacuum truck.
- For 6-ft diameter models and larger, the vacuum hose is inserted into the lower chamber via the 24-inch outlet riser pipe.
- For 4-ft diameter model, the removable drop tee is lifted out, and the vacuum hose is inserted into the lower chamber via the 12-inch drop tee hole.
- Using the vacuum hose, decant the water from the lower chamber to the sanitary sewer, if permitted by the local regulating authority, or into a separate containment tank.
- Remove the sludge from the bottom of the unit using the vacuum hose.
- Re-fill the lower chamber with water where required by the local jurisdiction.
- Units that have not been maintained regularly, have surpassed the maximum recommended sediment capacity, or contain damaged components may require manned entry by trained personnel using proper confined space entry procedures.

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What is required for proper disposal?

- Disposal requirements for recovered pollutants may vary depending on local guidelines. In most areas the sediment, once dewatered, can be disposed of in a sanitary landfill. It is not anticipated that the sediment would be classified as hazardous waste.

What about oil spills?

- Petroleum-based pollutants captured by the Stormceptor system (oil/chemical/fuel spills) should be removed and disposed of by a licensed waste management company.
- Although Stormceptor captures virtually all free oil, a sheen at the outlet **does not** mean the unit isn't working. A rainbow or sheen can be visible at oil concentrations of less than 10 mg/L (ppm).

What factors affect the costs involved with inspection/maintenance?

- Inspection and maintenance costs are based on unit size, sediment/oil/hazardous material loads, transportation distances, tipping fees, disposal requirements and other local regulations.

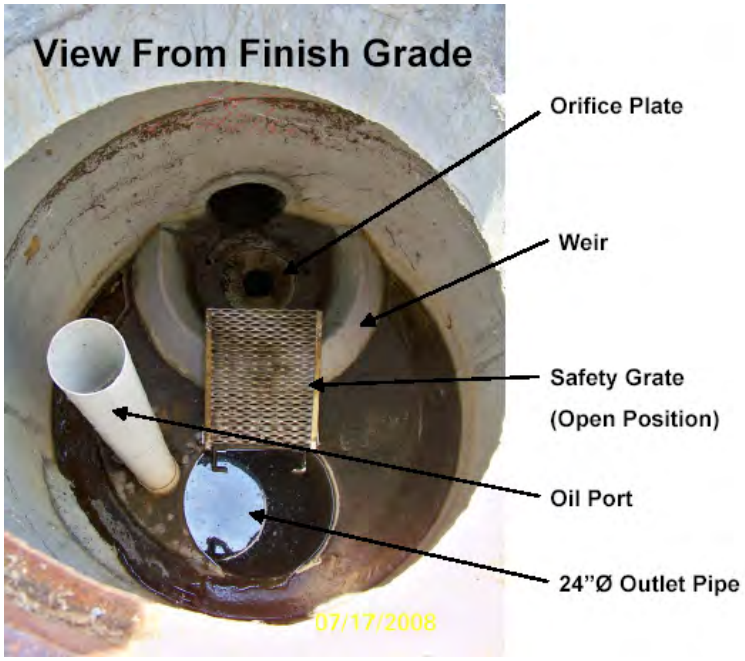
System schematic and component functions

Below is a schematic of the Stormceptor System with key components identified and their functions briefly described.

- **Manhole access cover** – provides access to the subsurface components
- **Precast reinforced concrete structure** – provides the vessel's watertight structural support
- **Fiberglass insert** – separates vessel into upper and lower chambers
- **Weir** – directs incoming stormwater and oil spills into the lower treatment chamber
- **Orifice plate** – controls water flow rate into the lower treatment chamber and prevents scour of accumulated pollutants
- **Inlet drop tee** – conveys stormwater into the lower treatment chamber and splits flow into two opposite tangential streams
- **Fiberglass skirt** – provides double-wall containment of hydrocarbons
- **Outlet riser pipe** – conveys treated water to the upper chamber; primary vactor access port for sediment removal

- **Oil inspection port** – primary access for measuring oil depth and oil removal
- **Safety grate** – safety measure to cover riser pipe in the event of manned entry into vessel

The Stormceptor System has no moving parts to wear out and therefore maintenance activities are generally focused on pollutant removal.



The depth of sediment can be measured from the surface by using a sediment probe or dipstick tube equipped with a ball check valve and inserted through the 24-inch outlet riser pipe. Oil level can similarly be checked through the oil inspection port.

A maintenance worker stationed on the surface uses a vacuum hose to evacuate water, sediment, and debris from the system.

Purchasing replacement parts

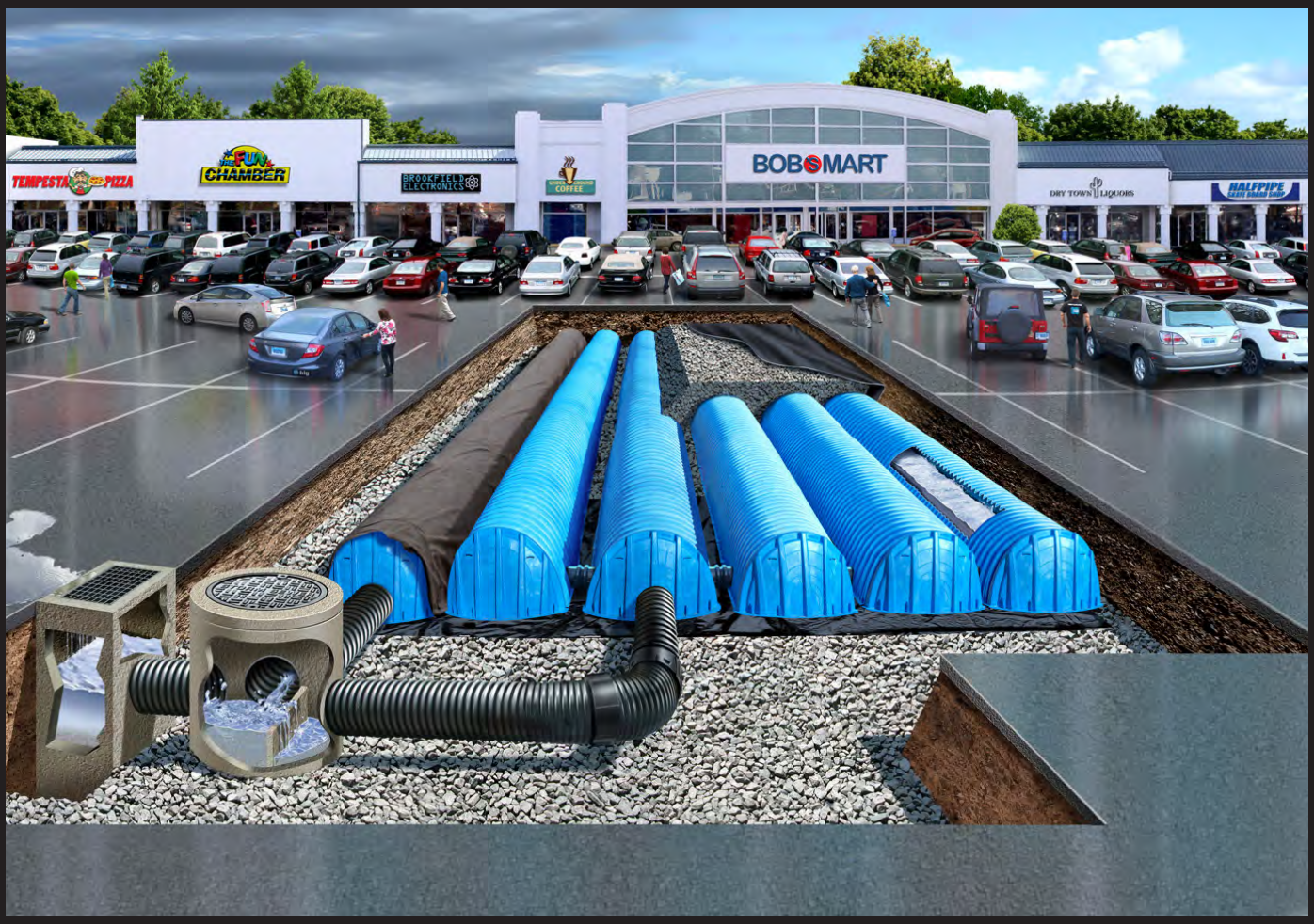
Since there are no moving parts in the Stormceptor System, broken, damaged, or worn parts are not typically encountered. However, if replacements parts are necessary, they may be obtained by contacting the following supplier of authentic Stormceptor components.

Camtek Construction Products Corp.
3481 Treeline Drive
Murrysville, PA 15668
Phone: (724) 327-3400

The benefits of regular inspection and maintenance are many – from ensuring maximum operation efficiency, to keeping maintenance costs low, to the continued protection of natural waterways – and provide the key to Stormceptor's long and effective service life.

CULTEC SEPARATOR™ ROW

WATER QUALITY SYSTEM



OPERATION & MAINTENANCE GUIDE

FOR CULTEC STORMWATER MANAGEMENT SYSTEMS

GLOBE VERIFIED VÉRIFIÉ

STORMWATER MANAGEMENT SOLUTIONS

CULTEC®

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Doc ID: CLT043 02-22
Feb 2022

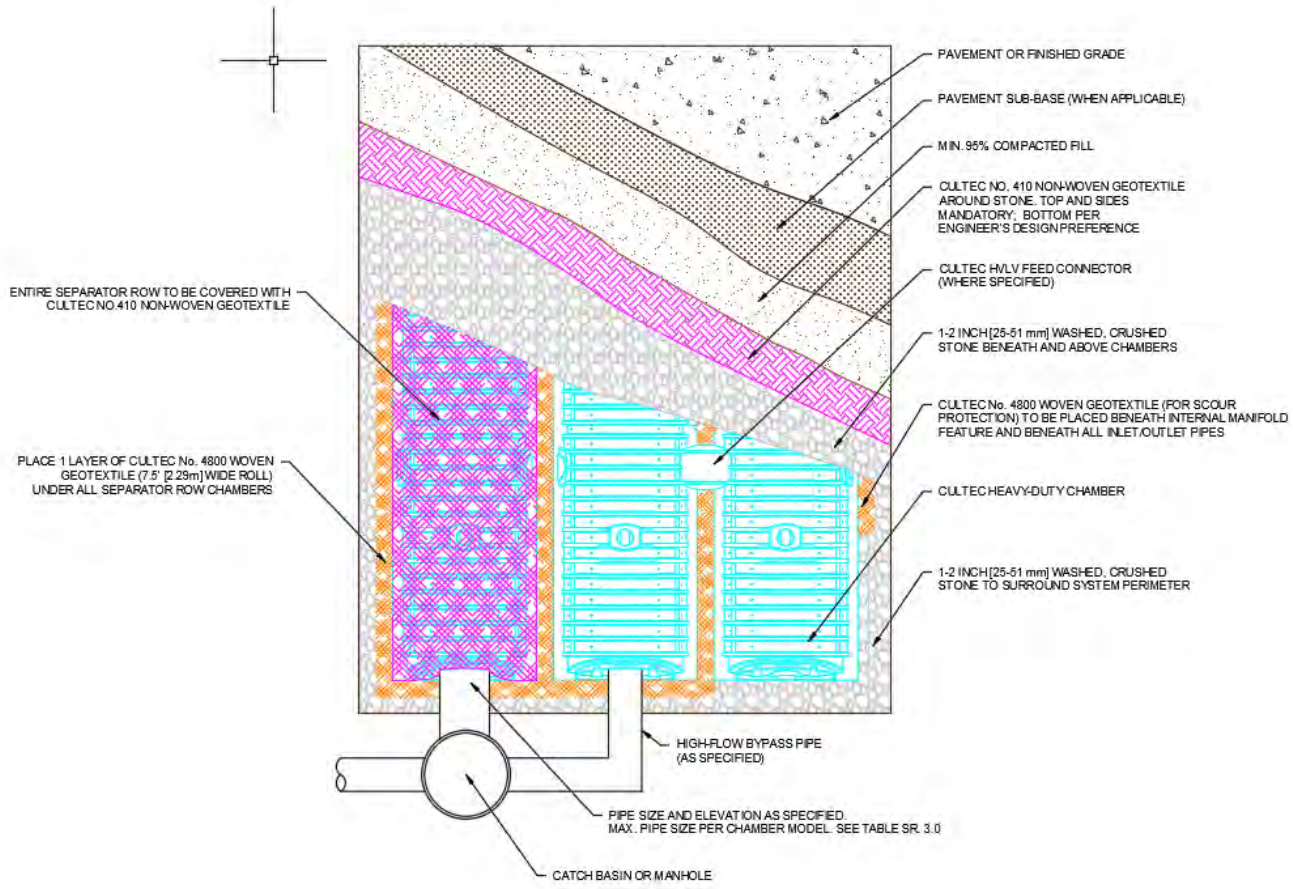
Introduction

CULTEC's Separator™ Row is an inexpensive means of removing Total Suspended Solids from the CULTEC chamber system, as well as providing easier access for inspection and maintenance. The Separator Row is designed to capture the First Flush of a rain event and is typically included as part of the "Treatment Train" for water quality.

The CULTEC Separator Row is a row of CULTEC Contactor or Recharger Chambers that are surrounded on all sides by filter fabric. One layer of CULTEC No. 4800™ Woven Geotextile are placed between the clean foundation stone and the chamber feet. The chambers are then completely wrapped with CULTEC No. 410™ non-woven geotextile. This configuration is designed to trap any sediment and/or debris that may pass through the upstream water-quality structures and into the chamber system.

A manhole is typically located adjacent to the separator row for ease of inspection and maintenance. This manhole is placed upstream of the system and can include a high-flow bypass pipe to pass peak-flows onto adjacent rows of chambers. The upstream manhole is designed with a sump to trap heavier sediment and allow for proper cleaning of the Separator Row. A JetVac process with a high pressure water nozzle is introduced down the Separator Row via the access manhole to clean all sediment and debris from the Separator Row. Captured pollutants are flushed into the sumped access manhole for vacuuming, and the process is repeated until the Separator Row is completely free of sediment and debris.

The Separator Row performance has been tested and verified to the protocols and procedures as defined by Environmental Technology Verification (ETV) Canada to achieve 80% TSS removal.



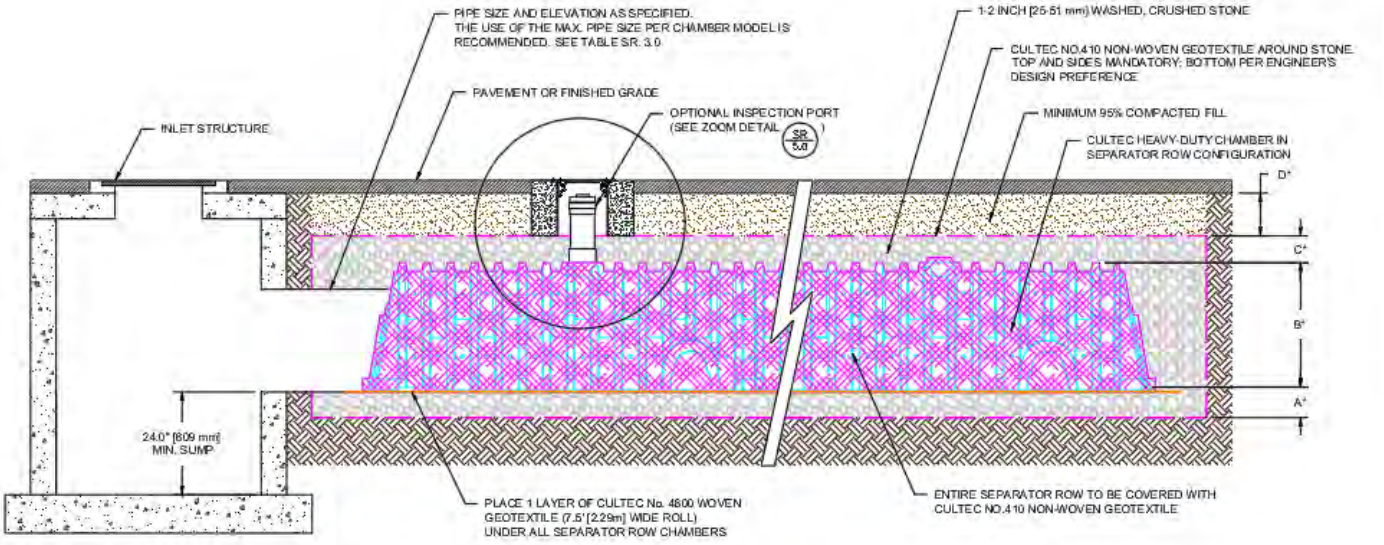
Design

There is no single design to achieve a high level of water quality. The CULTEC Separator Row should be designed as part of an overall best management practices water quality system. Pre-treatment devices such as sump catch basins, inlet baffles and proprietary oil-grit separators and filter systems can all be incorporated upstream of the CULTEC Separator Row. Sumped access/diversion manholes should be installed directly upstream of the Separator Row.

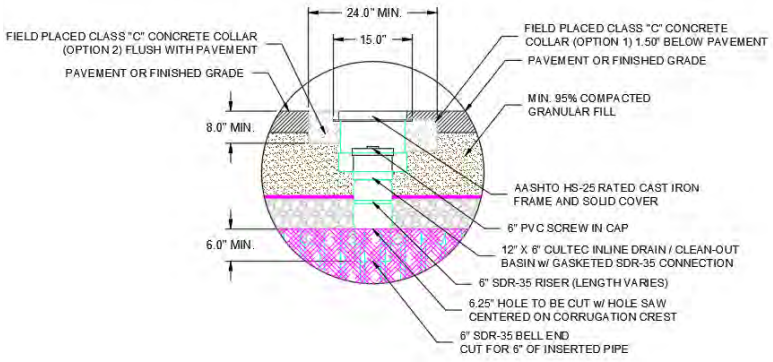
The following is a list of recommended design practices to ensure proper maintenance for the life of the system:

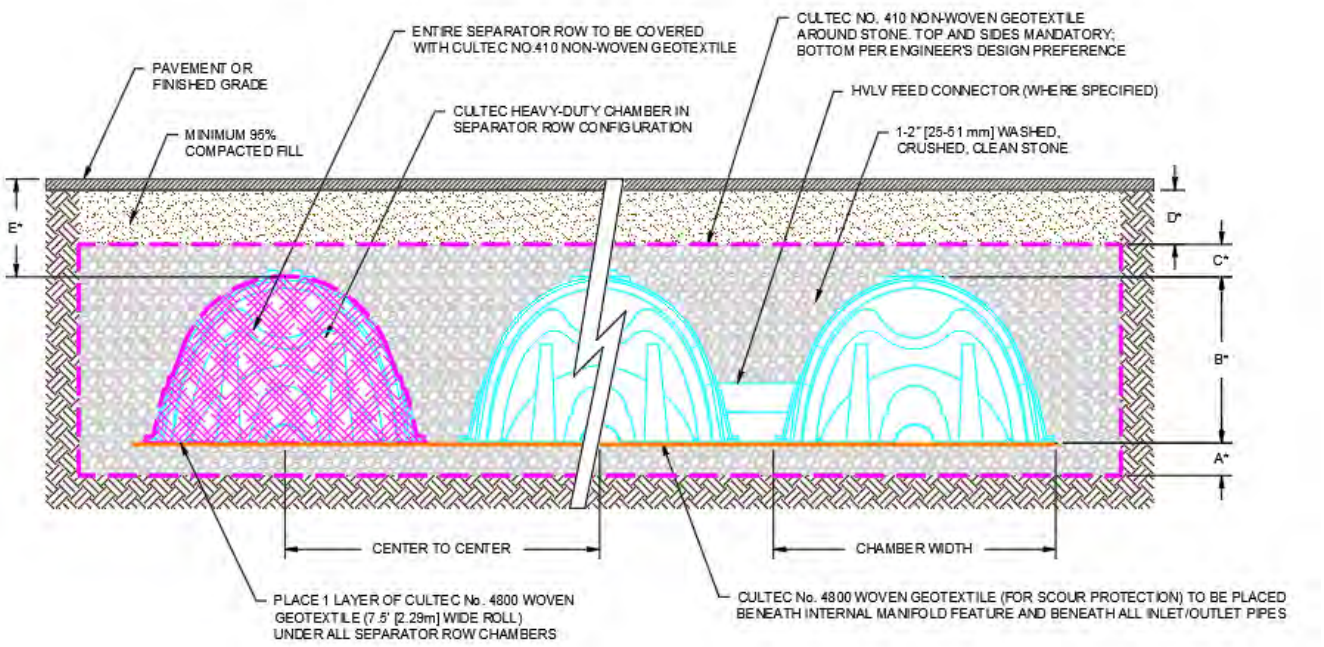
- Install sumped access/diversion manholes, including a minimum 24” (600 mm) sump, directly upstream of the Separator Row.
- Include a high-flow bypass pipe to divert peak flows that exceed the capacity of the Separator Row to adjacent rows.
- Connect the access manhole to the Separator Row with the largest diameter pipe allowable based on the CULTEC chamber model used.
- Maintain a minimum distance between the access manhole and the Separator Row to promote efficient maintenance.
- Include at least one inspection port per Separator Row for periodic inspection.

Note: Typical JetVac maintenance reels have a maximum of 400 feet (121.9 m) of available hose. Consider this when designing the length of the CULTEC Separator Rows.



*SEE SR 3.0 - CROSS SECTION TABLE REFERENCE





*SEE SR 3.0 - CROSS SECTION TABLE REFERENCE

Table SR 3.0

	Description	Contactor 100HD	Recharger 150XLHD	Recharger 280HD	Recharger 330XLHD	Recharger 360HD	Recharger 902HD
A	Min. depth of stone base	6″ 152 mm	6″ 152 mm	6″ 152 mm	6″ 152 mm	6″ 152 mm	9″ 229 m
B	Chamber height	12.5″ 318 mm	18.5″ 470 mm	26.5″ 673 mm	30.5″ 775 mm	36″ 914 mm	48″ 1219 mm
C	Min. depth of stone required above units for traffic applications	6″ 152 mm	6″ 152 mm	6″ 152 mm	6″ 152 mm	6″ 152 mm	12″ 305 mm
D	Min. depth required of 95% compacted fill for paved traffic application	8″ 203 mm	8″ 203 mm	8″ 203 mm	10″ 254 mm	12″ 305 mm	12″ 305 mm
E	Max. depth of cover allowed above crown of chamber	12′ 3.65 m	12′ 3.65 m	12′ 3.65 m	12′ 3.65 m	12′ 3.65 m	8.5′ 2.59 m
	Max. allowable pipe size into chamber end wall/end cap	10″ 250 mm	12″ 300 mm	18″ 450 mm	24″ 600 mm	24″ 600 mm	24″ 600 mm

Inspection and Maintenance

CULTEC recommends inspection of the Separator Row to be performed every six months for the first year of service. Future inspection frequency can be adjusted based upon previous inspection observations. However annual inspections are recommended. Inspection of the Separator Row can be achieved via an inspection port riser installed during construction. This inspection port riser will connect the top of the Separator Row chambers to finished grade with a removable lid. Alternatively the Separator Row may be inspected via the manhole(s) located at the end(s) of the Separator Row. However this method of inspection requires confined space entry. If entry into the manhole is required, all local and OSHA rules for confined space entries must be strictly followed.

To inspect:

- Remove the inspection port lid from the floor box frame.
- Remove the riser pipe cap.
- With a flashlight and stadia rod, measure the depth of sediment.
- Record results in a maintenance log.
- When depth of sediment exceeds 3” (76 mm), use the JetVac procedure described below.

The JetVac process utilizes a high pressure water nozzle controlled from the surface. The high pressure nozzle is introduced down the Separator Row via the access manhole(s). The high pressure water cleans all sediment and debris from the Separator Row as the nozzle is retrieved. Captured pollutants are flushed into the sumped access manhole for vacuuming. This process is repeated until the Separator Row is completely free of sediment and debris. A small diameter culvert cleaning nozzle is recommended for this procedure.

High pressure water nozzle

Cleaning Separator Row and pipes with high pressure water nozzle

SEPARATOR ROW: Separator Row prior to cleaning

ADJACENT ROW: When the Separator Row is working properly, the adjacent rows will not show signs of sediment.

Inspection and Maintenance Record

Date	Mode of Access	Frequency	Depth of Sediment	Actions	Expenses	Inspector	Notes
Ex.	Inspection Port	Semi-annually	2″	Measure sediment depth with stadia rod. Visually inspect	$100	DPG	Depth of Sediment was measured via Northeast Inspection Port Adjacent to MH-1. Sediment depth was found to be 2″. No further action required at this time.
Ex.	Access Manhole	Annually					

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P: (203) 775-4416 • Toll Free: 1(800) 4-CULTEC • www.cultec.com

RETENTION • DETENTION • INFILTRATION • WATER QUALITY

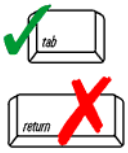
MADEP Stormwater Checklist

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

Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

---

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature

Susan Carter 12/12/25

Signature and Date

Checklist

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

☐ New development

☐ Redevelopment

☒ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Ledge was encountered within the limits of work Infiltration is not feasible.

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 does not disturb >1 acre.

☐ 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.

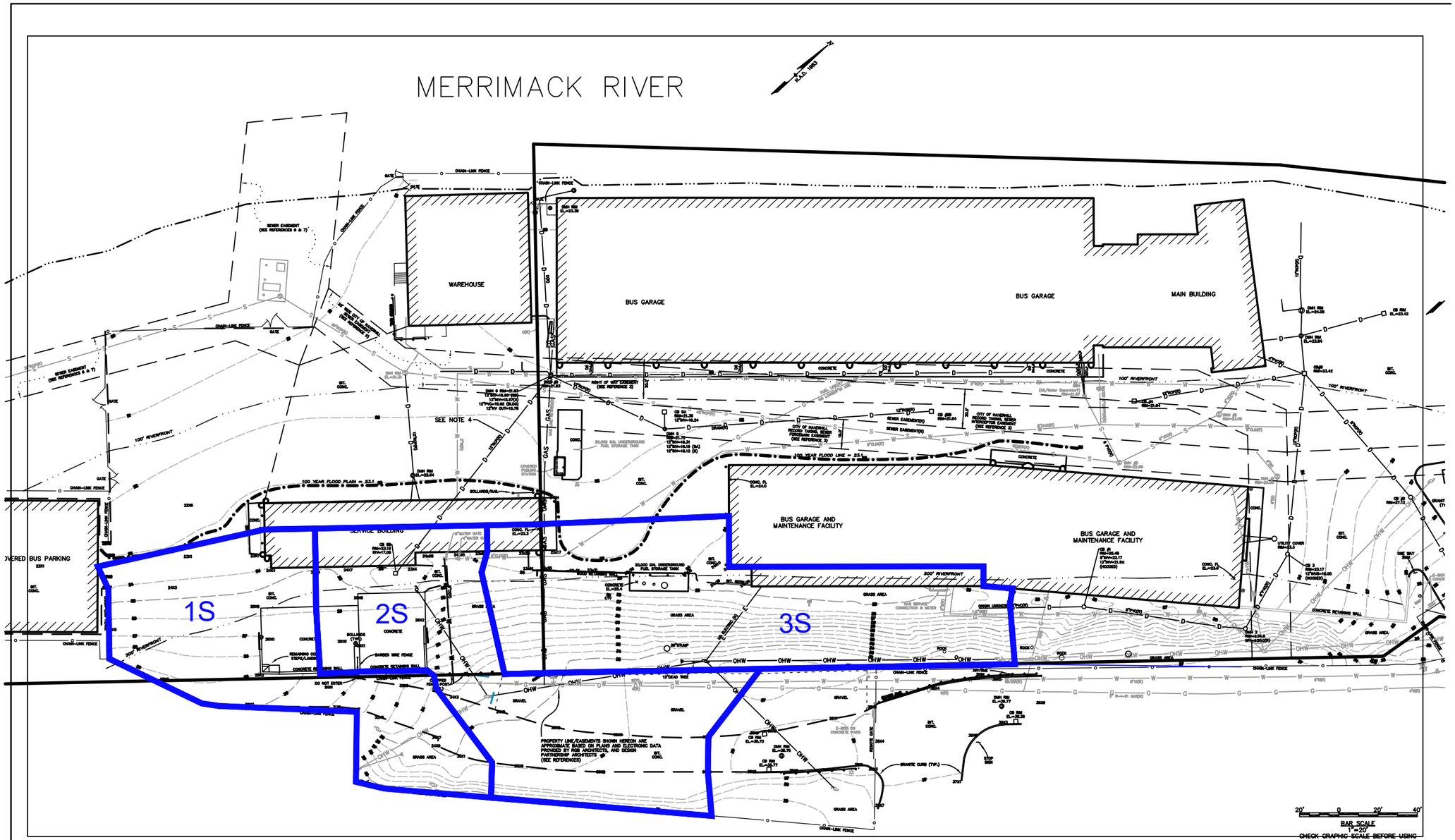
Standard 10: Prohibition of Illicit Discharges

☒ 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.

HydroCAD Map
Existing Conditions



Certification

Drawn by Author

Checked by Checker

Revised on

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Project

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FUEL TANK RELOCATION AND RETAINING WALL

MeVa Merrimack Valley Transit

123 RAILROAD AVE.
HAVERHILL, MA 01835

Drawing Status
100% FOR REVIEW

Issued On 3/27/2025

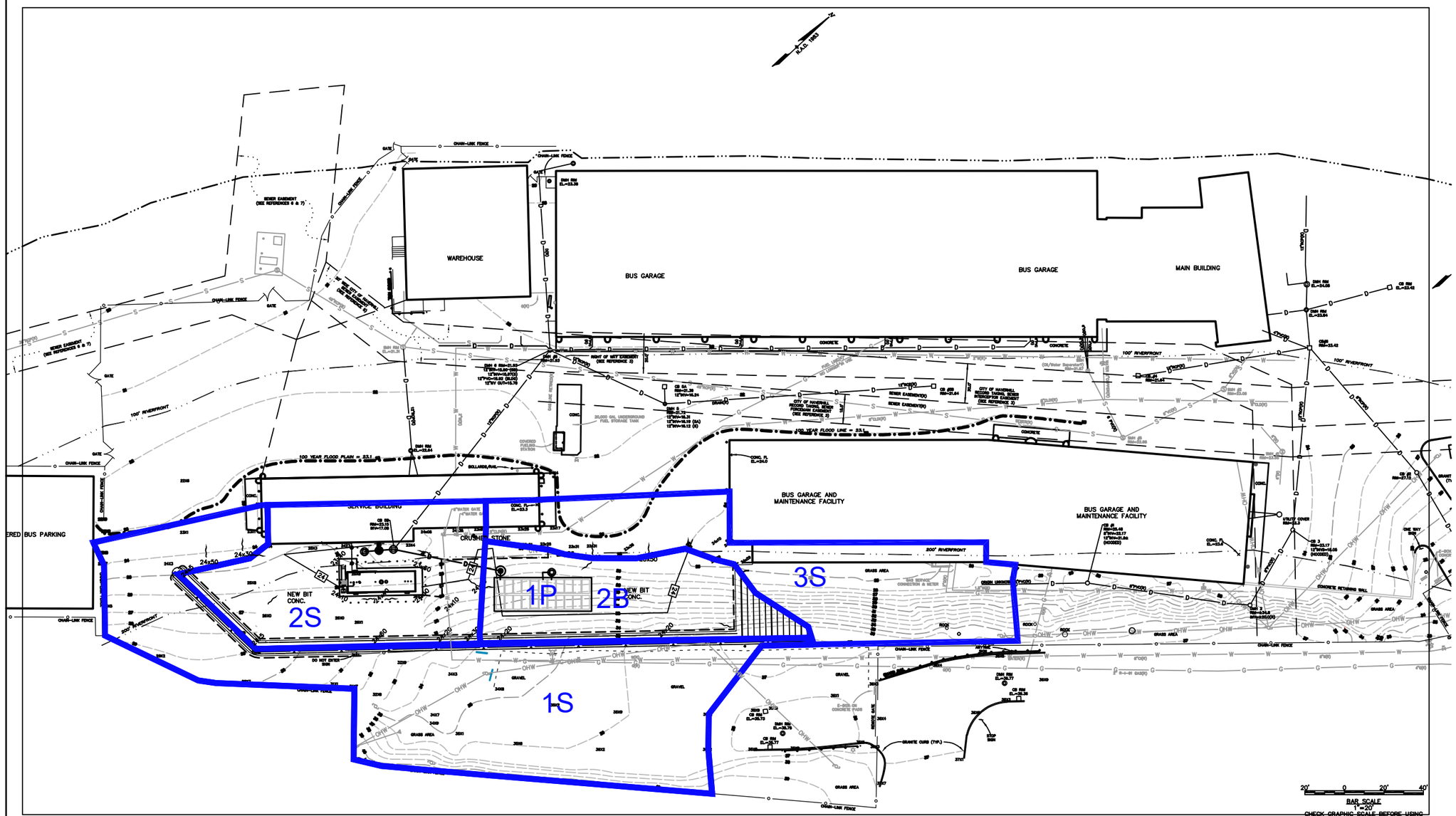
Sheet Contents
EXISTING CONDITIONS HYDROCAD PLAN

Project Number. 6859

Drawing No.
A000

Sheet of

HydroCAD Map
Proposed Conditions



Certification

Drawn by Author

Checked by Checker

Revised on

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Project

MERRIMACK VALLEY REGIONAL TRANSIT AUTHORITY

FUEL TANK RELOCATION AND RETAINING WALL

123 RAILROAD AVE.
HAVERHILL, MA 01835

Drawing Status
100% FOR REVIEW

Issued On 3/27/2025

Sheet Contents
PROPOSED CONDITIONS HYDROCAD PLAN

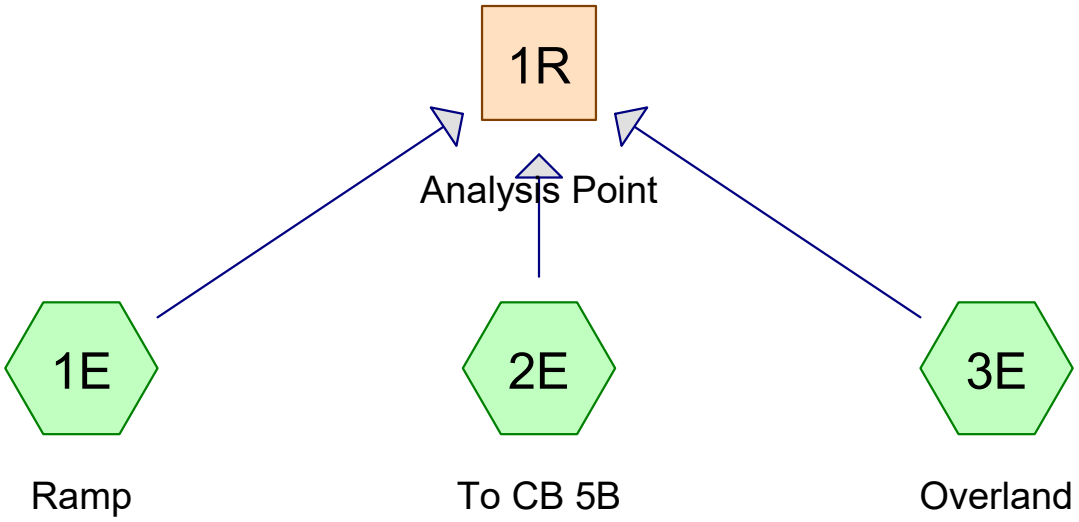
Project Number. 6859

Drawing No.
A100

Sheet of

HydroCAD Data
Existing Conditions Output

Existing Conditions 25-Year 24-hour Storm Detailed



Subcat Reach Pond Link

Routing Diagram for MeVa Drainage- PRE REV1
Prepared by Places Associates, Inc, Printed 12/10/2025

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	25-yr	Type III 24-hr		Default	24.00	1	6.21	2

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
44,202	HSG C	1E, 2E, 3E
0	HSG D	
0	Other	
44,202		**TOTAL AREA**

Summary for Subcatchment 1E: Ramp

Runoff = 1.63 cfs @ 12.09 hrs, Volume= 5,357 cf, Depth> 5.28"
Routed to Reach 1R : Analysis Point

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.21"

Area (sf)	CN	Description
10,092	98	Paved parking, HSG C
2,093	79	50-75% Grass cover, Fair, HSG C
12,185	95	Weighted Average
2,093		17.18% Pervious Area
10,092		82.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, 6 minutes minimum**

Summary for Subcatchment 2E: To CB 5B

Runoff = 2.00 cfs @ 12.09 hrs, Volume= 6,399 cf, Depth> 4.98"
Routed to Reach 1R : Analysis Point

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.21"

Area (sf)	CN	Description
10,892	98	Paved parking, HSG C
4,525	79	50-75% Grass cover, Fair, HSG C
15,417	92	Weighted Average
4,525		29.35% Pervious Area
10,892		70.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, 6 minutes minimum**

Summary for Subcatchment 3E: Overland

Runoff = 2.18 cfs @ 12.09 hrs, Volume= 7,030 cf, Depth> 5.08"
Routed to Reach 1R : Analysis Point

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.21"

Area (sf)	CN	Description
11,909	98	Paved parking, HSG C
4,691	79	50-75% Grass cover, Fair, HSG C
16,600	93	Weighted Average
4,691		28.26% Pervious Area
11,909		71.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, 6 minutes minimum**

Summary for Reach 1R: Analysis Point

Inflow Area = 44,202 sf, 74.42% Impervious, Inflow Depth > 5.10" for 25-yr event
Inflow = 5.81 cfs @ 12.09 hrs, Volume= 18,787 cf
Outflow = 5.81 cfs @ 12.09 hrs, Volume= 18,787 cf, Atten= 0%, Lag= 0.0 min

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

Existing Conditions 2-, 10- and 100-Year 24-hour Storm

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1E: Ramp Runoff Area=12,185 sf 82.82% Impervious Runoff Depth>2.49"
Tc=6.0 min CN=95 Runoff=0.80 cfs 2,528 cf

Subcatchment 2E: To CB 5B Runoff Area=15,417 sf 70.65% Impervious Runoff Depth>2.21"
Tc=6.0 min CN=92 Runoff=0.93 cfs 2,837 cf

Subcatchment 3E: Overland Runoff Area=16,600 sf 71.74% Impervious Runoff Depth>2.30"
Tc=6.0 min CN=93 Runoff=1.03 cfs 3,183 cf

Reach 1R: Analysis Point Inflow=2.76 cfs 8,549 cf
Outflow=2.76 cfs 8,549 cf

Total Runoff Area = 44,202 sf Runoff Volume = 8,549 cf Average Runoff Depth = 2.32"
25.58% Pervious = 11,309 sf 74.42% Impervious = 32,893 sf

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1E: Ramp Runoff Area=12,185 sf 82.82% Impervious Runoff Depth>4.21"
Tc=6.0 min CN=95 Runoff=1.31 cfs 4,272 cf

Subcatchment 2E: To CB 5B Runoff Area=15,417 sf 70.65% Impervious Runoff Depth>3.91"
Tc=6.0 min CN=92 Runoff=1.59 cfs 5,024 cf

Subcatchment 3E: Overland Runoff Area=16,600 sf 71.74% Impervious Runoff Depth>4.01"
Tc=6.0 min CN=93 Runoff=1.74 cfs 5,549 cf

Reach 1R: Analysis Point Inflow=4.65 cfs 14,844 cf
Outflow=4.65 cfs 14,844 cf

Total Runoff Area = 44,202 sf Runoff Volume = 14,844 cf Average Runoff Depth = 4.03"
25.58% Pervious = 11,309 sf 74.42% Impervious = 32,893 sf

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1E: Ramp Runoff Area=12,185 sf 82.82% Impervious Runoff Depth>6.91"
Tc=6.0 min CN=95 Runoff=2.12 cfs 7,019 cf

Subcatchment 2E: To CB 5B Runoff Area=15,417 sf 70.65% Impervious Runoff Depth>6.62"
Tc=6.0 min CN=92 Runoff=2.62 cfs 8,511 cf

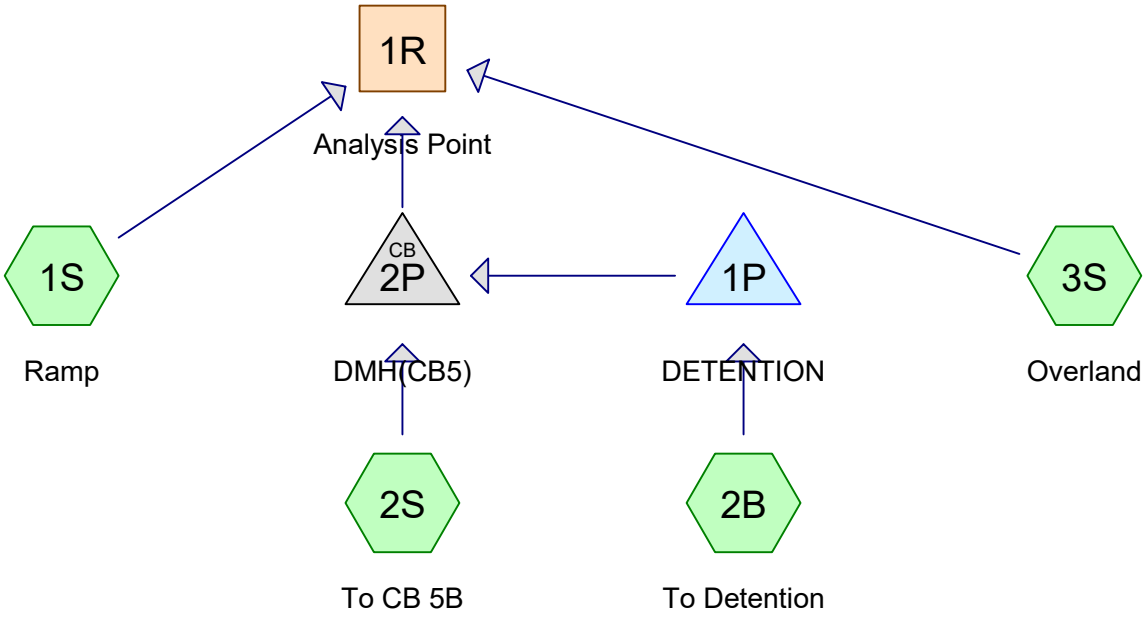
Subcatchment 3E: Overland Runoff Area=16,600 sf 71.74% Impervious Runoff Depth>6.72"
Tc=6.0 min CN=93 Runoff=2.85 cfs 9,302 cf

Reach 1R: Analysis Point Inflow=7.59 cfs 24,831 cf
Outflow=7.59 cfs 24,831 cf

Total Runoff Area = 44,202 sf Runoff Volume = 24,831 cf Average Runoff Depth = 6.74"
25.58% Pervious = 11,309 sf 74.42% Impervious = 32,893 sf

HydroCAD Data
Proposed Conditions Output

Proposed Conditions 25-Year 24-hour Storm Detailed



Subcat Reach Pond Link

Routing Diagram for MeVa Drainage- POST REV1
Prepared by Places Associates, Inc, Printed 12/10/2025

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	25-yr	Type III 24-hr		Default	24.00	1	6.21	2

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
44,202	HSG C	1S, 2B, 2S, 3S
0	HSG D	
0	Other	
44,202		**TOTAL AREA**

Summary for Subcatchment 1S: Ramp

Runoff = 2.48 cfs @ 12.09 hrs, Volume= 8,469 cf, Depth= 5.39"
Routed to Reach 1R : Analysis Point

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-34.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.21"

Area (sf)	CN	Description
14,140	98	Paved parking, HSG C
4,715	79	50-75% Grass cover, Fair, HSG C
18,855	93	Weighted Average
4,715		25.01% Pervious Area
14,140		74.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, 6 minutes minimum**

Summary for Subcatchment 2B: To Detention

Runoff = 0.87 cfs @ 12.09 hrs, Volume= 3,074 cf, Depth= 5.74"
Routed to Pond 1P : DETENTION

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-34.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.21"

Area (sf)	CN	Description
5,631	98	Paved parking, HSG C
800	79	50-75% Grass cover, Fair, HSG C
6,431	96	Weighted Average
800		12.44% Pervious Area
5,631		87.56% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, 6 minutes minimum**

Summary for Subcatchment 2S: To CB 5B

Runoff = 1.24 cfs @ 12.09 hrs, Volume= 4,536 cf, Depth= 5.97"
Routed to Pond 2P : DMH(CB5)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-34.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.21"

Area (sf)	CN	Description
8,885	98	Paved parking, HSG C
230	79	50-75% Grass cover, Fair, HSG C
9,115	98	Weighted Average
230		2.52% Pervious Area
8,885		97.48% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, 6 minutes minimum**

Summary for Subcatchment 3S: Overland

Runoff = 1.22 cfs @ 12.09 hrs, Volume= 4,034 cf, Depth= 4.94"
Routed to Reach 1R : Analysis Point

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-34.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-yr Rainfall=6.21"

Area (sf)	CN	Description
5,155	98	Paved parking, HSG C
4,646	79	50-75% Grass cover, Fair, HSG C
9,801	89	Weighted Average
4,646		47.40% Pervious Area
5,155		52.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, 6 minutes minimum**

Summary for Reach 1R: Analysis Point

Inflow Area = 44,202 sf, 76.49% Impervious, Inflow Depth = 5.35" for 25-yr event
Inflow = 5.15 cfs @ 12.09 hrs, Volume= 19,697 cf
Outflow = 5.15 cfs @ 12.09 hrs, Volume= 19,697 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-34.00 hrs, dt= 0.05 hrs

Summary for Pond 1P: DETENTION

Inflow Area = 6,431 sf, 87.56% Impervious, Inflow Depth = 5.74" for 25-yr event
Inflow = 0.87 cfs @ 12.09 hrs, Volume= 3,074 cf
Outflow = 0.26 cfs @ 12.41 hrs, Volume= 2,658 cf, Atten= 70%, Lag= 19.2 min
Primary = 0.26 cfs @ 12.41 hrs, Volume= 2,658 cf
Routed to Pond 2P : DMH(CB5)

Routing by Stor-Ind method, Time Span= 0.00-34.00 hrs, dt= 0.05 hrs
Peak Elev= 18.56' @ 12.41 hrs Surf.Area= 837 sf Storage= 1,205 cf

Plug-Flow detention time= 148.4 min calculated for 2,658 cf (86% of inflow)

Center-of-Mass det. time= 88.2 min (845.6 - 757.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	16.50'	674 cf	**49.25'W x 17.00'L x 3.21'H Field A** 2,686 cf Overall - 1,002 cf Embedded = 1,684 cf x 40.0% Voids
#2A	17.00'	1,002 cf	**Cultec R-280HD** x 22 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 11 rows
		1,676 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	17.35'	**12.0" Round Culvert** L= 52.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 17.35' / 17.08' S= 0.0052 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	20.00'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Device 1	17.00'	**3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.26 cfs @ 12.41 hrs HW=18.56' (Free Discharge)
└**1=Culvert** (Passes 0.26 cfs of 2.72 cfs potential flow)
  └**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
  └**3=Orifice/Grate** (Orifice Controls 0.26 cfs @ 5.30 fps)

Summary for Pond 2P: DMH(CB5)

Inflow Area = 15,546 sf, 93.37% Impervious, Inflow Depth = 5.55" for 25-yr event
Inflow = 1.45 cfs @ 12.09 hrs, Volume= 7,194 cf
Outflow = 1.45 cfs @ 12.09 hrs, Volume= 7,194 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.45 cfs @ 12.09 hrs, Volume= 7,194 cf
Routed to Reach 1R : Analysis Point

Routing by Stor-Ind method, Time Span= 0.00-34.00 hrs, dt= 0.05 hrs
Peak Elev= 17.71' @ 12.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	17.08'	**12.0" Round Culvert** L= 125.0' RCP, groove end w/headwall, Ke= 0.200 Inlet / Outlet Invert= 17.08' / 15.90' S= 0.0094 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=1.42 cfs @ 12.09 hrs HW=17.70' (Free Discharge)
└**1=Culvert** (Barrel Controls 1.42 cfs @ 3.99 fps)

Proposed Conditions 2-, 10- and 100-Year 24-hour Storm

Time span=0.00-34.00 hrs, dt=0.05 hrs, 681 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Ramp Runoff Area=18,855 sf 74.99% Impervious Runoff Depth=2.44"
Tc=6.0 min CN=93 Runoff=1.17 cfs 3,828 cf

Subcatchment 2B: To Detention Runoff Area=6,431 sf 87.56% Impervious Runoff Depth=2.74"
Tc=6.0 min CN=96 Runoff=0.43 cfs 1,468 cf

Subcatchment 2S: To CB 5B Runoff Area=9,115 sf 97.48% Impervious Runoff Depth=2.96"
Tc=6.0 min CN=98 Runoff=0.63 cfs 2,246 cf

Subcatchment 3S: Overland Runoff Area=9,801 sf 52.60% Impervious Runoff Depth=2.07"
Tc=6.0 min CN=89 Runoff=0.53 cfs 1,693 cf

Reach 1R: Analysis Point Inflow=2.46 cfs 8,819 cf
Outflow=2.46 cfs 8,819 cf

Pond 1P: DETENTION Peak Elev=17.77' Storage=702 cf Inflow=0.43 cfs 1,468 cf
Outflow=0.15 cfs 1,052 cf

Pond 2P: DMH(CB5) Peak Elev=17.51' Inflow=0.75 cfs 3,298 cf
12.0" Round Culvert n=0.013 L=125.0' S=0.0094 '/' Outflow=0.75 cfs 3,298 cf

Total Runoff Area = 44,202 sf Runoff Volume = 9,235 cf Average Runoff Depth = 2.51"
23.51% Pervious = 10,391 sf 76.49% Impervious = 33,811 sf

Time span=0.00-34.00 hrs, dt=0.05 hrs, 681 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Ramp Runoff Area=18,855 sf 74.99% Impervious Runoff Depth=4.25"
Tc=6.0 min CN=93 Runoff=1.98 cfs 6,673 cf

Subcatchment 2B: To Detention Runoff Area=6,431 sf 87.56% Impervious Runoff Depth=4.58"
Tc=6.0 min CN=96 Runoff=0.70 cfs 2,456 cf

Subcatchment 2S: To CB 5B Runoff Area=9,115 sf 97.48% Impervious Runoff Depth=4.81"
Tc=6.0 min CN=98 Runoff=1.01 cfs 3,656 cf

Subcatchment 3S: Overland Runoff Area=9,801 sf 52.60% Impervious Runoff Depth=3.82"
Tc=6.0 min CN=89 Runoff=0.96 cfs 3,120 cf

Reach 1R: Analysis Point Inflow=4.13 cfs 15,488 cf
Outflow=4.13 cfs 15,488 cf

Pond 1P: DETENTION Peak Elev=18.26' Storage=1,023 cf Inflow=0.70 cfs 2,456 cf
Outflow=0.23 cfs 2,039 cf

Pond 2P: DMH(CB5) Peak Elev=17.64' Inflow=1.19 cfs 5,695 cf
12.0" Round Culvert n=0.013 L=125.0' S=0.0094 '/' Outflow=1.19 cfs 5,695 cf

Total Runoff Area = 44,202 sf Runoff Volume = 15,905 cf Average Runoff Depth = 4.32"
23.51% Pervious = 10,391 sf 76.49% Impervious = 33,811 sf

Time span=0.00-34.00 hrs, dt=0.05 hrs, 681 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Ramp Runoff Area=18,855 sf 74.99% Impervious Runoff Depth=7.15"
Tc=6.0 min CN=93 Runoff=3.23 cfs 11,239 cf

Subcatchment 2B: To Detention Runoff Area=6,431 sf 87.56% Impervious Runoff Depth=7.51"
Tc=6.0 min CN=96 Runoff=1.12 cfs 4,025 cf

Subcatchment 2S: To CB 5B Runoff Area=9,115 sf 97.48% Impervious Runoff Depth=7.75"
Tc=6.0 min CN=98 Runoff=1.60 cfs 5,887 cf

Subcatchment 3S: Overland Runoff Area=9,801 sf 52.60% Impervious Runoff Depth=6.68"
Tc=6.0 min CN=89 Runoff=1.62 cfs 5,453 cf

Reach 1R: Analysis Point Inflow=6.70 cfs 26,188 cf
Outflow=6.70 cfs 26,188 cf

Pond 1P: DETENTION Peak Elev=19.15' Storage=1,489 cf Inflow=1.12 cfs 4,025 cf
Outflow=0.32 cfs 3,609 cf

Pond 2P: DMH(CB5) Peak Elev=17.80' Inflow=1.85 cfs 9,496 cf
12.0" Round Culvert n=0.013 L=125.0' S=0.0094 '/' Outflow=1.85 cfs 9,496 cf

Total Runoff Area = 44,202 sf Runoff Volume = 26,604 cf Average Runoff Depth = 7.22"
23.51% Pervious = 10,391 sf 76.49% Impervious = 33,811 sf

NOAA Atlas 14 Precipitation Data

NOAA Atlas 14, Volume 10, Version 3 GROVELAND
Station ID: 19-3276
Location name: Groveland, Massachusetts, USA*
Latitude: 42.7467°, Longitude: -71.0425°
Elevation:
Elevation (station metadata): 33 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.308** (0.243-0.382)	**0.368** (0.290-0.457)	**0.465** (0.366-0.581)	**0.546** (0.427-0.684)	**0.657** (0.496-0.860)	**0.741** (0.547-0.990)	**0.829** (0.592-1.15)	**0.926** (0.626-1.31)	**1.06** (0.689-1.56)	**1.17** (0.743-1.76)
10-min	**0.437** (0.345-0.542)	**0.521** (0.411-0.647)	**0.659** (0.518-0.821)	**0.773** (0.604-0.970)	**0.931** (0.703-1.22)	**1.05** (0.775-1.40)	**1.17** (0.839-1.62)	**1.31** (0.887-1.86)	**1.50** (0.977-2.21)	**1.66** (1.05-2.49)
15-min	**0.514** (0.406-0.637)	**0.613** (0.484-0.761)	**0.775** (0.610-0.966)	**0.910** (0.711-1.14)	**1.10** (0.827-1.43)	**1.24** (0.912-1.65)	**1.38** (0.987-1.91)	**1.54** (1.04-2.19)	**1.77** (1.15-2.60)	**1.96** (1.24-2.93)
30-min	**0.707** (0.559-0.878)	**0.844** (0.666-1.05)	**1.07** (0.839-1.33)	**1.25** (0.979-1.57)	**1.51** (1.14-1.97)	**1.70** (1.26-2.27)	**1.90** (1.36-2.63)	**2.12** (1.44-3.01)	**2.44** (1.58-3.58)	**2.69** (1.70-4.03)
60-min	**0.901** (0.712-1.12)	**1.08** (0.848-1.34)	**1.36** (1.07-1.70)	**1.60** (1.25-2.00)	**1.92** (1.45-2.51)	**2.17** (1.60-2.89)	**2.42** (1.73-3.35)	**2.70** (1.83-3.83)	**3.10** (2.02-4.55)	**3.43** (2.17-5.13)
2-hr	**1.16** (0.926-1.43)	**1.40** (1.11-1.72)	**1.78** (1.41-2.20)	**2.10** (1.65-2.61)	**2.53** (1.93-3.30)	**2.86** (2.13-3.81)	**3.20** (2.32-4.45)	**3.62** (2.46-5.10)	**4.25** (2.76-6.20)	**4.78** (3.03-7.11)
3-hr	**1.34** (1.08-1.65)	**1.62** (1.30-1.99)	**2.08** (1.66-2.56)	**2.45** (1.94-3.04)	**2.97** (2.28-3.86)	**3.35** (2.52-4.47)	**3.76** (2.75-5.24)	**4.27** (2.91-6.00)	**5.05** (3.30-7.35)	**5.73** (3.64-8.49)
6-hr	**1.72** (1.39-2.10)	**2.09** (1.69-2.55)	**2.69** (2.16-3.29)	**3.18** (2.54-3.92)	**3.87** (2.99-5.01)	**4.37** (3.31-5.80)	**4.92** (3.62-6.82)	**5.60** (3.83-7.82)	**6.67** (4.36-9.64)	**7.59** (4.84-11.2)
12-hr	**2.17** (1.77-2.63)	**2.65** (2.16-3.21)	**3.43** (2.78-4.18)	**4.08** (3.29-4.99)	**4.97** (3.87-6.40)	**5.63** (4.29-7.42)	**6.35** (4.70-8.73)	**7.24** (4.97-10.0)	**8.60** (5.65-12.3)	**9.79** (6.26-14.3)
24-hr	**2.57** (2.12-3.10)	**3.19** (2.63-3.85)	**4.20** (3.45-5.08)	**5.05** (4.11-6.14)	**6.21** (4.88-7.95)	**7.06** (5.43-9.26)	**7.99** (5.97-11.0)	**9.17** (6.32-12.6)	**11.0** (7.25-15.7)	**12.6** (8.09-18.3)
2-day	**2.89** (2.41-3.46)	**3.67** (3.05-4.39)	**4.94** (4.08-5.93)	**5.99** (4.92-7.23)	**7.44** (5.90-9.50)	**8.49** (6.60-11.1)	**9.67** (7.32-13.3)	**11.2** (7.75-15.4)	**13.7** (9.04-19.4)	**15.9** (10.2-22.9)
3-day	**3.17** (2.66-3.78)	**4.01** (3.35-4.78)	**5.37** (4.47-6.43)	**6.50** (5.37-7.82)	**8.06** (6.43-10.3)	**9.19** (7.18-12.0)	**10.5** (7.95-14.3)	**12.1** (8.41-16.6)	**14.8** (9.82-20.9)	**17.2** (11.1-24.8)
4-day	**3.45** (2.90-4.09)	**4.31** (3.61-5.12)	**5.71** (4.77-6.82)	**6.88** (5.70-8.25)	**8.48** (6.79-10.8)	**9.65** (7.56-12.6)	**11.0** (8.35-15.0)	**12.7** (8.81-17.2)	**15.5** (10.3-21.8)	**18.0** (11.6-25.7)
7-day	**4.21** (3.56-4.97)	**5.10** (4.31-6.03)	**6.55** (5.51-7.77)	**7.76** (6.48-9.26)	**9.42** (7.59-11.9)	**10.6** (8.37-13.7)	**12.0** (9.15-16.2)	**13.7** (9.60-18.6)	**16.6** (11.0-23.2)	**19.1** (12.4-27.3)
10-day	**4.89** (4.16-5.76)	**5.80** (4.93-6.84)	**7.30** (6.17-8.63)	**8.54** (7.17-10.2)	**10.2** (8.28-12.8)	**11.5** (9.07-14.7)	**12.9** (9.83-17.3)	**14.6** (10.3-19.7)	**17.4** (11.6-24.3)	**19.9** (12.9-28.3)
20-day	**6.82** (5.86-7.97)	**7.83** (6.72-9.16)	**9.48** (8.10-11.1)	**10.9** (9.20-12.8)	**12.7** (10.3-15.7)	**14.1** (11.2-17.8)	**15.6** (11.9-20.5)	**17.4** (12.3-23.2)	**19.9** (13.4-27.5)	**22.0** (14.3-31.0)
30-day	**8.42** (7.28-9.80)	**9.51** (8.21-11.1)	**11.3** (9.70-13.2)	**12.8** (10.9-15.0)	**14.8** (12.1-18.1)	**16.4** (12.9-20.4)	**17.9** (13.6-23.1)	**19.6** (13.9-26.1)	**22.0** (14.8-30.2)	**23.8** (15.5-33.4)
45-day	**10.4** (9.08-12.1)	**11.6** (10.1-13.5)	**13.5** (11.7-15.8)	**15.1** (13.0-17.7)	**17.3** (14.2-21.0)	**19.0** (15.1-23.5)	**20.7** (15.6-26.4)	**22.4** (16.0-29.6)	**24.6** (16.6-33.6)	**26.1** (17.1-36.6)
60-day	**12.2** (10.6-14.1)	**13.4** (11.7-15.5)	**15.4** (13.4-17.9)	**17.1** (14.7-20.0)	**19.4** (15.9-23.5)	**21.3** (16.9-26.1)	**23.0** (17.4-29.1)	**24.7** (17.7-32.5)	**26.8** (18.1-36.5)	**28.2** (18.4-39.4)

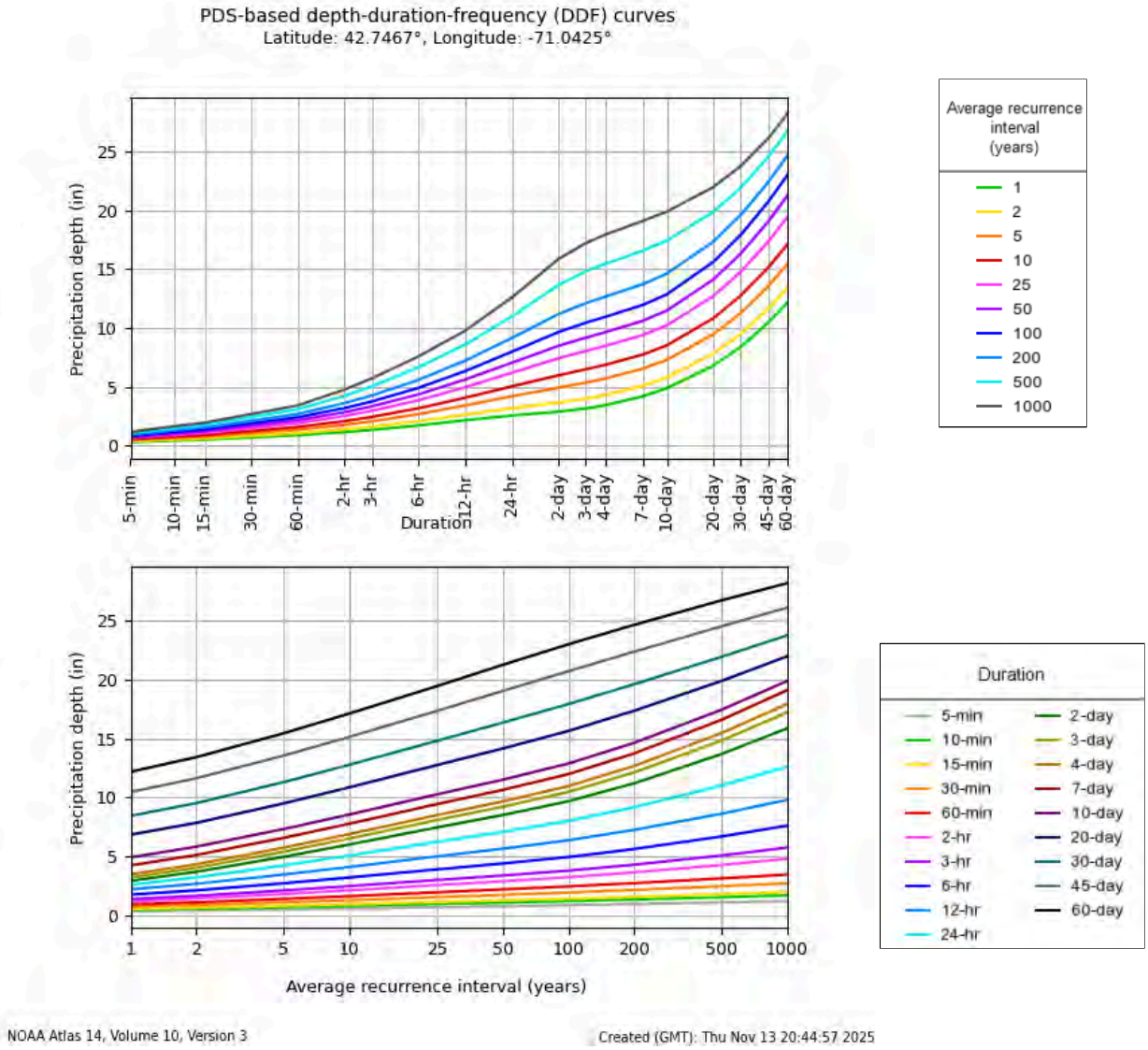
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Back to Top

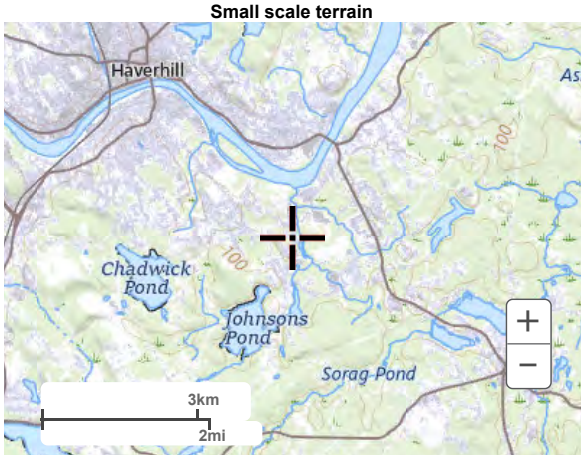
PF graphical



Back to Top

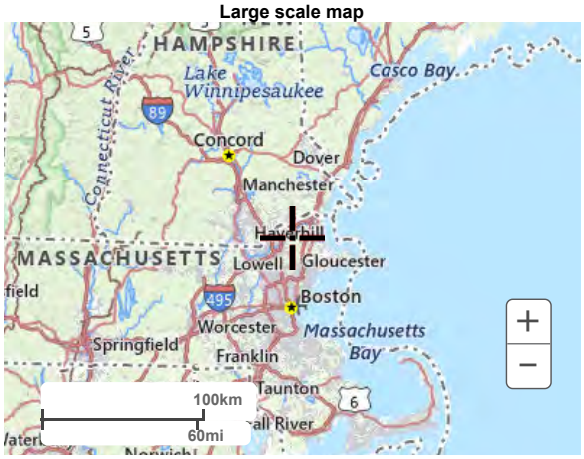
Maps & aerials

Small scale terrain

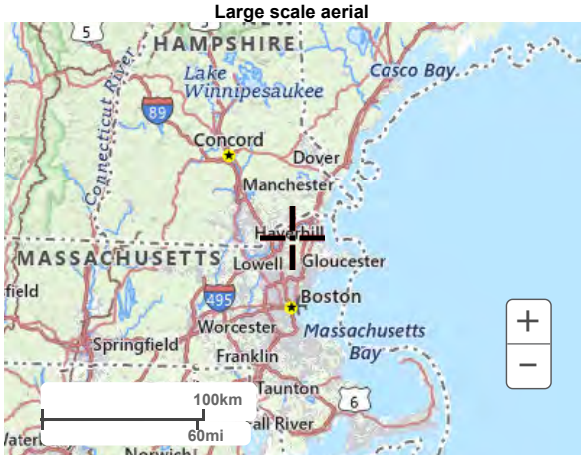


Large scale terrain

Large scale map



Large scale aerial



Back to Top

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

Supporting Data – Stormceptor TSS Removal Calculations

Brief Stormceptor Sizing Report - MVRTA

Project Information & Location			
Project Name	MVRTA	**Project Number**	50524
City	Haverhill	**State/ Province**	Massachusetts
Country	United States of America	**Date**	3/13/2025
Designer Information		**EOR Information (optional)**	
Name		**Name**	
Company	PLACES Associates, Inc.	**Company**	
Phone #	978-486-0334	**Phone #**	
Email	pburke@placesassociates.com	**Email**	

Stormwater Treatment Recommendation
The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	MVRTA
Target TSS Removal (%)	71
TSS Removal (%) Provided	80
Recommended Stormceptor Model	STC 450i

The recommended Stormceptor Model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary	
Stormceptor Model	**% TSS Removal Provided**
STC 450i	80
STC 900	85
STC 1200	86
STC 1800	86
STC 2400	89
STC 3600	89
STC 4800	91
STC 6000	92
STC 7200	93
STC 11000	95
STC 13000	95
STC 16000	96

Stormceptor®

CONTECH ENGINEERED SOLUTIONS
A FORTERRA COMPANY

Sizing Details

Drainage Area

Total Area (acres)	0.21
Imperviousness %	97.5

Rainfall

Station Name	BOSTON WSFO AP
State/Province	Massachusetts
Station ID #	0770
Years of Records	58
Latitude	42°21'38"N
Longitude	71°0'38"W

Water Quality Objective

TSS Removal (%)	71.0
Runoff Volume Capture (%)	
Oil Spill Capture Volume (Gal)	
Peak Conveyed Flow Rate (CFS)	1.26
Water Quality Flow Rate (CFS)	

Up Stream Storage

Storage (ac-ft)	Discharge (cfs)
0.000	0.000

Up Stream Flow Diversion

Max. Flow to Stormceptor (cfs)	

Particle Size Distribution (PSD)
The selected PSD defines TSS removal

NJDEP

Particle Diameter (microns)	Distribution %	Specific Gravity
2.0	5.0	2.65
5.0	5.0	2.65
8.0	10.0	2.65
20.0	15.0	2.65
50.0	10.0	2.65
75.0	5.0	2.65
100.0	10.0	2.65
150.0	15.0	2.65
250.0	15.0	2.65
500.0	5.0	2.65
1000.0	5.0	2.65

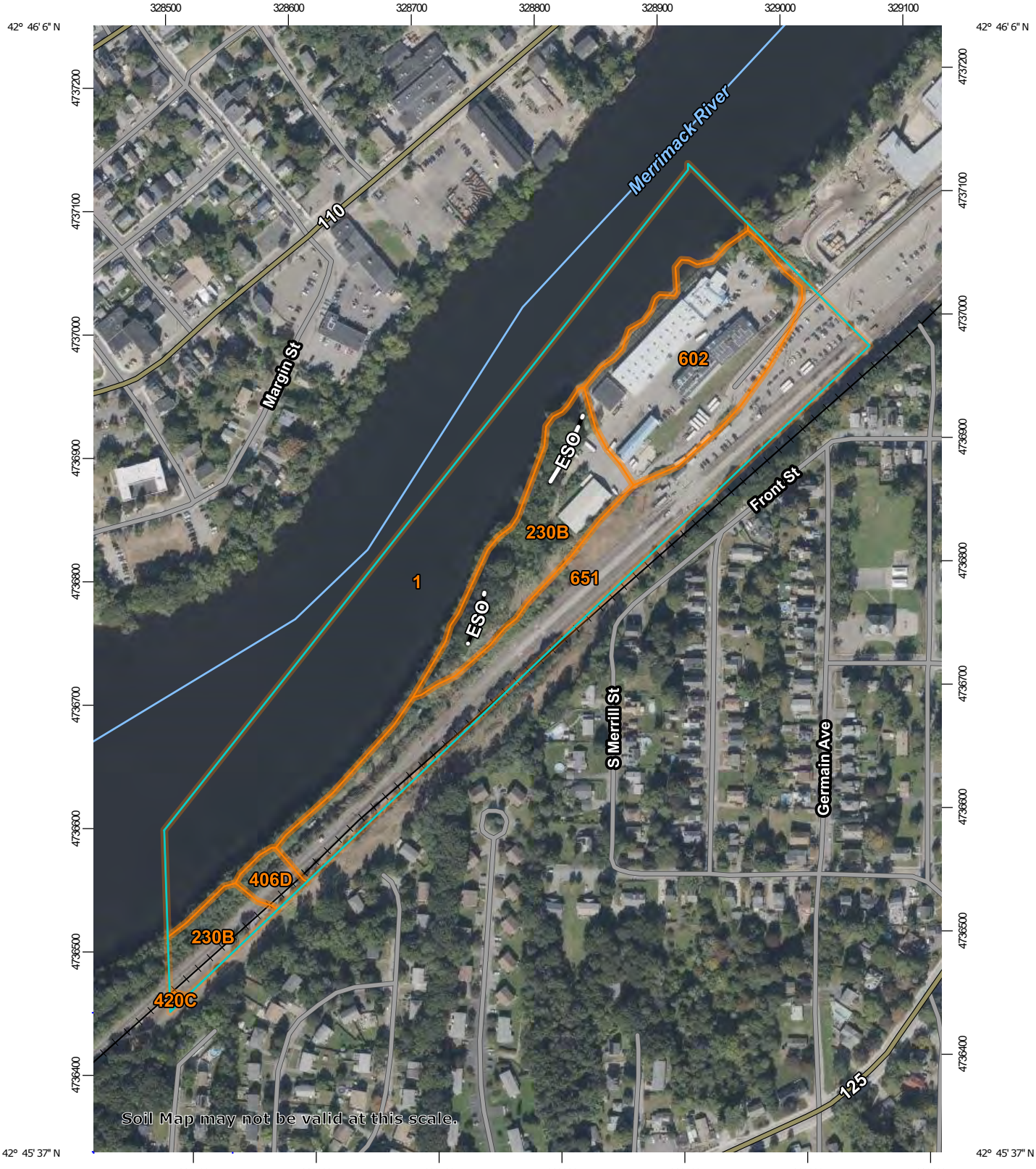
Notes

• Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
• Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
• For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

For Stormceptor Specifications and Drawings Please Visit:
https://www.conteches.com/technical-guides/search?filter=1WBC0O5EYX

Soils Data

Soil Map—Essex County, Massachusetts, Northern Part
(MeVa Haverhill, MA)



Map Scale: 1:4,450 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 200 400 800 1200

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

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

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: Essex County, Massachusetts, Northern Part
Survey Area Data: Version 21, Sep 5, 2025

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

Date(s) aerial images were photographed: Mar 1, 2023—Sep 1, 2023

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1	Water	12.0	42.6%
230B	Unadilla very fine sandy loam, 3 to 8 percent slopes	4.1	14.6%
406D	Charlton fine sandy loam, 15 to 25 percent slopes, very stony	0.4	1.4%
420C	Canton fine sandy loam, 8 to 15 percent slopes	0.0	0.1%
602	Urban land	4.8	17.2%
651	Udorthents, smoothed	6.8	24.0%
Totals for Area of Interest		**28.2**	**100.0%**

Essex County, Massachusetts, Northern Part

602—Urban land

Map Unit Setting

National map unit symbol: vjx3
Frost-free period: 125 to 165 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Setting

Parent material: Excavated and filled land

Minor Components

Udorthents

Percent of map unit: 10 percent
Hydric soil rating: No

Merrimac

Percent of map unit: 2 percent
Hydric soil rating: No

Windsor

Percent of map unit: 2 percent
Hydric soil rating: No

Charlton

Percent of map unit: 2 percent
Hydric soil rating: No

Paxton

Percent of map unit: 2 percent
Hydric soil rating: No

Hinckley

Percent of map unit: 2 percent
Hydric soil rating: No

Data Source Information

Soil Survey Area: Essex County, Massachusetts, Northern Part
Survey Area Data: Version 21, Sep 5, 2025

Essex County, Massachusetts, Northern Part

651—Udorthents, smoothed

Map Unit Setting

National map unit symbol: vjwk
Elevation: 0 to 3,000 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Udorthents

Setting

Parent material: Excavated and filled land loamy and/or excavated and filled land sandy and gravelly

Typical profile

H1 - 0 to 6 inches: variable
H2 - 6 to 60 inches: variable

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to very high (0.06 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Hydric soil rating: Unranked

Minor Components

Urban land

Percent of map unit: 10 percent
Hydric soil rating: Unranked

Beaches

Percent of map unit: 8 percent
Hydric soil rating: Unranked

Dumps

Percent of map unit: 2 percent
Hydric soil rating: Unranked

Data Source Information

Soil Survey Area: Essex County, Massachusetts, Northern Part
Survey Area Data: Version 21, Sep 5, 2025

Essex County, Massachusetts, Northern Part

406D—Charlton fine sandy loam, 15 to 25 percent slopes, very stony

Map Unit Setting

National map unit symbol: vj6v
Elevation: 0 to 330 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Charlton

Setting

Landform: Ridges, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope, base slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Friable coarse-loamy eolian deposits over friable coarse-loamy basal till derived from granite and gneiss

Typical profile

H1 - 0 to 4 inches: fine sandy loam
H2 - 4 to 28 inches: gravelly fine sandy loam
H3 - 28 to 60 inches: gravelly fine sandy loam

Properties and qualities

Slope: 15 to 25 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 7.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A

Ecological site: F144AY034CT - Well Drained Till Uplands
Hydric soil rating: No

Minor Components

Canton
Percent of map unit: 17 percent
Hydric soil rating: No

Sutton
Percent of map unit: 3 percent
Hydric soil rating: No

Data Source Information

Soil Survey Area: Essex County, Massachusetts, Northern Part
Survey Area Data: Version 21, Sep 5, 2025

Essex County, Massachusetts, Northern Part

230B—Unadilla very fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: vjwr
Elevation: 600 to 1,800 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Unadilla

Setting

Landform: Lakebeds (relict)
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Rise
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Soft coarse-silty glaciolacustrine deposits

Typical profile

H1 - 0 to 9 inches: very fine sandy loam
H2 - 9 to 53 inches: very fine sandy loam
H3 - 53 to 60 inches: very fine sandy loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 10.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Ecological site: F144AY024NY - Well Drained Eolian Outwash
Hydric soil rating: No

Minor Components

Raynham
Percent of map unit: 10 percent
Landform: Depressions
Hydric soil rating: Yes

Belgrade
Percent of map unit: 10 percent
Hydric soil rating: No

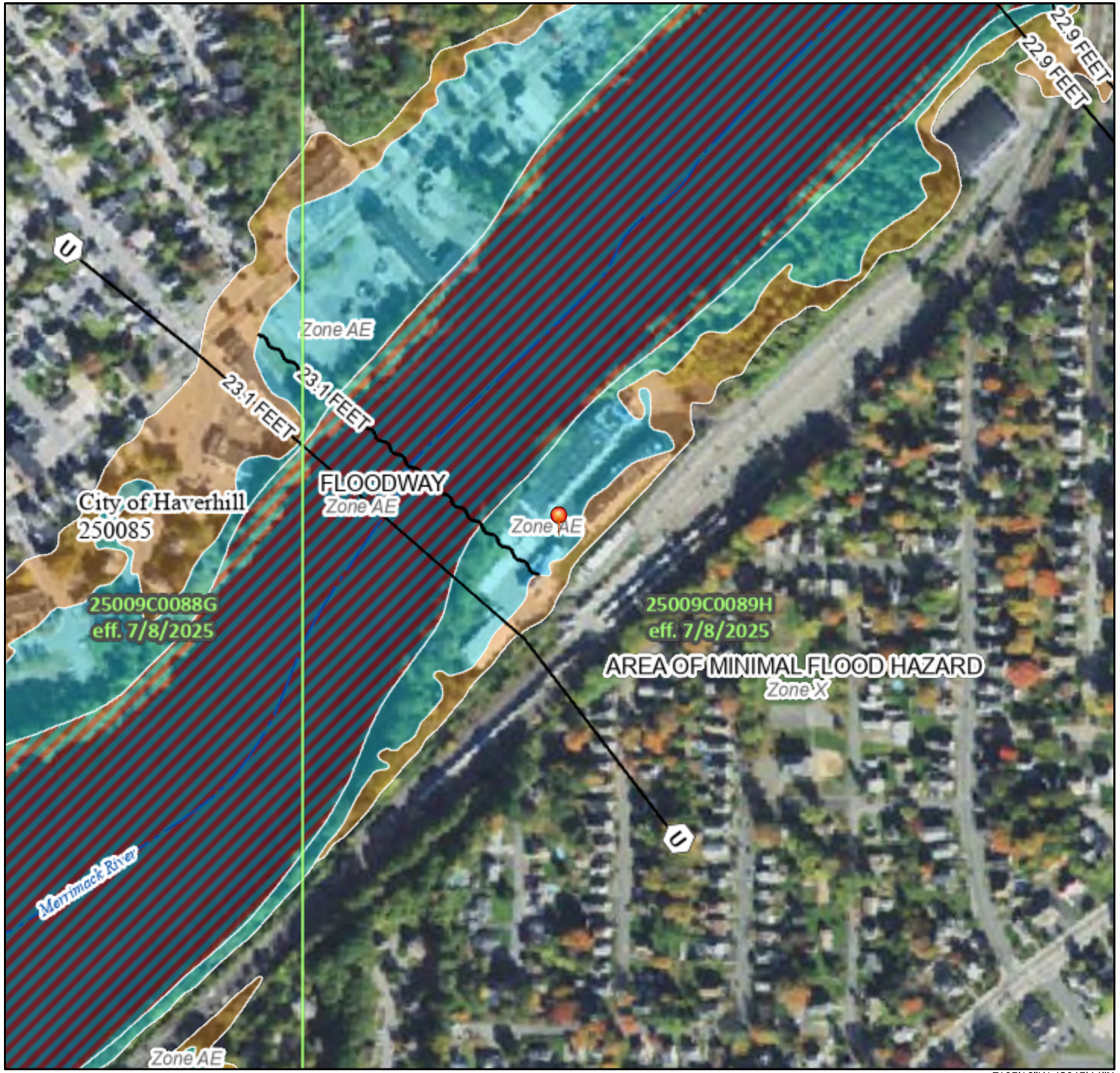
Data Source Information

Soil Survey Area: Essex County, Massachusetts, Northern Part
Survey Area Data: Version 21, Sep 5, 2025

FEMA Firmette

National Flood Hazard Layer FIRMette

71°5'48"W 42°46'10"N



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

1:6,000

71°5'10"W 42°45'44"N

Basemap Imagery Source: USGS National Map 2023

Legend

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

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

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

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

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

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

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

N

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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 11/3/2025 at 8:10 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

Cultec Separator Row TSS Removal Documentation

◆ Verification Statement ◆ Verification Statement ◆ Verification Statement ◆

VERIFICATION STATEMENT

GLOBE Performance Solutions

Verifies the performance of

Cultec Separator™ Row Filtration System

Developed by Cultec
Brookfield, Connecticut, USA

Registration: GPS-ETV_VR2024-03-31

In accordance with

ISO 14034:2016

Environmental Management —
Environmental Technology Verification (ETV)

John D. Wiebe, PhD
Executive Chairman
GLOBE Performance Solutions

March 31, 2024
Vancouver, BC, Canada

Verification Body
GLOBE Performance Solutions
404 – 999 Canada Place | Vancouver, B.C | Canada |V6C 3E2

Technology description and application

Cultec Recharger and Contactor chambers are used for infiltration, detention and/or retention of stormwater underground. The system is comprised of thermoplastic arch-shaped chambers surrounded by clear crushed stone. Water enters the system through a Separator row and then flows through the stone and into a Chamber row prior to exiting. The Cultec stormwater system is sized based on the volume of stormwater which is stored in the voids created by the chamber and the voids in the clear stone surround, with a void ratio of 40%. The entire system is wrapped in a non-woven geotextile and/or impermeable geomembrane. In order to minimize fine particles and silts from blinding the voids in the clear stone surround, a single chamber row is wrapped in non-woven geotextile and placed on a woven geotextile. This row is connected to the inlet pipe of the Cultec system providing a filtration function as the surface stormwater run-off passes through the geotextile wrapped inlet row. Sediment is trapped within the Cultec Separator™ Row and may be removed through back flushing of this row. A typical system installation is illustrated in Figure 1 and Figure 2 below.

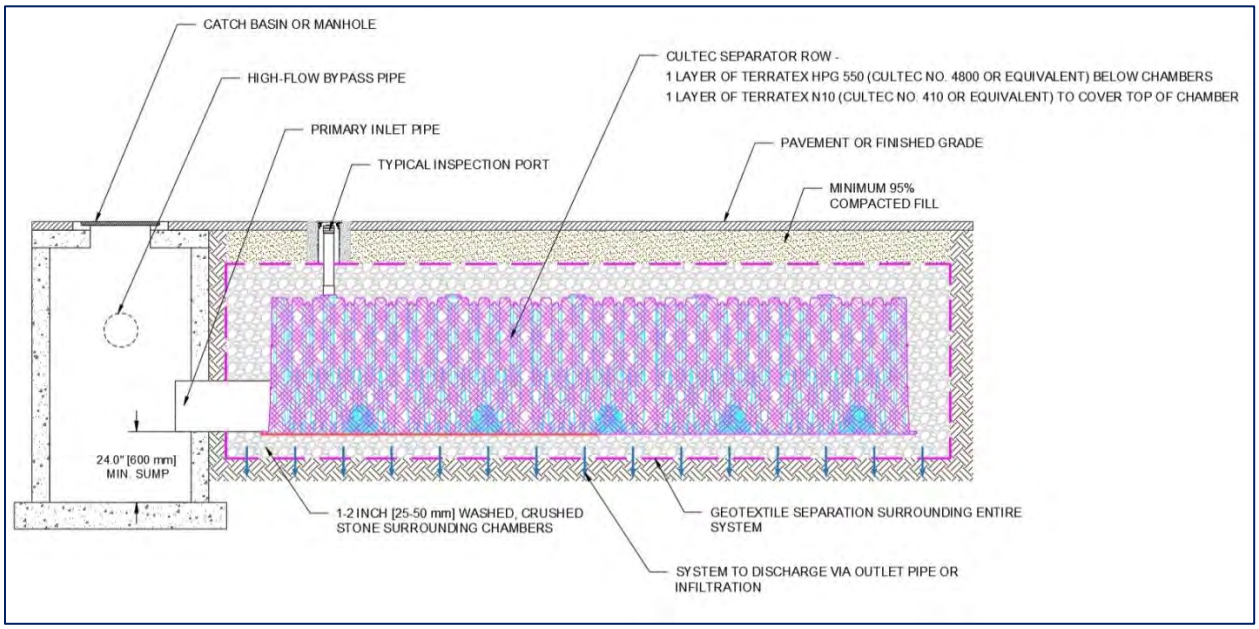


Figure 1: Cultec Separator™ Row Filtration System – Cross-Sectional View

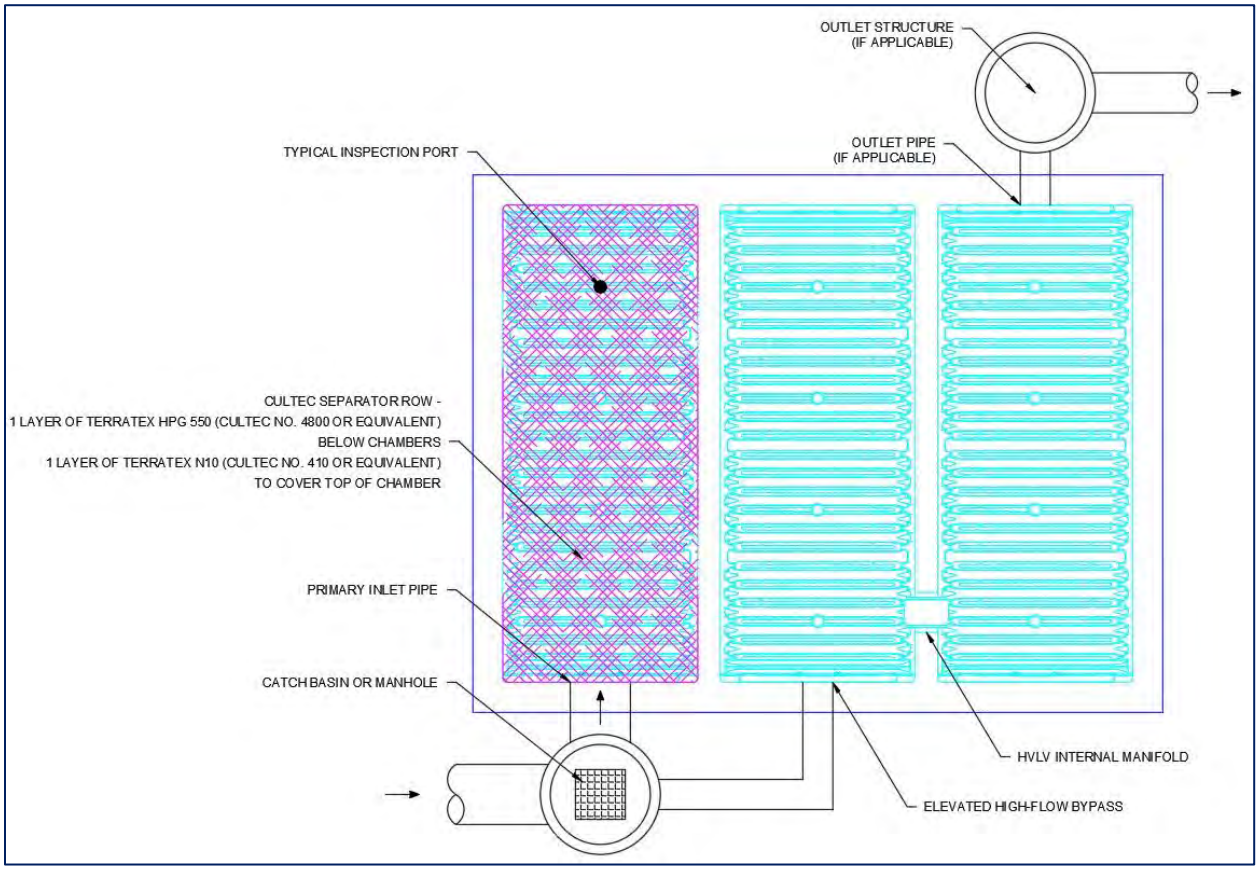


Figure 2: Cultec Separator™ Row Filtration System – Plan View

Performance & testing conditions

The data and results published in this Verification Statement were obtained from the testing program conducted on the Cultec Separator™ Row in accordance with a technology specific test plan (TSTP) developed and approved by the client and test lab (Good Harbour Laboratories, Mississauga, Ontario), and reviewed by the Verification Expert and Verifying Organization, in compliance with ISO/IEC 14034.

The device tested was a Cultec Recharger 150XLHD R chamber with a base width of 838 mm (33″) and height of 470 mm (18.5″).

Test Setup

Two chambers were used for this study, a receiving chamber and a separation chamber. The two chambers were housed in a containment cell constructed out of wood, lined with an impermeable membrane. The dimensions of the test cell were 142” X 71” X 23.5” (3.58 m X 1.80 m X 0.60 m, L X W X H). The chambers were set up in the test cell in a manner consistent with a normal installation. The floor of the cell was covered with approximately 76 mm (3”) of washed, crushed, clear stone[1] which in turn was covered by one layer of woven geotextile fabric as required for the installation of the system. The two chambers sat next to each other, in parallel. Washed crushed stone filled in the space around the test units up to a height of approximately 51 mm (2”) from the base.[2] The test set-up is illustrated in Figure 3.

The geotextiles used for this study were:

Woven: Terratex HPG 550
Nonwoven: Terratex N10

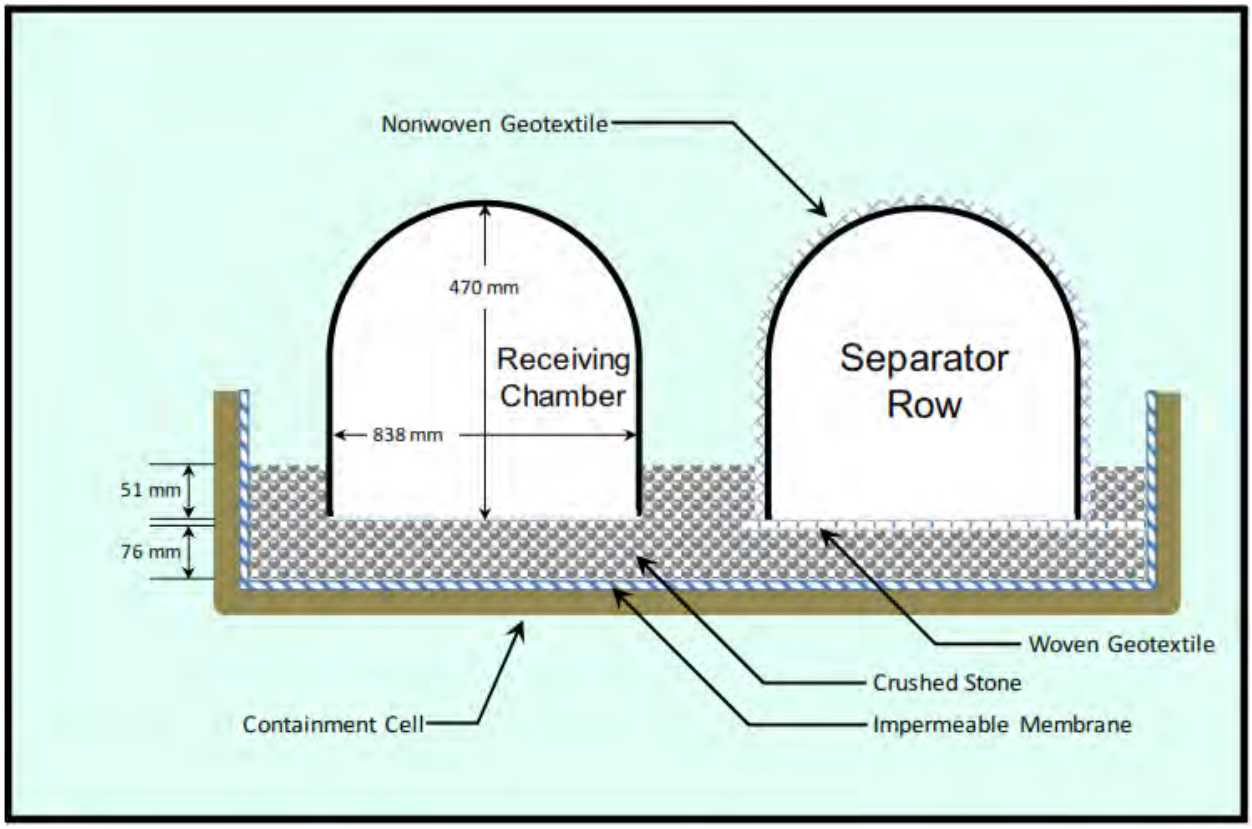


Figure 3: Test Cell Cross-Section for Model Recharger® 150XLHD R

[1] A normal installation would typically have a crushed stone depth of 150 mm (6″).

[2] For a normal installation, the stone completely fills the column between chamber rows and up to a minimum of 6″ above the top of the crown of the chamber.

The laboratory test set-up was a water flow loop, capable of moving water at a rate of up to 900 L/min. The loop was comprised of water reservoirs, pumps, stand pipe, receiving tank and a flow meter, in addition to the test cell.

Fresh water was pumped from the storage tank through a flow meter to the stand pipe, and from there it flowed by gravity through an inlet pipe to the separation chamber in the test cell. Sediment was added at an addition port in the inlet pipe upstream of the separation chamber.

From the water supply tanks, water was pumped by a centrifugal pump. Flow measurement was done using an electromagnetic type flow meter with an accuracy of ± 0.5% of reading (1 – 200 gpm). The data logger was configured to record a flow measurement once every minute.

The influent pipe was 100 mm (4 inches) in diameter and sediment addition was done through a port at the crown of the influent pipe, 4 pipe diameters (406 mm) upstream of the containment cell. The sediment feeder was a volumetric screw feeder with vibratory hopper.

Water flow exited the receiving chamber and terminated with a free-fall into the Receiving Tank. Water was pumped from the Receiving Tank back to the storage tanks to complete the flow loop.

Sample Collection & Parameter Measurement

Background water samples were collected in 1L jars from the standpipe. The sample was taken by submerging the jar below the surface of the water until full.

Effluent samples were also grabbed by hand. The effluent pipe drained freely into the Receiving Tank and the effluent sample was taken at that point. The sampling technique was to take the grab sample by sweeping a wide-mouth 1 L jar through the stream of effluent flow such that the jar was full after a single pass.

Effluent water temperature was taken using a data logger submerged into the receiving tank during each run and configured to take a temperature reading once every minute. Run and sampling times were measured using NIST traceable stopwatches. The sediment feed samples that were taken during the run were collected in 500 mL jars and weighed
on an analytical balance.

Test Sediment

The final test sediment particle size distribution (PSD) met the required tolerances of the Canada ETV Procedure for Laboratory Testing of Oil-Grit Separators (Rev. June 6, 2014 – Ver. 3.0). Three replicate samples of the test sediment blend were sent to a qualified 3rd party analytical laboratory for analysis of the sediment PSD in a manner consistent with ASTM method D422-63 (Reapproved 2007), "Standard Test Method for Particle-Size Analysis of Soils". The samples were composite samples created by taking samples throughout the blending process and in various positions within the blending drum.

Removal Efficiency Testing

The objective of this study was to establish a baseline for treatment performance (removal efficiency) over a range of flow rates up to 125% of the maximum treatment flow rate (MTFR) with an influent suspended sediment concentration (SSC) of 200 mg/L. Sediment removal efficiency testing was conducted at 25%, 50%, 75%, 100% and 125% MTFR. The sediment feed rate had a coefficient of variance (COV) ≤ 0.10 and the influent sediment concentration was maintained within ± 20 mg/L of target, based on the average sediment feed rate and water flow rate for the run. The water flow rates were held within 10% of target with a COV of 0.03 and water temperatures were maintained below 25°C.

A minimum of eight influent background samples were taken at regular intervals. A minimum of 15 effluent samples were collected during each test run. The first sample was collected after a minimum of 3 detention times (DT), at which time a constant flow and sediment feed were established. The interval between sequential effluent samples was evenly spaced; however, when the test sediment feed was interrupted for measurement, the next effluent sample was collected after waiting at least 3 DT to re-establish equilibrium conditions.

The system detention time was determined empirically by measuring the height of water in the containment cell during clean water flow at the chosen flow rate. The wet volume of the system was calculated and the approximate volume of the stones was subtracted. The remaining volume was the estimated water volume in the containment cell, which was divided by the flow rate to give detention time.

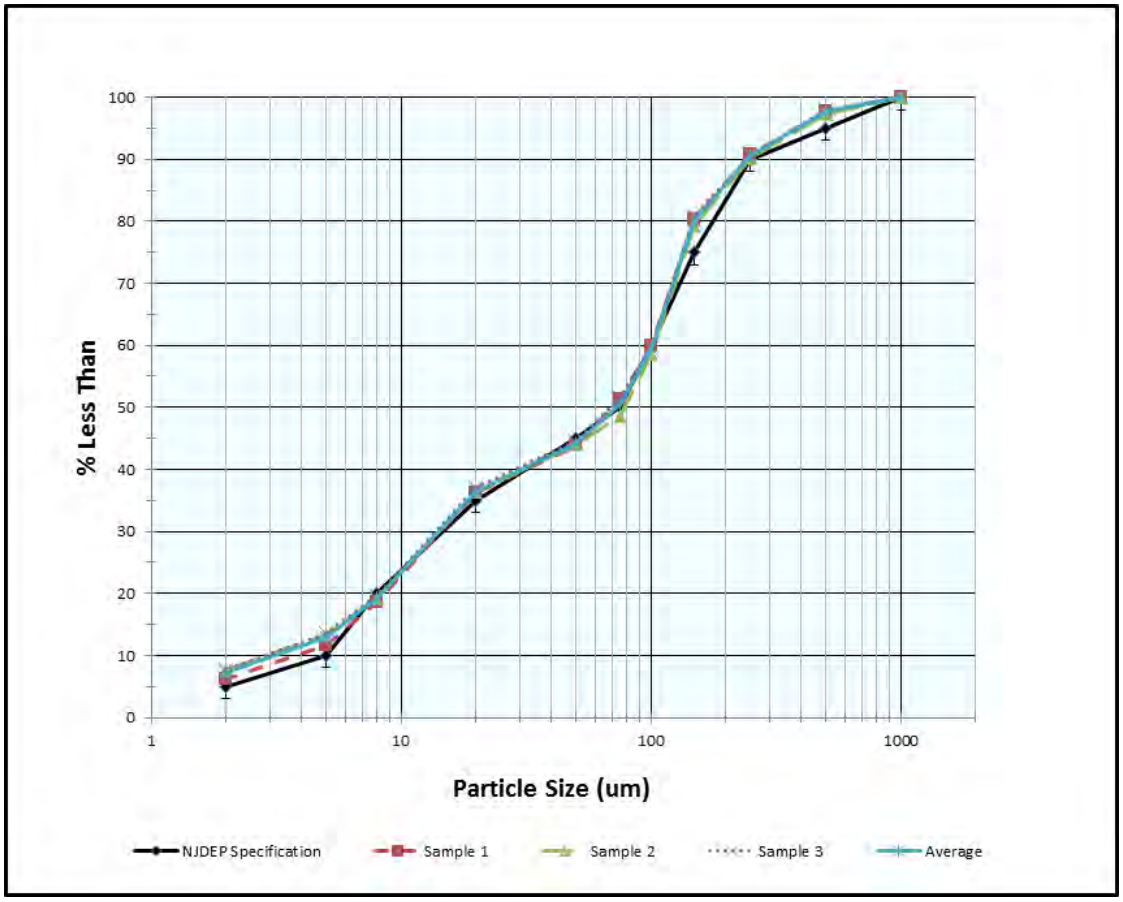
The sediment feed rate was checked using six calibration samples taken at evenly spaced intervals over the duration of each test run. Each sample was collected over an interval timed to the nearest 0.01 second and was a minimum of 0.1 liters, or the collection interval did not exceed one minute, whichever came first. The COV of the samples was < 0.10. The feed rate samples were also used to calculate an influent concentration in order to double check the concentration calculated by mass balance.

Performance claims

When installed with Terratex HPG 550 and Terratex N10 geotextiles, and tested with silica sediment having a particle size distribution conforming to the *Canadian Environmental Technology Verification Program Procedure for Laboratory Testing of Oil-Grit Separators*, the Cultec Recharger® 150XLHD Separator Row™ will remove at least the following fractions of suspended sediment at the corresponding flow rates: 80% at 24 gpm, 77% at 49 gpm, 73% at 73 gpm, 70% at 97 gpm, and 65% at 121 gpm. These performance claims are verified statistically at a 95% level of confidence.

Performance results

TEST SEDIMENT PARTICLE SIZE DISTRIBUTION IN RELATION TO SPECIFIED PSD



SUSPENDED SEDIMENT REMOVAL EFFICIENCY AT A FLOW RATE OF 24 GPM

	Suspended Sediment Concentration (mg/L)														
Sample #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Effluent	39.6	38.7	39.2	39.8	39.1	39.5	41.7	41.9	41.1	42.4	43.2	41.6	40.8	41.1	41.6
Background	2		2		2		2		2		2		2		2
Adjusted Effluent	37.6	36.7	37.2	37.8	37.1	37.5	39.7	39.9	39.1	40.4	41.2	39.6	38.8	39.1	39.6
Average Adjusted Effluent Concentration					38.8 mg/L			Removal Efficiency					80.2%		

SUSPENDED SEDIMENT REMOVAL EFFICIENCY AT A FLOW RATE OF 48 GPM

	Suspended Sediment Concentration (mg/L)														
Sample #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Effluent	47.1	47.0	47.1	46.8	47.3	47.3	49.0	50.1	49.5	50.4	49.1	50.2	52.2	49.7	51.8
Background	2		2		2		2		2		2		2		2
Adjusted Effluent	45.1	45.0	45.1	44.8	45.3	45.3	47.0	48.1	47.5	48.4	47.1	48.2	50.2	47.7	49.8
Average Adjusted Effluent Concentration					47.0 mg/L			Removal Efficiency					76.9%		

SUSPENDED SEDIMENT REMOVAL EFFICIENCY AT A FLOW RATE OF 73 GPM

	Suspended Sediment Concentration (mg/L)														
Sample #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Effluent	54.3	55.2	53.3	53.8	55.8	55.8	55.3	54.5	53.5	56.2	56.4	56.5	58.4	56.8	57.7
Background	2		2		2		2		2		2		2		2
Adjusted Effluent	52.3	53.2	51.3	51.8	53.8	53.8	53.3	52.5	51.5	54.2	54.4	54.5	56.4	54.8	55.7
Average Adjusted Effluent Concentration					53.6 mg/L			Removal Efficiency					73.3%		

SUSPENDED SEDIMENT REMOVAL EFFICIENCY AT A FLOW RATE OF 97 GPM

	Suspended Sediment Concentration (mg/L)														
Sample #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Effluent	58.4	59.4	59.0	61.2	61.6	61.1	58.9	60.4	59.9	63.9	63.3	62.5	61.9	61.0	61.0
Background	2		2		2		2		2		2		2		2
Adjusted Effluent	56.4	57.4	57.0	59.2	59.6	59.1	56.9	58.4	57.9	61.9	61.3	60.5	59.9	59.0	59.0
Average Adjusted Effluent Concentration					58.9 mg/L			Removal Efficiency					70.0 %		

SUSPENDED SEDIMENT REMOVAL EFFICIENCY AT A FLOW RATE OF 121 GPM

	Suspended Sediment Concentration (mg/L)														
Sample #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Effluent	72.0	72.8	71.7	72.1	70.1	72.1	69.3	72.3	77.2	71.0	70.7	72.7	71.1	70.4	73.0
Background	2		2		2		2		2		2		2		2
Adjusted Effluent	70.0	70.8	69.7	70.1	68.1	70.1	67.3	70.3	75.2*	69.0	68.7	70.7	69.1	68.4	71.0
Average Adjusted Effluent Concentration					69.9 mg/L			Removal Efficiency					65.3%		

*Note: This data point was considered to be a significant outlier and was therefore omitted as part of the overall statistical calculations to verify performance at a 95% level of confidence.

Verification

This verification was completed by the Verification Expert, the Centre for Advancement of Water and Wastewater Technologies ("CAWT"), contracted by GLOBE Performance Solutions, using the International Standard ***ISO 14034:2016 Environmental Management -- Environmental Technology Verification (ETV)***. Data and information provided by Cultec to support the performance claim included the final test report prepared by Good Harbour Laboratories of Mississauga, Ontario and dated November 9, 2017. The test report is based on testing completed in compliance with the requirements of ISO/IEC 17025.

What is ISO14034:2016 Environmental Management – Environmental Technology Verification (ETV)?

ISO 14034:2016 specifies principles, procedures and requirements for environmental technology verification (ETV), and was developed and published by the *International Organization for Standardization (ISO)*. The objective of ETV is to provide credible, reliable and independent verification of the performance of environmental technologies. An environmental technology is a technology that either results in an environmental added value or measures parameters that indicate an environmental impact. Such technologies have an increasingly important role in addressing environmental challenges and achieving sustainable development.

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