STORMWATER MANAGEMENT REPORT
Proposed Retail Motor Fuel Outlet
Site Re-Development
234 & 236 HAYNES STREET (ROUTE 15)
STURBRIDGE, MASSACHUSETTS

Prepared for:

Petrogas Group New England, Inc.
168 North Main Street
Andover, MA 01810

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Prepared By:

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MHF Project No. 419217

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SECTION 1 EXECUTIVE SUMMARY

This report contains a stormwater management analysis for the proposed retail motor fuel outlet redevelopment located at 234 & 236 Haynes Street (Route 15) in Sturbridge, Massachusetts. The analysis includes both pre- and post-development calculations of stormwater runoff rates at specific locations on the project site and has been prepared in accordance with both Town of Sturbridge requirements and the guidelines contained in the Massachusetts Department of Environmental Protection (MassDEP) Massachusetts Stormwater Handbook; Volumes 1-3.

The project site consists of 4 parcels totaling 16.4 acres +/- located on the northeast corner of Haynes Street and Mashapaug Road. The study watershed area is approximately 5.74 acres in size encompassing the redevelopment site and surrounding buffer areas which are tributary to a section of stream which bisects the site via an existing 36"CMP culvert. There are onsite wetland areas to the north and south which ultimately discharge to the stream culvert. The site project area is currently fully developed with little to no stormwater management measures in place. Untreated runoff either sheet flows to the adjacent wetlands or is discharged directly into the stream culvert via a series of onsite catch basin structures.

Petrogas Group New England, Inc. is proposing to redevelop this existing gas station / restaurant site. The redevelopment includes remodeling the existing restaurant and converting to a retail motor fuel outlet which includes a 6,680sf convenience store and two fast food establishments with a drive-thru window and a retail fuel dispensing area with 6 fuel dispensers (12 fueling location) and an overhead canopy, and 4 diesel truck dispensers (3 diesel fueling locations) and an overhead canopy. Site work will also include reconfigured parking facilities, site grading, erosion control measures, utility connections, septic system improvements, a new well, and construction of a new stormwater management system.

This project, which is considered a redevelopment project under the DEP Stormwater Policy Standards, provides significant onsite stormwater management improvements in comparison to the existing site conditions. To accommodate the stormwater runoff from the new impervious surfaces on the property, a new closed drainage system consisting of deep-sump, hooded catch basins, multiple First Defense hydrodynamic separator (water quality) units, three 3,500 gallon oil/water separators, and an above ground roof infiltration basin will be constructed. The BMP's included in the proposed stormwater system are designed in accordance with Mass DEP Stormwater Policy Standards, and will improve stormwater quality and quantity to all design points.

The results of the pre- and post-development stormwater analysis at the design point are summarized as shown in the following table:

Table 1: Analysis Summary

Design Storm	Pre-Development (cfs)	Post-Development (cfs)	Change (cfs)
DESIGN POINT #1 (Stream Culvert)			
2-year	4.3	4.4	0.1
10-year	8.9	8.1	0.0
100-year	16.9	13.5	-3.4
DESIGN POINT #2 (Route 15 Roadway)			
2-year	0.2	0.2	0.0
10-year	0.3	0.4	0.1
100-year	0.5	0.5	0.0

(All values shown are peak rates in CFS)

In conclusion, by incorporating a new on-site drainage system that includes provisions for stormwater treatment, detention, and infiltration there will be no increase in the peak rate of runoff leaving the property as a result of this project.

SECTION 2 EXISTING CONDITIONS

The project site consists of 4 parcels totaling 16.4 acres +/- located on the northeast corner of Haynes Street (Route 15) and Mashapaug Road. The existing development spans Parcels 234 & 236 with a portion of Parcel 228 being used for the septic system servicing the existing restaurant. The remaining lot is a frontage lot along Mashapaug Road which is currently vacant and primarily consists of wetlands. Parcel 234 is currently occupied by a vacant 6,470 sf former restaurant building with an associated paved parking area. Parcel 236 includes a motor fuel outlet consisting of a 2,250 sf convenience store and a retail fuel dispensing area with 4 dispensers (8 fueling locations) along with a separate diesel fuel dispensing area with 1 fuel dispenser (2 diesel truck fueling locations). There are two access driveways along Rte 15 and a third curb cut along Mashapaug Road which are all located on Parcel 236 but service both developments.

The existing development is an upland area along Rte 15 and is bordered by wetlands to the north and south. There is an existing 36" CMP stream culvert that bisects the site flowing northerly from Mashapaug Road running behind the convenience store and under the corner of the existing restaurant building before exiting the site and becoming part of the MassDOT closed drainage system along Route 15. The elevation of the stream culvert is approximately 17 feet below the parking lot grades and there are a number of onsite catch basin structures that discharge the majority of the existing pavement areas directly to the culvert. Portions of the development sheet flow directly to the surrounding wetlands without treatment.

An examination of the soil map for the area as published on the NRCS Web Soil Survey website indicates that the soil in the area of the project site are identified as "Udorthents" with surrounding areas being identified as "Merrimac" fine sandy loam and "Hinckley" loamy sand which both have a hydrologic soil group classification "A."

On-site test pits were performed for purposes of identifying the seasonal high water table. The observed seasonal high water table was found to range from approximately 24" to 72". Test pit logs can be found in Appendix C of this report.

SECTION 3 PROPOSED CONDITIONS

Petrogas Group New England, Inc. is proposing to redevelop this existing gas station / restaurant site. The redevelopment includes remodeling the existing restaurant and converting to a retail motor fuel outlet which includes a 6,680sf convenience store and two fast food establishments with a drive-thru window and a retail fuel dispensing area with 6 fuel dispensers (12 fueling location) and an overhead canopy, and 4 diesel truck dispensers (3 diesel fueling locations) and an overhead canopy. Site work will also include reconfigured parking facilities, site grading, erosion control measures, utility connections, septic system improvements, a new well, and construction of a new stormwater management system.

This project, which is considered a redevelopment project under the DEP Stormwater Policy Standards, provides significant onsite stormwater management improvements in comparison to the existing site conditions while meeting the DEP stormwater standards to the maximum extent practicable. To accommodate the stormwater runoff from the new impervious surfaces on the property, a new closed drainage system consisting of deep-sump, hooded catch basins, multiple First Defense hydrodynamic separator (water quality) units, three 3,500 gallon oil/water separators, and an above ground roof infiltration basin will be constructed.

Additional stormwater management measures were considered, including bioretention basins and gravel wetlands; however, implementation of these BMPs would have required additional disturbance within the local Town of Sturbridge Wetland Buffers. Furthermore, the onsite test pits identify a high groundwater table in the buffer area to the rear of the existing convenience store where the BMPs were considered. This is also the location of an existing leach field servicing the convenience store.

The BMP's included in the proposed stormwater system are designed in accordance with Mass DEP Stormwater Policy Standards, and will improve stormwater quality and quantity to all design points.

In order to safeguard against oil or gas introduction into the drainage systems, storm water runoff from parking areas and driveways would be collected into hooded catch basins with deep sumps (see Site Plan Details). Such pretreatment of storm water reduces both suspended solids and oils in the drainage system and is recommended by DEP's Stormwater Management Handbook. Runoff would then further be treated by means of an oil/water separator and a First Defense hydrodynamic separator (water quality) unit designed to filter suspended solids/silt/debris.

Stormwater recharge is implemented to the maximum extent practicable by the use of an above ground infiltration basin. The basin receives runoff from the clean roof tops of the canopy and convenience store. No recharge of stormwater generated from the LUHPPL use areas onsite is proposed. In addition to the recharge basin provided, the proposed redevelopment also reduces impervious area by approximately 7,000 sf.

Another safeguard against future intrusion of contaminants into the groundwater is the implementation of an Operation & Maintenance Plan, which would assure proper function of drainage components and reduce TSS entering the system.

To prevent erosion and sedimentation during construction, Best Management Practices including stabilized construction exits, silt fence, catch basin inserts, and temporary and permanent seeding have been incorporated into the construction sequence.

The total area of disturbance related to the proposed construction on this property is approximately 225,000 square feet therefore the project is subject to the US EPA Construction General Permit requirements.

Storm water Quality Controls:

1. **Street Sweeping** - to capture sediment prior to entering the drainage system. This would be done on a scheduled basis. TSS Removal Rate = 5%
2. **Hooded Catch Basins with Deep Sumps** to capture, treat and redirect storm water toward the proposed above and underground detention systems. TSS Removal Rate = 25%
3. **Oil/Grit Separators** to provide additional pretreatment, as well sediment & oil storage capacity prior to discharge to the underground systems. TSS Removal Rate = 25%
4. **First Defense units** – to provide adequate pretreatment and TSS removal of stormwater runoff from a LUHPPL prior to discharge to the infiltration basin. TSS removal rate = 80%.
5. **Infiltration Basin** – to recharge canopy & C-store rooftop. TSS removal rate = 80%

Groundwater Recharge:

In order to provide groundwater recharge to the maximum extent practicable, the site plans have incorporated an above ground infiltration basin which receives building/canopy roof runoff. Calculations supporting the rates and capacities are included below.

In addition to the recharge basin provided, the proposed redevelopment also reduces impervious area by approximately 7,000 sf.

Stormwater Quantity Controls:

The **infiltration system** was designed to detain and recharge all runoff generated from the onsite roof/canopy areas for the 2, 10 & 100-year events without overtopping the emergency overflow weir.

The redevelopment plan proposes to remove approximately 7,000 sf of impervious area which will also reduce runoff.

The overall system thereby achieves the following:

- Control of runoff rates to abutting properties.
- Water quality maintenance – TSS removal from storm water of more than 80%.

The points of analysis are the existing steam culvert and the Haynes Street drainage system.

Stormwater Management & Water Quality Calculations:

Standard # 1: Untreated Stormwater

- Full Compliance

No new storm water conveyances are to discharge untreated storm water directly to or cause erosion in wetlands or waters of the Commonwealth.

Standard # 2: Post Development Peak Discharge Rates

- Full Compliance

The storm water management system is designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates.

Standard # 3: Groundwater Recharge

- Compliance to the maximum extent practicable. An infiltration basin is proposed to recharge roof runoff. No recharge of LUHPPL areas is proposed.

Proposed recharge systems: Roof infiltration basin.

In accordance with Massachusetts stormwater policy, **A** soils require a volume to recharge of **0.6 inches of runoff**.

Total Proposed onsite impervious area = 93,515 sf

Volume required to be recharged:

A-soils = 0.6 inches x 1ft/ 12" x 93,515 sf = **4,676 c.f.**

Total Site Volume required to be recharged = 4,676 c.f.

Site recharge volume provided = Volume within the infiltration basin below the lowest outlet elevation (measured statically).

Total Volume Provided = **2,739 c.f.** (See attached Hydrocad Stage-Storage tables)

= **2,739 c.f.** Total Volume Recharged <1,876 c.f. (Maximum extent practicable)

Standard # 4: TSS Removal

- Full Compliance

Explanation of systems:

Pavement areas directly associated with the fueling activities would be treated by hooded Catch Basins with deep sumps prior to discharge into an Oil/Grit Separator then by a First Defense hydrodynamic separator (water quality) unit. Remaining paved areas are treated by First Defense units.

Canopy and C-Store runoff would be routed into the infiltration BMP for recharge.

Calculations: Water Quality Volume

Roof & Canopy Runoff (Non-LUHPPL):

WQV = 0.5" x Impervious Area

= 0.5" x 1ft/ 12" x 12,939 sf = **539 c.f.**

Onsite Pavement Runoff (LUHPPL):

WQV = 1.0" x Impervious Area

= 1.0" x 1ft/ 12" x 80,576 sf = **6,715 c.f.**

Total Site WQV Required = 7,254 c.f.

Calculations: TSS Removal

Drainage Area	BMP	TSS Removal Rate
Driveway/Parking	Street Sweeping	5%
Driveway/Parking	Catch Basin w/sump	25%
Driveway/Parking	First Defense	80%
Driveway/Parking/Roofs	Infiltration Systems	80%
Driveway/Parking	Oil/Grit Separators	25%

C-Store roof & canopy runoff:

Beginning Load: 1.00 x Infiltration System removal rate (0.80) = **0.80**

Load Remaining = 1.00 – 0.80 = 0.20

TSS Removal Rate = (1.00 – 0.20) = **80%**

Note: Roof runoff from Non-metal roofs does not require pretreatment; however, the C-Store and canopy runoff meet the required 80% TSS removal from treatment by the Infiltration System.

Runoff to CB #s 1 & 2:

Beginning Load: 1.00 x Street Sweeping removal rate (0.05) = **0.05**

Load Remaining = 1.00 – 0.05 = 0.95

Remaining Load: 0.95 x Catch Basin w/ sump removal rate (0.25) = **0.24**

Load Remaining = 0.95 – 0.24 = 0.71

Remaining Load: 0.71 x First Defense removal rate (0.80) = **0.58**

Load Remaining = 0.71 – 0.58 = 0.13

TSS Removal Rate = (1.00 – 0.13) = **87%**

Runoff to CB #s 3, 8 & 13:

Beginning Load: 1.00 x Street Sweeping removal rate (0.05) = 0.05

Load Remaining = 1.00 – 0.05 = 0.95

Remaining Load: 0.95 x First Defense removal rate (0.80) = 0.76

Load Remaining = 0.95 – 0.76 = 0.19

TSS Removal Rate = (1.00 – 0.19) = 81%

Runoff from paved surfaces near fueling areas:

Beginning Load: 1.00 x Street Sweeping removal rate (0.05) = 0.05

Load Remaining = 1.00 – 0.05 = 0.95

Remaining Load: 0.95 x Catch Basin w/ sump removal rate (0.25) = 0.24

Load Remaining = 0.95 – 0.24 = 0.71

Remaining Load: 0.71 x Oil/Water separator removal rate (0.25) = 0.18

Load Remaining = 0.71 – 0.18 = 0.53

Remaining Load: 0.53 x First Defense removal rate (0.80) = 0.42

Load Remaining = 0.53 – 0.42 = 0.11

TSS Removal Rate = (1.00 – 0.13) = 89%

Standard # 5: Higher potential pollutant loads

The site does contain land uses with higher potential pollutant loads as it is a gas station development.

Standard # 6: Protection of critical areas

The site is located within Zone I & IWPAs for the existing public water supply wells onsite which are to be decommissioned and/or relocated as part of the proposed redevelopment project.

Standard # 7: Redevelopment projects

The site is a redevelopment project.

Standard # 8: Erosion/sediment control

Erosion and sediment controls are incorporated into the project design to prevent erosion. A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan is included in Appendix F of this report.

Standard #9: Operation/maintenance plan

A long term operation and maintenance plan meeting the requirements of this standard has been prepared and is included as a separate document.

Standard #10: (Illicit Discharges)

To the best of our knowledge, the site does not contain any illicit discharges.

SECTION 4 STORMWATER MODELING METHODOLOGY

The drainage system for this project was modeled using HydroCAD, a stormwater modeling computer program that analyzes the hydrology, and hydraulics of stormwater runoff. HydroCAD is based largely on the hydrology techniques developed by the Soil Conservation Service (SCS/NRCS), combined with other hydrology and hydraulics calculations. For a given rainfall event, these techniques are used to generate hydrographs throughout a watershed. This provides verification that a given drainage system is adequate for the area under consideration, or to predict where flooding or erosion is likely to occur.

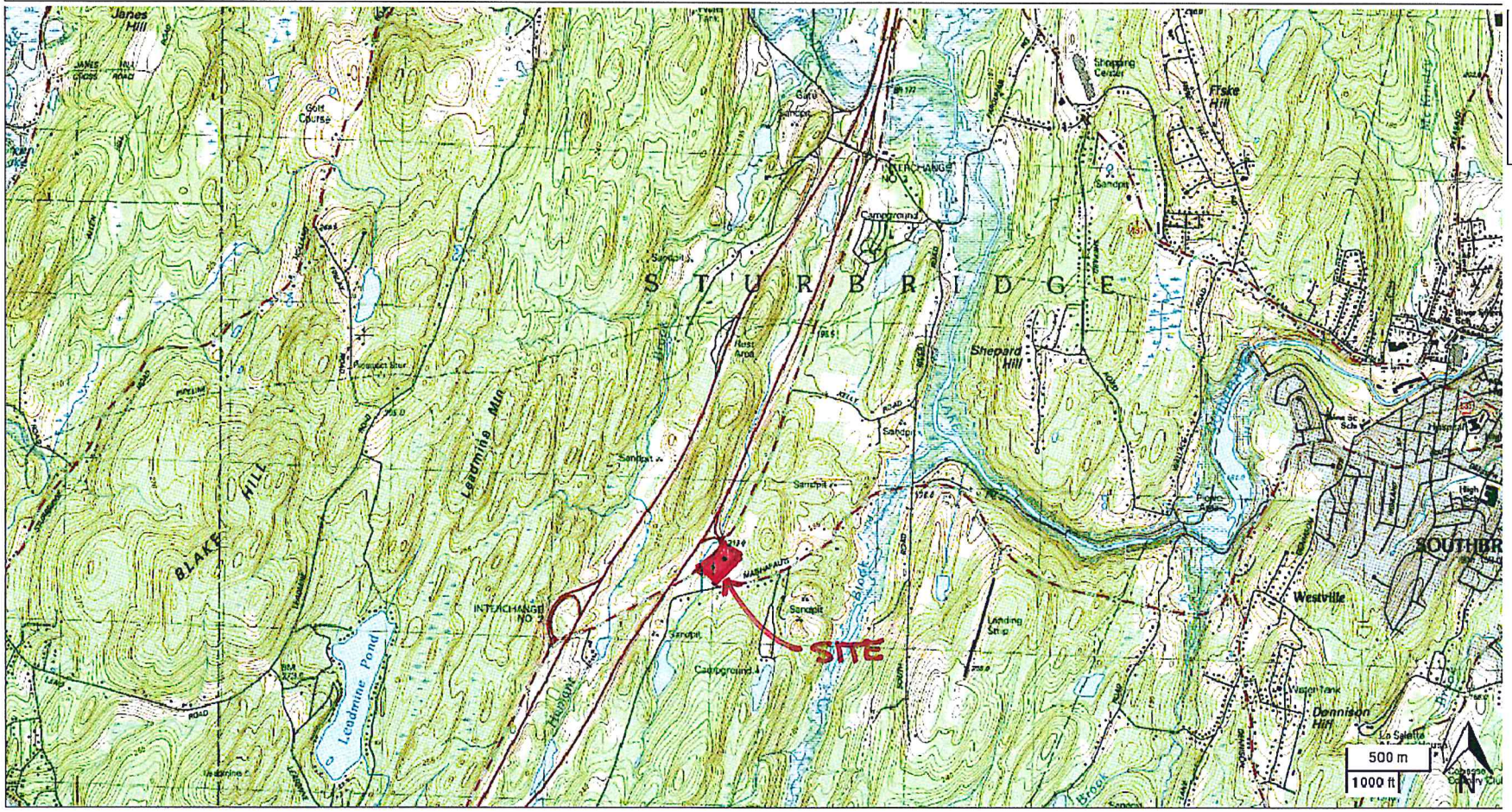
In HydroCAD, each watershed is modeled as a Subcatchment, streams and culverts as a Reach (or Pond, depending on available storage capacity), and large wetlands and other natural or artificial storage areas as a Pond. SCS hydrograph generation and routing procedures were used to model both Pre-development and Post-development runoff conditions.

The Pre-development and Post-development watershed limits and the subcatchment characteristics were determined using both USGS and on-the-ground topographic survey information and through visual, on-site inspection. Conservative estimates were used at all times in estimating the hydrologic characteristics of each watershed or subcatchment.

APPENDIX A

USGS Map

Sturbridge USGS



USGS Topographic Maps

Detailed Features

MassGIS Statewide Baseme
MassGIS Topographic Featu

APPENDIX B

NRCS Soil Information

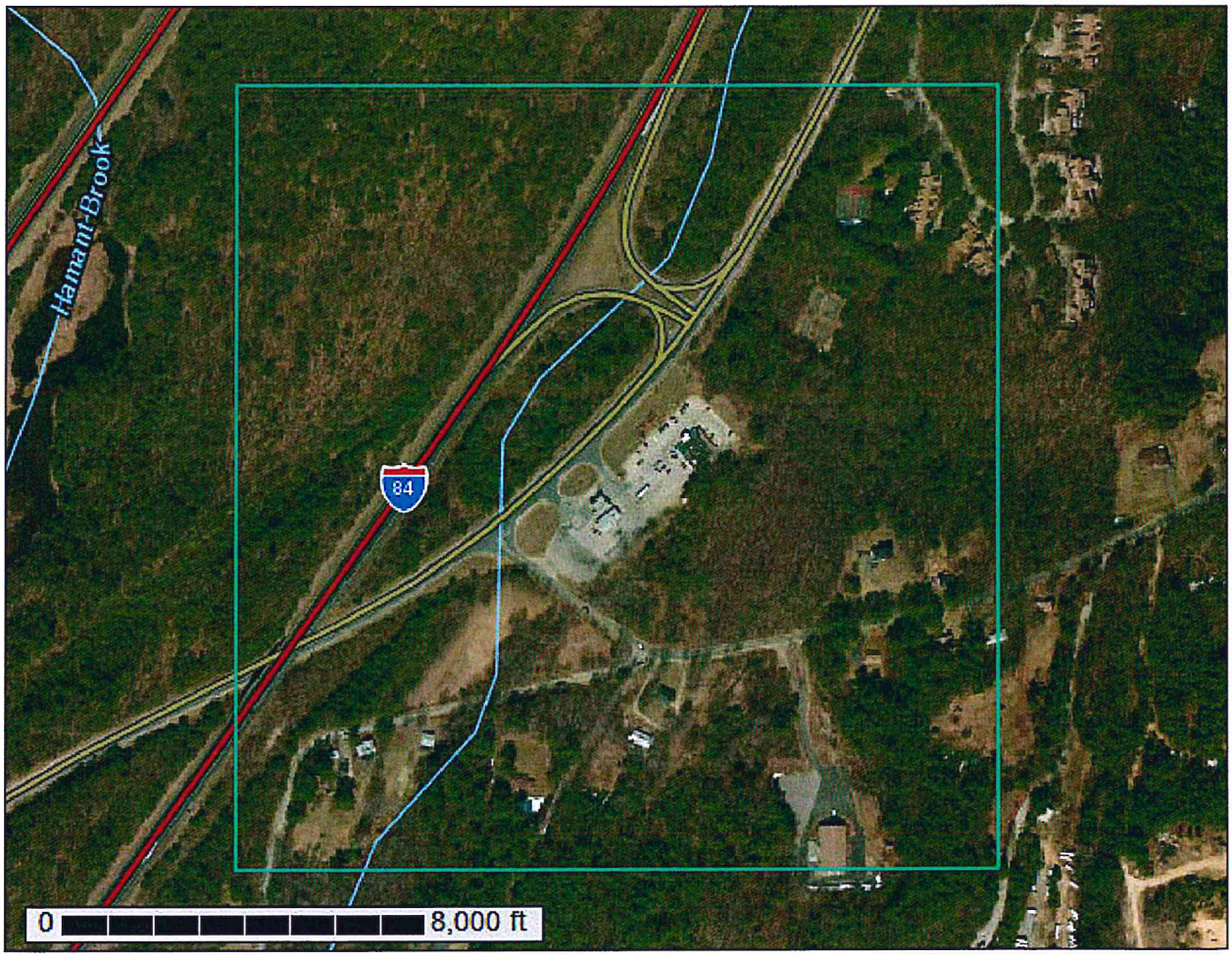
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for Worcester County, Massachusetts, Southern Part



January 17, 2018

Preface

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

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

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

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

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

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

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Contents

How Soil Surveys Are Made

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

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

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

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

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

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

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

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

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

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

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

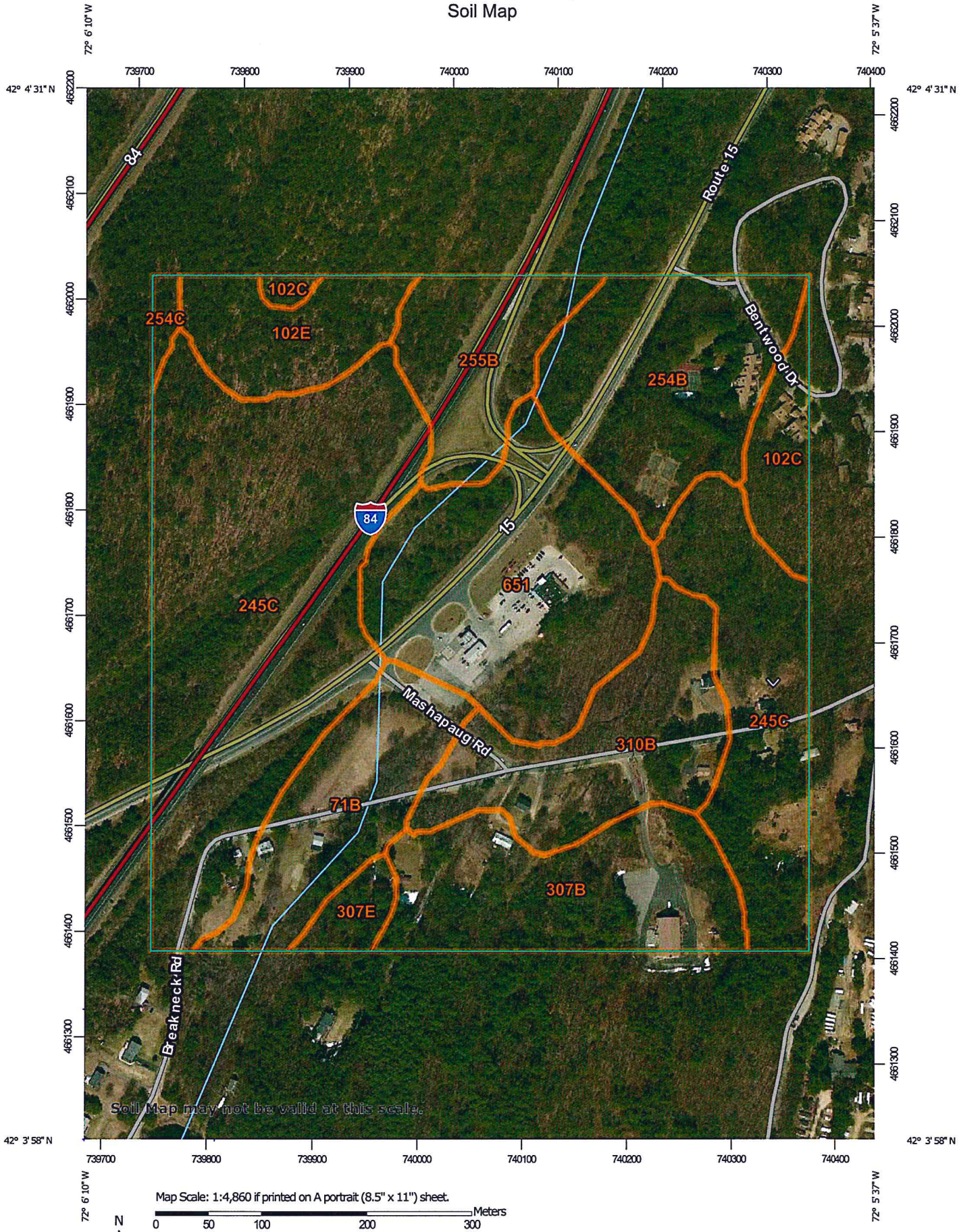
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

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

Custom Soil Resource Report
Soil Map



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 1:25,000.

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

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

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

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

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

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

Soil Survey Area: Worcester County, Massachusetts, Southern Part
Survey Area Data: Version 10, Oct 6, 2017

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

Date(s) aerial images were photographed: Apr 8, 2011—Apr 9, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND

MAP INFORMATION

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
71B	Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony	7.3	7.3%
102C	Chatfield-Hollis-Rock outcrop complex, 0 to 15 percent slopes	3.1	3.1%
102E	Chatfield-Hollis-Rock outcrop complex, 15 to 35 percent slopes	4.7	4.7%
245C	Hinckley loamy sand, 8 to 15 percent slopes	33.6	33.7%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	10.4	10.5%
254C	Merrimac fine sandy loam, 8 to 15 percent slopes	0.5	0.5%
255B	Windsor loamy sand, 3 to 8 percent slopes	5.9	5.9%
307B	Paxton fine sandy loam, 0 to 8 percent slopes, extremely stony	9.7	9.8%
307E	Paxton fine sandy loam, 15 to 35 percent slopes, extremely stony	1.3	1.3%
310B	Woodbridge fine sandy loam, 3 to 8 percent slopes	9.0	9.1%
651	Udorthents, smoothed	14.2	14.2%
Totals for Area of Interest		**99.7**	**100.0%**

Map Unit Descriptions

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

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

up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

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

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

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

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

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

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

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

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

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

Worcester County, Massachusetts, Southern Part

71B—Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2w69c
Elevation: 0 to 1,290 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Ridgebury, Extremely Stony

Setting

Landform: Depressions, hills, ground moraines, drumlins, drainageways
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope, head slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 6 inches: fine sandy loam
Bw - 6 to 10 inches: sandy loam
Bg - 10 to 19 inches: gravelly sandy loam
Cd - 19 to 66 inches: gravelly sandy loam

Properties and qualities

Slope: 3 to 8 percent
Percent of area covered with surface fragments: 9.0 percent
Depth to restrictive feature: 15 to 35 inches to densic material
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Hydric soil rating: Yes

Minor Components

Woodbridge, extremely stony
Percent of map unit: 10 percent
Landform: Hills, ground moraines, drumlins
Landform position (two-dimensional): Footslope, summit, backslope
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Whitman, extremely stony
Percent of map unit: 8 percent
Landform: Depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Paxton, extremely stony
Percent of map unit: 2 percent
Landform: Hills, ground moraines, drumlins
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Hydric soil rating: No

102C—Chatfield-Hollis-Rock outcrop complex, 0 to 15 percent slopes

Map Unit Setting
National map unit symbol: 2w69g
Elevation: 0 to 1,540 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition
Chatfield, extremely stony, and similar soils: 39 percent
Hollis, extremely stony, and similar soils: 26 percent
Rock outcrop: 17 percent
Minor components: 18 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chatfield, Extremely Stony

Setting
Landform: Hills, ridges
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Crest, side slope, nose slope

Down-slope shape: Convex
Across-slope shape: Linear, convex
Parent material: Coarse-loamy melt-out till derived from granite, gneiss, and/or schist

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
A - 1 to 2 inches: fine sandy loam
Bw - 2 to 30 inches: gravelly fine sandy loam
2R - 30 to 40 inches: bedrock

Properties and qualities

Slope: 0 to 15 percent
Percent of area covered with surface fragments: 9.0 percent
Depth to restrictive feature: 20 to 41 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: B
Hydric soil rating: No

Description of Hollis, Extremely Stony

Setting

Landform: Hills, ridges
Landform position (two-dimensional): Shoulder, summit, backslope
Landform position (three-dimensional): Crest, side slope, nose slope
Down-slope shape: Convex
Across-slope shape: Linear, convex
Parent material: Coarse-loamy melt-out till derived from granite, gneiss, and/or schist

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A - 2 to 7 inches: gravelly fine sandy loam
Bw - 7 to 16 inches: gravelly fine sandy loam
2R - 16 to 26 inches: bedrock

Properties and qualities

Slope: 0 to 15 percent
Percent of area covered with surface fragments: 9.0 percent
Depth to restrictive feature: 8 to 23 inches to lithic bedrock
Natural drainage class: Somewhat excessively drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches

Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Hydric soil rating: No

Description of Rock Outcrop

Setting

Parent material: Igneous and metamorphic rock

Properties and qualities

Slope: 0 to 15 percent
Depth to restrictive feature: 0 inches to lithic bedrock
Runoff class: Very high

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Charlton, extremely stony

Percent of map unit: 12 percent
Landform: Hills, ridges
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Sutton, extremely stony

Percent of map unit: 3 percent
Landform: Ground moraines, hills
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Paxton, extremely stony

Percent of map unit: 2 percent
Landform: Hills, ground moraines, drumlins
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex, linear
Hydric soil rating: No

Leicester, extremely stony

Percent of map unit: 1 percent

Landform: Depressions, hills, ground moraines, drainageways
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear, concave
Across-slope shape: Concave
Hydric soil rating: Yes

102E—Chatfield-Hollis-Rock outcrop complex, 15 to 35 percent slopes

Map Unit Setting

National map unit symbol: 2w69h
Elevation: 0 to 1,540 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Chatfield, extremely stony, and similar soils: 35 percent
Hollis, extremely stony, and similar soils: 30 percent
Rock outcrop: 20 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chatfield, Extremely Stony

Setting

Landform: Hills, ridges
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Crest, side slope, nose slope
Down-slope shape: Convex
Across-slope shape: Convex, linear
Parent material: Coarse-loamy melt-out till derived from granite, gneiss, and/or schist

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
A - 1 to 2 inches: fine sandy loam
Bw - 2 to 30 inches: gravelly fine sandy loam
2R - 30 to 40 inches: bedrock

Properties and qualities

Slope: 15 to 35 percent
Percent of area covered with surface fragments: 9.0 percent
Depth to restrictive feature: 20 to 41 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: High

Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: B
Hydric soil rating: No

Description of Hollis, Extremely Stony

Setting

Landform: Hills, ridges
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Side slope, nose slope, crest
Down-slope shape: Convex
Across-slope shape: Linear, convex
Parent material: Coarse-loamy melt-out till derived from granite, gneiss, and/or schist

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A - 2 to 7 inches: gravelly fine sandy loam
Bw - 7 to 16 inches: gravelly fine sandy loam
2R - 16 to 26 inches: bedrock

Properties and qualities

Slope: 15 to 35 percent
Percent of area covered with surface fragments: 9.0 percent
Depth to restrictive feature: 8 to 23 inches to lithic bedrock
Natural drainage class: Somewhat excessively drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Hydric soil rating: No

Description of Rock Outcrop

Setting

Landform: Hills, ridges
Parent material: Igneous and metamorphic rock

Typical profile

R - 0 to 79 inches: bedrock

Properties and qualities

Slope: 15 to 35 percent
Depth to restrictive feature: 0 inches to lithic bedrock
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Available water storage in profile: Very low (about 0.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Charlton, extremely stony

Percent of map unit: 7 percent
Landform: Hills, ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Leicester, extremely stony

Percent of map unit: 4 percent
Landform: Depressions, hills, ground moraines, drainageways
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear, concave
Across-slope shape: Concave
Hydric soil rating: Yes

Sutton, extremely stony

Percent of map unit: 2 percent
Landform: Hills, ground moraines
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Paxton, extremely stony

Percent of map unit: 2 percent
Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Hydric soil rating: No

245C—Hinckley loamy sand, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2svm9
Elevation: 0 to 1,480 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Hinckley

Setting

Landform: Moraines, kame terraces, outwash terraces, outwash deltas, eskers, outwash plains, kames
Landform position (two-dimensional): Shoulder, toeslope, footslope, backslope
Landform position (three-dimensional): Nose slope, side slope, crest, head slope, riser
Down-slope shape: Convex, linear, concave
Across-slope shape: Linear, convex, concave
Parent material: Sandy and gravelly glaciofluvial deposits derived from gneiss and/or granite and/or schist

Typical profile

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

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)

Available water storage in profile: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Merrimac

Percent of map unit: 5 percent
Landform: Moraines, outwash terraces, eskers, outwash plains, kames
Landform position (two-dimensional): Shoulder, backslope, footslope, toeslope
Landform position (three-dimensional): Side slope, crest, head slope, nose slope, riser
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Windsor

Percent of map unit: 5 percent
Landform: Moraines, kame terraces, outwash terraces, outwash deltas, eskers, outwash plains, kames
Landform position (two-dimensional): Shoulder, backslope, footslope, toeslope
Landform position (three-dimensional): Nose slope, side slope, crest, head slope, riser
Down-slope shape: Convex, linear, concave
Across-slope shape: Linear, convex, concave
Hydric soil rating: No

Sudbury

Percent of map unit: 5 percent
Landform: Moraines, outwash terraces, kame terraces, outwash deltas, outwash plains
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Concave, linear
Across-slope shape: Linear, concave
Hydric soil rating: No

254B—Merrimac fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2tyqs
Elevation: 0 to 1,290 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Merrimac

Setting

Landform: Moraines, outwash terraces, eskers, kames, outwash plains
Landform position (two-dimensional): Backslope, footslope, summit, shoulder
Landform position (three-dimensional): Side slope, crest, riser, tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy glaciofluvial deposits derived from granite, schist, and gneiss over sandy and gravelly glaciofluvial deposits derived from granite, schist, and gneiss

Typical profile

Ap - 0 to 10 inches: fine sandy loam
Bw1 - 10 to 22 inches: fine sandy loam
Bw2 - 22 to 26 inches: stratified gravel to gravelly loamy sand
2C - 26 to 65 inches: stratified gravel to very gravelly sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 2 percent
Salinity, maximum in profile: Nonsaline (0.0 to 1.4 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 1.0
Available water storage in profile: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Sudbury

Percent of map unit: 5 percent
Landform: Deltas, terraces, outwash plains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Hinckley

Percent of map unit: 5 percent
Landform: Deltas, eskers, outwash plains, kames
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Nose slope, side slope, crest, head slope, rise
Down-slope shape: Convex
Across-slope shape: Convex, linear
Hydric soil rating: No

Windsor

Percent of map unit: 3 percent
Landform: Deltas, outwash terraces, outwash plains, dunes
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Riser, tread
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Hydric soil rating: No

Agawam

Percent of map unit: 2 percent
Landform: Moraines, outwash terraces, eskers, kames, outwash plains, stream terraces
Landform position (three-dimensional): Rise
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

254C—Merrimac fine sandy loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2tyqt
Elevation: 0 to 1,030 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Merrimac

Setting

Landform: Moraines, outwash terraces, eskers, kames, outwash plains
Landform position (two-dimensional): Backslope, footslope, summit, shoulder
Landform position (three-dimensional): Side slope, crest, riser, tread
Down-slope shape: Convex

Across-slope shape: Convex
Parent material: Loamy glaciofluvial deposits derived from granite, schist, and gneiss over sandy and gravelly glaciofluvial deposits derived from granite, schist, and gneiss

Typical profile

Ap - 0 to 10 inches: fine sandy loam
Bw1 - 10 to 22 inches: fine sandy loam
Bw2 - 22 to 26 inches: stratified gravel to gravelly loamy sand
2C - 26 to 65 inches: stratified gravel to very gravelly sand

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 2 percent
Salinity, maximum in profile: Nonsaline (0.0 to 1.4 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 1.0
Available water storage in profile: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Hinckley

Percent of map unit: 5 percent
Landform: Deltas, eskers, outwash plains, kames
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Nose slope, side slope, crest, head slope, rise
Down-slope shape: Convex
Across-slope shape: Convex, linear
Hydric soil rating: No

Sudbury

Percent of map unit: 5 percent
Landform: Deltas, terraces, outwash plains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Windsor

Percent of map unit: 5 percent
Landform: Deltas, outwash terraces, outwash plains, dunes
Landform position (two-dimensional): Backslope

Landform position (three-dimensional): Riser, tread
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Hydric soil rating: No

255B—Windsor loamy sand, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2svkf
Elevation: 0 to 1,210 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Windsor, Loamy Sand

Setting

Landform: Deltas, outwash terraces, outwash plains, dunes
Landform position (three-dimensional): Riser, tread
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Parent material: Loose sandy glaciofluvial deposits derived from granite and/or loose sandy glaciofluvial deposits derived from schist and/or loose sandy glaciofluvial deposits derived from gneiss

Typical profile

O - 0 to 1 inches: moderately decomposed plant material
A - 1 to 3 inches: loamy sand
Bw - 3 to 25 inches: loamy sand
C - 25 to 65 inches: sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Hinckley, loamy sand

Percent of map unit: 10 percent
Landform: Deltas, eskers, outwash plains, kames
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Head slope, nose slope, side slope, crest, rise
Down-slope shape: Convex
Across-slope shape: Convex, linear
Hydric soil rating: No

Deerfield, loamy sand

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

307B—Paxton fine sandy loam, 0 to 8 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2w675
Elevation: 0 to 1,580 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Paxton, Extremely Stony

Setting

Landform: Hills, ground moraines, drumlins
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex, linear

Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Oe - 0 to 2 inches: moderately decomposed plant material
A - 2 to 10 inches: fine sandy loam
Bw1 - 10 to 17 inches: fine sandy loam
Bw2 - 17 to 28 inches: fine sandy loam
Cd - 28 to 67 inches: gravelly fine sandy loam

Properties and qualities

Slope: 0 to 8 percent
Percent of area covered with surface fragments: 9.0 percent
Depth to restrictive feature: 20 to 43 inches to densic material
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 18 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Woodbridge, extremely stony

Percent of map unit: 10 percent
Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Backslope, footslope, summit
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Charlton, extremely stony

Percent of map unit: 5 percent
Landform: Hills
Landform position (two-dimensional): Shoulder, summit, backslope
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Ridgebury, extremely stony

Percent of map unit: 4 percent
Landform: Depressions, hills, ground moraines, drumlins, drainageways
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope, head slope
Down-slope shape: Concave
Across-slope shape: Concave

Hydric soil rating: Yes

Whitman, extremely stony

Percent of map unit: 1 percent
Landform: Depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

307E—Paxton fine sandy loam, 15 to 35 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2w67m
Elevation: 310 to 1,130 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Paxton, extremely stony, and similar soils: 75 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Paxton, Extremely Stony

Setting

Landform: Hills, ground moraines, drumlins
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex, linear
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Oe - 0 to 2 inches: moderately decomposed plant material
A - 2 to 10 inches: fine sandy loam
Bw1 - 10 to 17 inches: fine sandy loam
Bw2 - 17 to 28 inches: fine sandy loam
Cd - 28 to 67 inches: gravelly fine sandy loam

Properties and qualities

Slope: 15 to 35 percent
Percent of area covered with surface fragments: 9.0 percent
Depth to restrictive feature: 20 to 43 inches to densic material
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 18 to 37 inches

Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Charlton, extremely stony

Percent of map unit: 20 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Woodbridge, extremely stony

Percent of map unit: 4 percent
Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Ridgebury, extremely stony

Percent of map unit: 1 percent
Landform: Depressions, hills, ground moraines, drumlins, drainageways
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope, head slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

310B—Woodbridge fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2t2ql
Elevation: 0 to 1,470 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Woodbridge, fine sandy loam, and similar soils: 82 percent
Minor components: 18 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Woodbridge, Fine Sandy Loam

Setting

Landform: Hills, ground moraines, drumlins
Landform position (two-dimensional): Backslope, footslope, summit
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Ap - 0 to 7 inches: fine sandy loam
Bw1 - 7 to 18 inches: fine sandy loam
Bw2 - 18 to 30 inches: fine sandy loam
Cd - 30 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 20 to 39 inches to densic material
Natural drainage class: Moderately well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C/D
Hydric soil rating: No

Minor Components

Paxton

Percent of map unit: 10 percent
Landform: Hills, ground moraines, drumlins
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest, nose slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Ridgebury

Percent of map unit: 8 percent
Landform: Depressions, hills, ground moraines, drainageways
Landform position (two-dimensional): Toeslope, backslope, footslope

Landform position (three-dimensional): Base slope, head slope, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

651—Udorthents, smoothed

Map Unit Setting

National map unit symbol: 9bfc
Elevation: 0 to 3,000 feet
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Udorthents

Setting

Parent material: Made land over firm coarse-loamy basal till and/or dense coarse-loamy lodgment till

Typical profile

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

Properties and qualities

Slope: 0 to 25 percent
Depth to restrictive feature: More than 80 inches
Runoff class: Low
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: No

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group

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

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

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

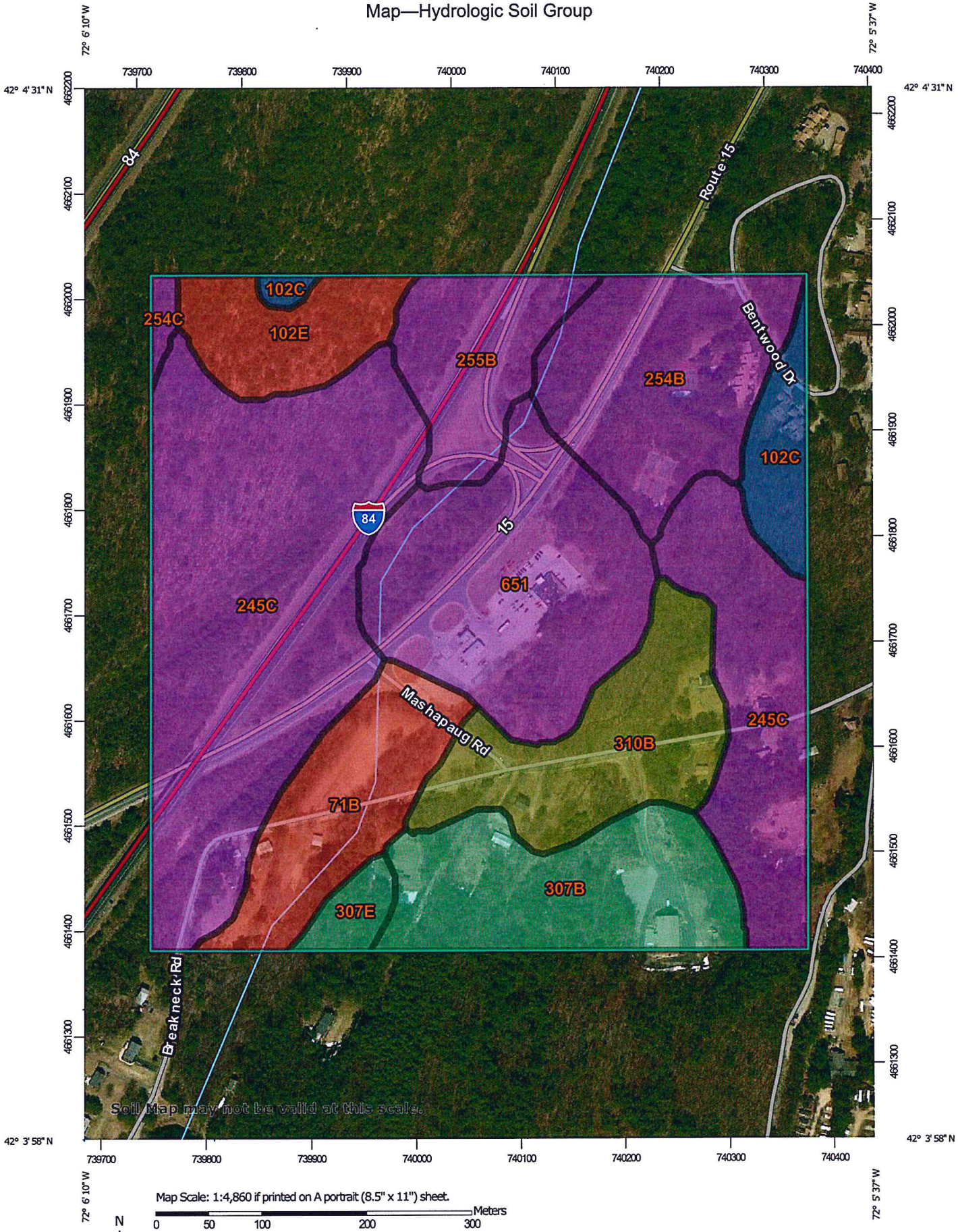
Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

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

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

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

Custom Soil Resource Report
Map—Hydrologic Soil Group



Map Scale: 1:4,860 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 18N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

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

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

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

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

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

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

Soil Survey Area: Worcester County, Massachusetts, Southern Part
Survey Area Data: Version 10, Oct 6, 2017

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

Date(s) aerial images were photographed: Apr 8, 2011—Apr 9, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND

MAP INFORMATION

imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
71B	Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony	D	7.3	7.3%
102C	Chatfield-Hollis-Rock outcrop complex, 0 to 15 percent slopes	B	3.1	3.1%
102E	Chatfield-Hollis-Rock outcrop complex, 15 to 35 percent slopes	D	4.7	4.7%
245C	Hinckley loamy sand, 8 to 15 percent slopes	A	33.6	33.7%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	A	10.4	10.5%
254C	Merrimac fine sandy loam, 8 to 15 percent slopes	A	0.5	0.5%
255B	Windsor loamy sand, 3 to 8 percent slopes	A	5.9	5.9%
307B	Paxton fine sandy loam, 0 to 8 percent slopes, extremely stony	C	9.7	9.8%
307E	Paxton fine sandy loam, 15 to 35 percent slopes, extremely stony	C	1.3	1.3%
310B	Woodbridge fine sandy loam, 3 to 8 percent slopes	C/D	9.0	9.1%
651	Udorthents, smoothed	A	14.2	14.2%
Totals for Area of Interest			**99.7**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

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APPENDIX C

Test Pit Logs

MHF Design Consultants, Inc.

44 Stiles Road • Suite One • Salem, New Hampshire 03079
TEL (603) 893-0720 • FAX (603) 893-0733
www.mhfdesign.com

TEST PIT DATA

Client: Petrogas Group New England, Inc.
Project Address: 236 Route 15
Town/State: Sturbridge, MA
Job Number: 419217
Date: October 10, 2017
Performed by: Diane Pantermoller

Test Pit No. **TP-1** SCS Soil:
ESHWT: 72" Standing Water: None
Refusal: >114" Roots: None

Depth	Horizon	Soil Texture	Color	Consistence	Mottles; Quantity/Contrast
0-60"	Fill	Sandy Fill			
60-114"	C	Sand	10yr 6/8	FR	@ 72" Faint

Test Pit No. **TP-2** SCS Soil:
ESHWT: 24" Standing Water: 40"
Refusal: >100" Roots: None

Depth	Horizon	Soil Texture	Color	Consistence	Mottles; Quantity/Contrast
0-5"	A	Loamy Sand	10yr 3/2	FR	
5-16"	B	Loamy Sand	10yr 5/6	FR	
16-40"	C1	Loamy Sand	7.5yr 6/8	FR	@ 24" Distinct
40-100"	C2	Loamy Sand	2.5y 5/1	FR	Stones Cobbles Boulders

Test Pit No. **TP-3** SCS Soil:
ESHWT: 48" Standing Water: None
Refusal: 96" Roots: None

Depth	Horizon	Soil Texture	Color	Consistence	Mottles; Quantity/Contrast
0-8"	A	Loamy Sand	10yr 3/2	FR	
8-22"	B	Loamy Sand	10yr 5/6	FR	
22-96"	C	Loamy Sand	2.5y 7/1	FR	Stones Cobbles Boulders

APPENDIX D

Miscellaneous Calculations

OUTLET APRON DESIGN

Project: Petrogas - Sturbridge, MA Job # 419217
Date: 7-Nov-17

FES#1 OUTLET APRON
(from HydroCAD **POND DMH14)**
Q10= 1.59 cfs
D_o = 12 inches
Tw = 0.77 feet

MHF Design Consultants, Inc.
ENGINEERS • PLANNERS • SURVEYORS

Design Criteria
Apron Dimensions

The dimensions of the apron at the outlet of the pipe shall be determined as follows:

1.) The width of the apron at the outlet of the pipe or channel shall be 3 times the diameter of the pipe or width of the channel.

USE THIS W= **3** feet

2.) The length of the apron shall be determined from the following formula when the tailwater depth at the outlet of the pipe or channel is less than one-half the diameter of the pipe or one-half the width of the channel.

La=1.8*Q/ Do^3/2+ 7Do
La= **9.86** feet

Where: La is the length of the apron
Q is the discharge from the pipe or channel
D_o is the diameter of pipe of width of channel

3.) The length of the apron shall be determined from the following formula when the tailwater depth at the outlet of the pipe or channel is greater than one-half the diameter of the pipe or one-half the width of the channel.

USE THIS La=3.0*Qo/ Do^1.5 +7D_o
La= **11.77** feet

4.) Where there is no well defined channel downstream of the outlet the width of the downstream end of the apron shall be determined as follows:

a. For minimum tailwater conditions where the tailwater depth is less than one-half the pipe diameter:

W=3*Do+La
W= **12.86** feet

b. For maximum tailwater conditions where the tailwater depth is greater than one-half the diameter of the pipe:

USE THIS W=3*Do+0.4*La
W= **7.71** feet

5.) Where there is a stable well-defined channel downstream of the apron, the bottom of the apron shall be equal to the width of the channel.

W= **8** feet

6.) The side of the apron in a well-defined channel shall be 2:1 (horizontal to vertical) or flatter. The height of the structural lining along the channel sides shall begin at the elevation equal to the top of conduit and taper down to the channel bottom through the length of the apron.

7.) The bottom grade of the apron shall be level (0% grade). No overfall is allowable at the end of the apron.

8.) The apron shall be located so that there are no bends in the horizontal alignment of the apron

Rock Riprap

The following criteria shall be used to determine the dimensions of the rock riprap used for the apron:

1.) The median stone diameter shall be determined using the formula:

d_{50}=0.02*Q^4/3/(Tw*D_o)

d_{50}= **0.58** inches **USE** **3** inches

d_{50} minimum 3 inches

Where: d_{50} is the median stone diameter in feet
Tw is the tailwater depth above the invert of the pipe channel in feet
Q is the discharge from the pipe or channel in cubic feet per second
D_o is the diameter of the pipe or width of the channel in feet

2.) Fifty percent by weight of the riprap mixture shall be smaller the than median stone size designated as d_{50}. The largest stone size in the mixtureshall be 1.5 times the d_{50} size.

3.) The quality and gradation of the rock, the thickness of the riprap lining, filter material and the quality of the stone shall meet the requirements in the Rock Riprap BMP. The minimum depth shall be 6 inches or 1.5 times the largest stone size in the mixture whichever is larger (d).

Thickness of the riprap
d = 1.5*(1.5*d_{50}(largest stone size))

d= 7 inches*

* must use a minimum of 6"

Rock Rip Rap Gradation

% of weight smaller than the given size	size of stone in inches
100	**4.5** to **6.0**
85	**3.9** to **5.4**
50	**3.0** to **4.5**
15	**0.9** to **1.5**

Drawdown within 72 hours Analysis for Static Method

Proposed Above Ground Infiltration System

Infiltration Rate:	2.41	inches/hour (From table 2.3.3: Rawls, Brakensiek, Saxton, 1982)
Design Infiltration Rate:	2.41	inches/hour
Volume Provide for Infiltration:	2,739	cf
Basin bottom area:	1,079	sf

Time $_{drawdown}$ = (Required Recharge Volume in cubic feet as determined by the Static Method)(1/Design Infiltration Rate in inches per hour)(conversion for inches to feet)(1/bottom area in feet)

Time $_{drawdown}$ = (2,739 cf) (1 / 2.41 in/hr) (1ft/12 in.) (1 / 1,079 sf)

= 12.64 hours

Stage-Area-Storage for Pond 1P: BASIN1 (continued)

Elevation (feet)	Surface (sq-ft)	Wetted (sq-ft)	Storage (cubic-feet)
698.56	2,035	2,403	2,336
698.57	2,043	2,412	2,357
698.58	2,052	2,421	2,377
698.59	2,060	2,430	2,398
698.60	2,069	2,439	2,418
698.61	2,078	2,447	2,439
698.62	2,086	2,456	2,460
698.63	2,095	2,465	2,481
698.64	2,103	2,474	2,502
698.65	2,112	2,483	2,523
698.66	2,121	2,492	2,544
698.67	2,129	2,501	2,565
698.68	2,138	2,510	2,587
698.69	2,147	2,520	2,608
698.70	2,156	2,529	2,630
698.71	2,164	2,538	2,651
698.72	2,173	2,547	2,673
698.73	2,182	2,556	2,695
698.74	2,191	2,565	2,717
OUTLET WEIR ELEV. 698.75	2,200	2,574	2,739 ← GRV PROVIDED
698.76	2,208	2,583	2,761
698.77	2,217	2,592	2,783
698.78	2,226	2,602	2,805
698.79	2,235	2,611	2,827
698.80	2,244	2,620	2,850
698.81	2,253	2,629	2,872
698.82	2,262	2,638	2,895
698.83	2,271	2,648	2,917
698.84	2,280	2,657	2,940
698.85	2,289	2,666	2,963
698.86	2,298	2,675	2,986
698.87	2,307	2,685	3,009
698.88	2,316	2,694	3,032
698.89	2,325	2,703	3,055
698.90	2,334	2,713	3,079
698.91	2,343	2,722	3,102
698.92	2,352	2,731	3,125
698.93	2,361	2,741	3,149
698.94	2,371	2,750	3,173
698.95	2,380	2,759	3,196
698.96	2,389	2,769	3,220
698.97	2,398	2,778	3,244
698.98	2,407	2,788	3,268
698.99	2,417	2,797	3,292
699.00	2,426	2,806	3,317
699.01	2,435	2,816	3,341
699.02	2,444	2,825	3,365
699.03	2,454	2,835	3,390
699.04	2,463	2,844	3,414
699.05	2,472	2,854	3,439
699.06	2,482	2,863	3,464
699.07	2,491	2,873	3,489

APPENDIX E

MassDEP 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.

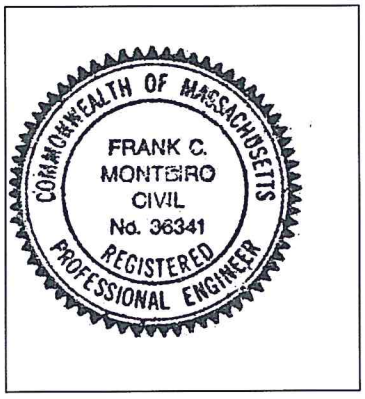
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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



2/26/18

Signature and Date

Checklist

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

☐ New development

☒ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided. **(See Soils Logs)**

☒ Required Recharge Volume calculation provided.

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

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

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

☐ is within the Zone II or Interim Wellhead Protection Area

☐ is near or to other critical areas

☐ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)

☒ involves runoff from land uses with higher potential pollutant loads.

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

☒ An Illicit Discharge Compliance Statement is attached;

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

MHF Design Consultants, Inc.

44 Stiles Road • Suite One • Salem, New Hampshire 03079
TEL (603) 893-0720 • FAX (603) 893-0733
www.mhfdesign.com

February 20, 2018

Town of Sturbridge Conservation Commission
308 Main Street
Sturbridge, MA 01566

Re: 234 & 236 Haynes Street

Sub: Illicit Discharge Statement
Standard #10

Dear Commission Members:

On behalf of our client, Petrogas Group New England, Inc., we hereby state that to the best of our knowledge, no illicit discharges exist on the above referenced site and none are proposed with the site re-development plans. Implementing the pollution prevention plan measures outlined in the site redevelopment plans will prevent illicit discharges to the stormwater management system, including wastewater discharges and discharges of stormwater contaminated by contact with process wastes, raw materials, toxic pollutants, hazardous substances, oil, or grease. Refer to the Grading & Drainage Plan from the site plan set for additional information.

Sincerely,
MHF Design Consultants, Inc.

Frank C. Monteiro, PE
President

F:\Projects\Eng\419217\Drainage\4192-Illicit Discharge Statement Standard10.doc

APPENDIX F

Construction Period Pollution Prevention and Erosion and Sediment Control Plan

CONSTRUCTION PERIOD POLLUTION PREVENTION AND EROSION AND SEDIMENTATION CONTROL PLAN

In accordance with DEP Stormwater Standard #8 the following is the construction period pollution prevention and erosion and sedimentation control plan for the proposed Retail Motor Fuel Outlet Site Re-Development project located at 234 & 236 Haynes Street (Route 15) in Sturbridge, MA:

Narrative

Petrogas Group New England, Inc. is proposing to redevelop this existing gas station / restaurant site. The redevelopment includes remodeling the existing restaurant and converting to a retail motor fuel outlet which includes a 6,680sf convenience store and two fast food establishments with a drive-thru window and a retail fuel dispensing area with 6 fuel dispensers (12 fueling location) and an overhead canopy, and 4 diesel truck dispensers (3 diesel fueling locations) and an overhead canopy. Site work will also include reconfigured parking facilities, site grading, erosion control measures, utility connections, septic system improvements, a new well, and construction of a new stormwater management system.

Construction Period Operation and Maintenance Plan

Operation and maintenance of the construction period BMP's will be performed in accordance with this document, the Massachusetts Stormwater Handbook, the Nonpoint Source Manual, the US EPA Stormwater Best Management Practices and the Site Re-Development Plans.

Name of Persons or Entities Responsible for Plan Compliance

Petrogas Group New England, Inc.

Construction Period Pollution Prevention Measures

- Silt fence barriers
- Protection of soil stockpiles
- Designated staging and material storage areas
- Temporary stabilized construction exits
- Catch basin inlet protection

Erosion and Sedimentation Control Plan Drawings

This information is included in the Site Re-Development Plans.

Details and Specifications for Erosion Control BMP's

This information is included in the Site Re-Development Plans.

Vegetation Planning

This information is included in the Site Re-Development Plans.

Site Development Plan

This information is included in the Site Re-Development Plans.

Construction Sequencing Plan

1. Install silt fence barriers
2. Remove existing site improvements that are not to remain
3. Cut and stump trees
4. Strip and stockpile topsoil
5. Excavate for footings for new structures
6. Bring site to subgrade
7. Install site utilities
8. Install pavement base courses
9. Finish grade all areas
10. Install finish course pavement
11. Install landscaping
12. Loam and seed all other disturbed areas
13. Remove sediment control barriers once permanent vegetation is established

Sequencing of Erosion and Sedimentation Controls

As outlined above and as detailed in the Site Re-Development Plans.

Operation and Maintenance of Erosion and Sedimentation Controls

Operation and maintenance of the erosion and sedimentation controls shall be performed by Petrogas Group New England, LLC or their designee. Maintenance shall be performed as outlined on the Site Re-Development Plans.

Inspection Schedule

Inspection of the erosion and sedimentation controls shall be performed as outlined on the Site Re-Development Plans.

Maintenance Schedule

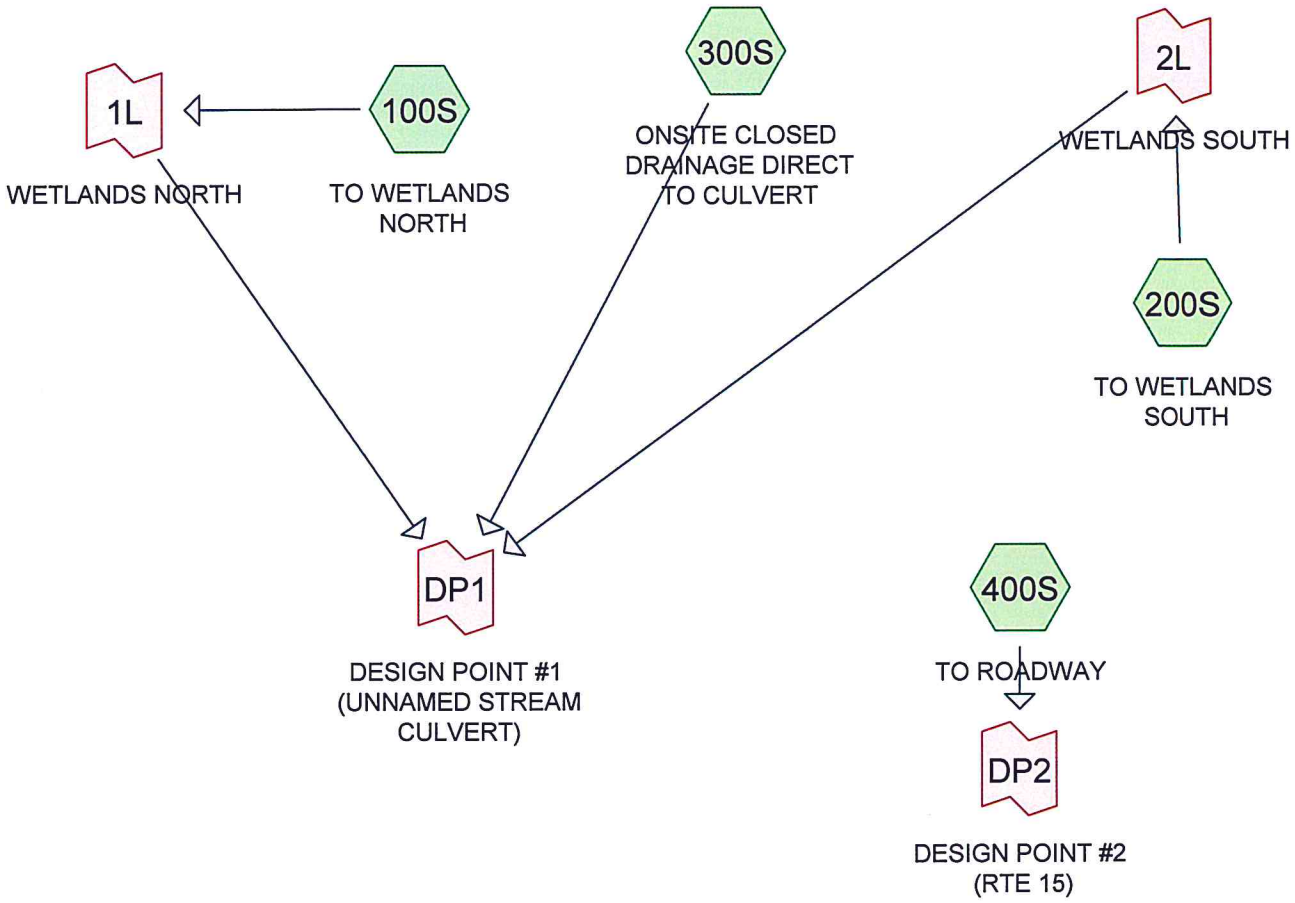
The maintenance schedule for the erosion and sedimentation controls shall be performed as outlined on the Site Re-Development Plans.

Inspection and Maintenance Log Form

A Construction Period Stormwater Operation and Log form is included on the following page.

APPENDIX G

Pre-Development HydroCAD Printouts



Subcat Reach Pond Link

Routing Diagram for 4192PreDrain
Prepared by Microsoft, Printed 2/26/2018

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
88,318	39	>75% Grass cover, Good, HSG A (100S, 200S, 300S)
96,778	98	Paved parking, HSG A (100S, 200S, 300S, 400S)
10,826	98	Roofs, HSG A (300S)
44,575	30	Woods, Good, HSG A (100S, 200S)
9,683	45	Woods, Poor, HSG A (300S)
250,180	**63**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
250,180	HSG A	100S, 200S, 300S, 400S
0	HSG B	
0	HSG C	
0	HSG D	
0	Other	
250,180		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover
88,318	0	0	0	0	88,318	>75% Grass cover, Good
96,778	0	0	0	0	96,778	Paved parking
10,826	0	0	0	0	10,826	Roofs
44,575	0	0	0	0	44,575	Woods, Good
9,683	0	0	0	0	9,683	Woods, Poor
250,180	**0**	**0**	**0**	**0**	**250,180**	**TOTAL AREA**

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 100S: TO WETLANDS Runoff Area=72,265 sf 20.62% Impervious Runoff Depth=0.07"
Flow Length=315' Slope=0.0200 '/' Tc=5.4 min CN=49 Runoff=0.02 cfs 448 cf

Subcatchment 200S: TO WETLANDS Runoff Area=48,814 sf 8.74% Impervious Runoff Depth=0.00"
Flow Length=110' Slope=0.0450 '/' Tc=6.6 min CN=39 Runoff=0.00 cfs 0 cf

Subcatchment 300S: ONSITE CLOSED Runoff Area=126,555 sf 67.87% Impervious Runoff Depth=1.25"
Flow Length=148' Tc=5.2 min CN=80 Runoff=4.32 cfs 13,183 cf

Subcatchment 400S: TO ROADWAY Runoff Area=2,546 sf 100.00% Impervious Runoff Depth=2.77"
Flow Length=25' Slope=0.0200 '/' Tc=0.4 min CN=98 Runoff=0.21 cfs 587 cf

Link 1L: WETLANDS NORTH Inflow=0.02 cfs 448 cf
Primary=0.02 cfs 448 cf

Link 2L: WETLANDS SOUTH Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Link DP1: DESIGN POINT #1 (UNNAMED STREAM CULVERT) Inflow=4.32 cfs 13,631 cf
Primary=4.32 cfs 13,631 cf

Link DP2: DESIGN POINT #2 (RTE 15) Inflow=0.21 cfs 587 cf
Primary=0.21 cfs 587 cf

Total Runoff Area = 250,180 sf Runoff Volume = 14,219 cf Average Runoff Depth = 0.68"
56.99% Pervious = 142,576 sf 43.01% Impervious = 107,604 sf

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 100S: TO WETLANDS Runoff Area=72,265 sf 20.62% Impervious Runoff Depth=0.46"
Flow Length=315' Slope=0.0200 '/' Tc=5.4 min CN=49 Runoff=0.39 cfs 2,746 cf

Subcatchment 200S: TO WETLANDS Runoff Area=48,814 sf 8.74% Impervious Runoff Depth=0.11"
Flow Length=110' Slope=0.0450 '/' Tc=6.6 min CN=39 Runoff=0.02 cfs 450 cf

Subcatchment 300S: ONSITE CLOSED Runoff Area=126,555 sf 67.87% Impervious Runoff Depth=2.46"
Flow Length=148' Tc=5.2 min CN=80 Runoff=8.63 cfs 25,960 cf

Subcatchment 400S: TO ROADWAY Runoff Area=2,546 sf 100.00% Impervious Runoff Depth=4.26"
Flow Length=25' Slope=0.0200 '/' Tc=0.4 min CN=98 Runoff=0.31 cfs 905 cf

Link 1L: WETLANDS NORTH Inflow=0.39 cfs 2,746 cf
Primary=0.39 cfs 2,746 cf

Link 2L: WETLANDS SOUTH Inflow=0.02 cfs 450 cf
Primary=0.02 cfs 450 cf

Link DP1: DESIGN POINT #1 (UNNAMED STREAM CULVERT) Inflow=8.89 cfs 29,156 cf
Primary=8.89 cfs 29,156 cf

Link DP2: DESIGN POINT #2 (RTE 15) Inflow=0.31 cfs 905 cf
Primary=0.31 cfs 905 cf

Total Runoff Area = 250,180 sf Runoff Volume = 30,061 cf Average Runoff Depth = 1.44"
56.99% Pervious = 142,576 sf 43.01% Impervious = 107,604 sf

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 100S: TO WETLANDS Runoff Area=72,265 sf 20.62% Impervious Runoff Depth=1.32"
Flow Length=315' Slope=0.0200 '/' Tc=5.4 min CN=49 Runoff=2.13 cfs 7,929 cf

Subcatchment 200S: TO WETLANDS Runoff Area=48,814 sf 8.74% Impervious Runoff Depth=0.60"
Flow Length=110' Slope=0.0450 '/' Tc=6.6 min CN=39 Runoff=0.31 cfs 2,432 cf

Subcatchment 300S: ONSITE CLOSED Runoff Area=126,555 sf 67.87% Impervious Runoff Depth=4.24"
Flow Length=148' Tc=5.2 min CN=80 Runoff=14.75 cfs 44,666 cf

Subcatchment 400S: TO ROADWAY Runoff Area=2,546 sf 100.00% Impervious Runoff Depth=6.26"
Flow Length=25' Slope=0.0200 '/' Tc=0.4 min CN=98 Runoff=0.45 cfs 1,328 cf

Link 1L: WETLANDS NORTH Inflow=2.13 cfs 7,929 cf
Primary=2.13 cfs 7,929 cf

Link 2L: WETLANDS SOUTH Inflow=0.31 cfs 2,432 cf
Primary=0.31 cfs 2,432 cf

Link DP1: DESIGN POINT #1 (UNNAMED STREAM CULVERT) Inflow=16.91 cfs 55,028 cf
Primary=16.91 cfs 55,028 cf

Link DP2: DESIGN POINT #2 (RTE 15) Inflow=0.45 cfs 1,328 cf
Primary=0.45 cfs 1,328 cf

Total Runoff Area = 250,180 sf Runoff Volume = 56,357 cf Average Runoff Depth = 2.70"
56.99% Pervious = 142,576 sf 43.01% Impervious = 107,604 sf

Summary for Subcatchment 100S: TO WETLANDS NORTH

Runoff = 0.39 cfs @ 12.14 hrs, Volume= 2,746 cf, Depth= 0.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
16,017	30	Woods, Good, HSG A
41,348	39	>75% Grass cover, Good, HSG A
14,900	98	Paved parking, HSG A
72,265	49	Weighted Average
57,365		79.38% Pervious Area
14,900		20.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.3	25	0.0200	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
2.1	290	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
5.4	315	Total			

Summary for Subcatchment 200S: TO WETLANDS SOUTH

Runoff = 0.02 cfs @ 14.72 hrs, Volume= 450 cf, Depth= 0.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
28,558	30	Woods, Good, HSG A
15,989	39	>75% Grass cover, Good, HSG A
4,267	98	Paved parking, HSG A
48,814	39	Weighted Average
44,547		91.26% Pervious Area
4,267		8.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.3	25	0.0450	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
1.3	85	0.0450	1.06		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
6.6	110	Total			

Summary for Subcatchment 300S: ONSITE CLOSED DRAINAGE DIRECT TO CULVERT

Runoff = 8.63 cfs @ 12.08 hrs, Volume= 25,960 cf, Depth= 2.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
9,683	45	Woods, Poor, HSG A
10,826	98	Roofs, HSG A
30,981	39	>75% Grass cover, Good, HSG A
75,065	98	Paved parking, HSG A
126,555	80	Weighted Average
40,664		32.13% Pervious Area
85,891		67.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	25	0.0800	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
0.4	30	0.0800	1.41		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.1	33	0.0800	4.55		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.5	60	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
5.2	148	Total			

Summary for Subcatchment 400S: TO ROADWAY

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.31 cfs @ 12.01 hrs, Volume= 905 cf, Depth= 4.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
2,546	98	Paved parking, HSG A
2,546		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	25	0.0200	1.01		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"

Summary for Link 1L: WETLANDS NORTH

Inflow Area = 72,265 sf, 20.62% Impervious, Inflow Depth = 0.46" for 10-yr event
Inflow = 0.39 cfs @ 12.14 hrs, Volume= 2,746 cf
Primary = 0.39 cfs @ 12.14 hrs, Volume= 2,746 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Summary for Link 2L: WETLANDS SOUTH

Inflow Area = 48,814 sf, 8.74% Impervious, Inflow Depth = 0.11" for 10-yr event
Inflow = 0.02 cfs @ 14.72 hrs, Volume= 450 cf
Primary = 0.02 cfs @ 14.72 hrs, Volume= 450 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Summary for Link DP1: DESIGN POINT #1 (UNNAMED STREAM CULVERT)

Inflow Area = 247,634 sf, 42.42% Impervious, Inflow Depth = 1.41" for 10-yr event
Inflow = 8.89 cfs @ 12.08 hrs, Volume= 29,156 cf
Primary = 8.89 cfs @ 12.08 hrs, Volume= 29,156 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

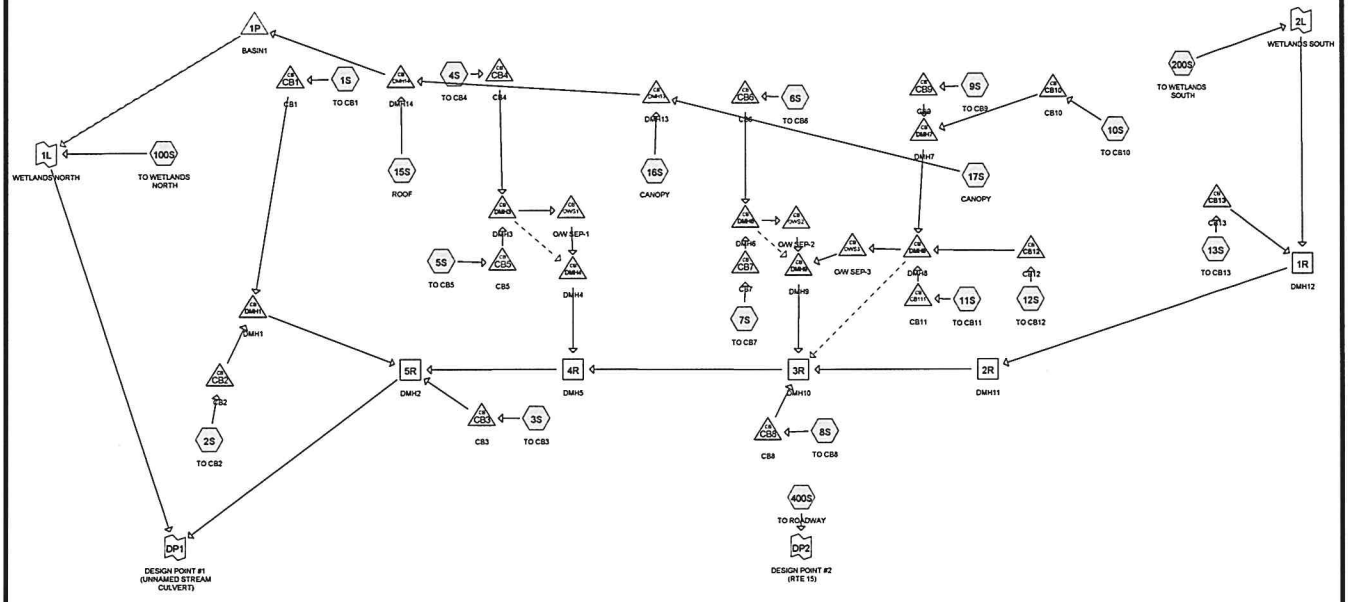
Summary for Link DP2: DESIGN POINT #2 (RTE 15)

Inflow Area = 2,546 sf,100.00% Impervious, Inflow Depth = 4.26" for 10-yr event
Inflow = 0.31 cfs @ 12.01 hrs, Volume= 905 cf
Primary = 0.31 cfs @ 12.01 hrs, Volume= 905 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

APPENDIX H

Post-Development HydroCAD Printouts



Subcat Reach Pond Link

Routing Diagram for 4192PostDrain
Prepared by Microsoft, Printed 2/26/2018
HydroCAD® 10.00-20 s/n 01710 © 2017 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
98,372	39	>75% Grass cover, Good, HSG A (1S, 3S, 4S, 5S, 6S, 7S, 9S, 10S, 11S, 12S, 13S, 100S, 200S)
87,604	98	Paved parking, HSG A (1S, 2S, 3S, 4S, 5S, 6S, 7S, 8S, 9S, 10S, 11S, 12S, 13S, 200S, 400S)
12,939	98	Roofs, HSG A (15S, 16S, 17S)
51,265	30	Woods, Good, HSG A (1S, 4S, 100S, 200S)
250,180	**61**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
250,180	HSG A	1S, 2S, 3S, 4S, 5S, 6S, 7S, 8S, 9S, 10S, 11S, 12S, 13S, 15S, 16S, 17S, 100S, 200S, 400S
0	HSG B	
0	HSG C	
0	HSG D	
0	Other	
250,180		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover
98,372	0	0	0	0	98,372	>75% Grass cover, Good
87,604	0	0	0	0	87,604	Paved parking
12,939	0	0	0	0	12,939	Roofs
51,265	0	0	0	0	51,265	Woods, Good
250,180	**0**	**0**	**0**	**0**	**250,180**	**TOTAL AREA**

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	CB1	695.75	695.05	133.0	0.0053	0.013	12.0	0.0	0.0
2	CB10	696.30	696.00	63.0	0.0048	0.013	12.0	0.0	0.0
3	CB111	697.90	697.80	11.0	0.0091	0.013	12.0	0.0	0.0
4	CB12	698.30	697.80	85.0	0.0059	0.013	12.0	0.0	0.0
5	CB13	696.80	696.65	24.0	0.0062	0.013	12.0	0.0	0.0
6	CB2	696.00	695.75	29.0	0.0086	0.013	12.0	0.0	0.0
7	CB3	696.50	696.30	37.0	0.0054	0.013	12.0	0.0	0.0
8	CB4	695.80	695.25	103.0	0.0053	0.013	12.0	0.0	0.0
9	CB5	696.50	696.40	19.0	0.0053	0.013	12.0	0.0	0.0
10	CB6	696.30	695.90	80.0	0.0050	0.013	12.0	0.0	0.0
11	CB7	697.30	697.20	15.0	0.0067	0.013	12.0	0.0	0.0
12	CB8	699.50	699.35	15.0	0.0100	0.013	12.0	0.0	0.0
13	CB9	696.30	696.25	10.0	0.0050	0.013	12.0	0.0	0.0
14	DMH1	694.95	694.55	70.0	0.0057	0.009	12.0	0.0	0.0
15	DMH13	698.10	697.55	111.0	0.0050	0.013	12.0	0.0	0.0
16	DMH14	697.45	697.00	90.0	0.0050	0.013	12.0	0.0	0.0
17	DMH3	695.15	695.05	17.0	0.0059	0.010	6.0	0.0	0.0
18	DMH3	696.15	694.70	33.0	0.0439	0.013	12.0	0.0	0.0
19	DMH4	694.60	694.50	20.0	0.0050	0.013	12.0	0.0	0.0
20	DMH6	695.80	695.50	10.0	0.0300	0.010	6.0	0.0	0.0
21	DMH6	696.80	695.15	28.0	0.0589	0.013	12.0	0.0	0.0
22	DMH7	696.00	695.60	82.0	0.0049	0.013	12.0	0.0	0.0
23	DMH8	695.60	695.50	10.0	0.0100	0.010	6.0	0.0	0.0
24	DMH8	696.60	694.95	55.0	0.0300	0.013	12.0	0.0	0.0
25	DMH9	695.15	694.95	39.0	0.0051	0.013	12.0	0.0	0.0
26	OWS1	694.80	694.70	10.0	0.0100	0.010	6.0	0.0	0.0
27	OWS2	695.25	695.15	9.0	0.0111	0.010	6.0	0.0	0.0
28	OWS3	695.25	695.15	10.0	0.0100	0.010	6.0	0.0	0.0

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: TO CB1 Runoff Area=7,453 sf 80.64% Impervious Runoff Depth=1.66"
Flow Length=71' Slope=0.0110 '/' Tc=3.9 min CN=86 Runoff=0.36 cfs 1,033 cf

Subcatchment 2S: TO CB2 Runoff Area=6,613 sf 100.00% Impervious Runoff Depth=2.77"
Flow Length=75' Slope=0.0130 '/' Tc=0.9 min CN=98 Runoff=0.53 cfs 1,526 cf

Subcatchment 3S: TO CB3 Runoff Area=3,948 sf 97.97% Impervious Runoff Depth=2.66"
Flow Length=50' Slope=0.0200 '/' Tc=0.2 min CN=97 Runoff=0.31 cfs 875 cf

Subcatchment 4S: TO CB4 Runoff Area=13,963 sf 52.41% Impervious Runoff Depth=0.63"
Flow Length=91' Tc=3.6 min CN=68 Runoff=0.21 cfs 729 cf

Subcatchment 5S: TO CB5 Runoff Area=8,407 sf 96.76% Impervious Runoff Depth=2.55"
Flow Length=20' Slope=0.0400 '/' Tc=2.1 min CN=96 Runoff=0.62 cfs 1,788 cf

Subcatchment 6S: TO CB6 Runoff Area=7,184 sf 91.83% Impervious Runoff Depth=2.25"
Flow Length=140' Slope=0.0210 '/' Tc=1.1 min CN=93 Runoff=0.50 cfs 1,349 cf

Subcatchment 7S: TO CB7 Runoff Area=7,828 sf 66.15% Impervious Runoff Depth=1.13"
Flow Length=155' Tc=3.4 min CN=78 Runoff=0.25 cfs 736 cf

Subcatchment 8S: TO CB8 Runoff Area=1,108 sf 100.00% Impervious Runoff Depth=2.77"
Flow Length=63' Slope=0.0440 '/' Tc=0.4 min CN=98 Runoff=0.09 cfs 256 cf

Subcatchment 9S: TO CB9 Runoff Area=6,065 sf 92.28% Impervious Runoff Depth=2.25"
Flow Length=116' Tc=2.4 min CN=93 Runoff=0.41 cfs 1,139 cf

Subcatchment 10S: TO CB10 Runoff Area=8,203 sf 96.04% Impervious Runoff Depth=2.55"
Flow Length=113' Tc=2.5 min CN=96 Runoff=0.60 cfs 1,745 cf

Subcatchment 11S: TO CB11 Runoff Area=9,680 sf 47.10% Impervious Runoff Depth=0.58"
Flow Length=162' Tc=4.1 min CN=67 Runoff=0.13 cfs 472 cf

Subcatchment 12S: TO CB12 Runoff Area=14,516 sf 28.88% Impervious Runoff Depth=0.22"
Flow Length=189' Tc=4.0 min CN=56 Runoff=0.03 cfs 266 cf

Subcatchment 13S: TO CB13 Runoff Area=25,264 sf 62.23% Impervious Runoff Depth=1.02"
Flow Length=270' Tc=4.6 min CN=76 Runoff=0.69 cfs 2,137 cf

Subcatchment 15S: ROOF Runoff Area=7,426 sf 100.00% Impervious Runoff Depth=2.77"
Tc=0.0 min CN=98 Runoff=0.60 cfs 1,713 cf

Subcatchment 16S: CANOPY Runoff Area=4,048 sf 100.00% Impervious Runoff Depth=2.77"
Tc=0.0 min CN=98 Runoff=0.33 cfs 934 cf

Subcatchment 17S: CANOPY Runoff Area=1,465 sf 100.00% Impervious Runoff Depth=2.77"
Tc=0.0 min CN=98 Runoff=0.12 cfs 338 cf

Subcatchment 100S: TO WETLANDS Runoff Area=58,071 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=315' Slope=0.0200 '/' Tc=5.4 min CN=37 Runoff=0.00 cfs 0 cf

Subcatchment 200S: TO WETLANDS Runoff Area=55,956 sf 3.30% Impervious Runoff Depth=0.00"
Flow Length=110' Slope=0.0450 '/' Tc=6.6 min CN=36 Runoff=0.00 cfs 0 cf

Subcatchment 400S: TO ROADWAY Runoff Area=2,982 sf 100.00% Impervious Runoff Depth=2.77"
Flow Length=57' Slope=0.0400 '/' Tc=0.4 min CN=98 Runoff=0.24 cfs 688 cf

Reach 1R: DMH12 Inflow=0.69 cfs 2,137 cf
Outflow=0.69 cfs 2,137 cf

Reach 2R: DMH11 Inflow=0.69 cfs 2,137 cf
Outflow=0.69 cfs 2,137 cf

Reach 3R: DMH10 Inflow=2.50 cfs 8,100 cf
Outflow=2.50 cfs 8,100 cf

Reach 4R: DMH5 Inflow=3.30 cfs 10,617 cf
Outflow=3.30 cfs 10,617 cf

Reach 5R: DMH2 Inflow=4.36 cfs 14,050 cf
Outflow=4.36 cfs 14,050 cf

Pond 1P: BASIN1 Peak Elev=697.77' Storage=980 cf Inflow=1.05 cfs 2,985 cf
Discarded=0.12 cfs 2,986 cf Secondary=0.00 cfs 0 cf Outflow=0.12 cfs 2,986 cf

Pond CB1: CB1 Peak Elev=696.10' Inflow=0.36 cfs 1,033 cf
12.0" Round Culvert n=0.013 L=133.0' S=0.0053 '/' Outflow=0.36 cfs 1,033 cf

Pond CB10: CB10 Peak Elev=697.11' Inflow=0.60 cfs 1,745 cf
12.0" Round Culvert n=0.013 L=63.0' S=0.0048 '/' Outflow=0.60 cfs 1,745 cf

Pond CB111: CB11 Peak Elev=698.09' Inflow=0.13 cfs 472 cf
12.0" Round Culvert n=0.013 L=11.0' S=0.0091 '/' Outflow=0.13 cfs 472 cf

Pond CB12: CB12 Peak Elev=698.40' Inflow=0.03 cfs 266 cf
12.0" Round Culvert n=0.013 L=85.0' S=0.0059 '/' Outflow=0.03 cfs 266 cf

Pond CB13: CB13 Peak Elev=697.29' Inflow=0.69 cfs 2,137 cf
12.0" Round Culvert n=0.013 L=24.0' S=0.0062 '/' Outflow=0.69 cfs 2,137 cf

Pond CB2: CB2 Peak Elev=696.39' Inflow=0.53 cfs 1,526 cf
12.0" Round Culvert n=0.013 L=29.0' S=0.0086 '/' Outflow=0.53 cfs 1,526 cf

Pond CB3: CB3 Peak Elev=696.82' Inflow=0.31 cfs 875 cf
12.0" Round Culvert n=0.013 L=37.0' S=0.0054 '/' Outflow=0.31 cfs 875 cf

Pond CB4: CB4 Peak Elev=696.33' Inflow=0.21 cfs 729 cf
12.0" Round Culvert n=0.013 L=103.0' S=0.0053 '/' Outflow=0.21 cfs 729 cf

Pond CB5: CB5 Peak Elev=696.98' Inflow=0.62 cfs 1,788 cf
12.0" Round Culvert n=0.013 L=19.0' S=0.0053 '/' Outflow=0.62 cfs 1,788 cf

Pond CB6: CB6 Peak Elev=696.99' Inflow=0.50 cfs 1,349 cf
12.0" Round Culvert n=0.013 L=80.0' S=0.0050 '/' Outflow=0.50 cfs 1,349 cf

Pond CB7: CB7 Peak Elev=697.59' Inflow=0.25 cfs 736 cf
12.0" Round Culvert n=0.013 L=15.0' S=0.0067 '/' Outflow=0.25 cfs 736 cf

Pond CB8: CB8 Peak Elev=699.65' Inflow=0.09 cfs 256 cf
12.0" Round Culvert n=0.013 L=15.0' S=0.0100 '/' Outflow=0.09 cfs 256 cf

Pond CB9: CB9 Peak Elev=697.07' Inflow=0.41 cfs 1,139 cf
12.0" Round Culvert n=0.013 L=10.0' S=0.0050 '/' Outflow=0.41 cfs 1,139 cf

Pond DMH1: DMH1 Peak Elev=695.42' Inflow=0.82 cfs 2,558 cf
12.0" Round Culvert n=0.009 L=70.0' S=0.0057 '/' Outflow=0.82 cfs 2,558 cf

Pond DMH13: DMH13 Peak Elev=698.52' Inflow=0.45 cfs 1,272 cf
12.0" Round Culvert n=0.013 L=111.0' S=0.0050 '/' Outflow=0.45 cfs 1,272 cf

Pond DMH14: DMH14 Peak Elev=698.07' Inflow=1.05 cfs 2,985 cf
12.0" Round Culvert n=0.013 L=90.0' S=0.0050 '/' Outflow=1.05 cfs 2,985 cf

Pond DMH3: DMH3 Peak Elev=696.29' Inflow=0.80 cfs 2,517 cf
Primary=0.72 cfs 2,503 cf Secondary=0.09 cfs 14 cf Outflow=0.80 cfs 2,517 cf

Pond DMH4: DMH4 Peak Elev=695.15' Inflow=0.80 cfs 2,517 cf
12.0" Round Culvert n=0.013 L=20.0' S=0.0050 '/' Outflow=0.80 cfs 2,517 cf

Pond DMH6: DMH6 Peak Elev=696.90' Inflow=0.72 cfs 2,086 cf
Primary=0.69 cfs 2,080 cf Secondary=0.05 cfs 6 cf Outflow=0.72 cfs 2,086 cf

Pond DMH7: DMH7 Peak Elev=697.05' Inflow=1.00 cfs 2,884 cf
12.0" Round Culvert n=0.013 L=82.0' S=0.0049 '/' Outflow=1.00 cfs 2,884 cf

Pond DMH8: DMH8 Peak Elev=696.93' Inflow=1.11 cfs 3,622 cf
Primary=0.68 cfs 3,475 cf Secondary=0.43 cfs 146 cf Outflow=1.11 cfs 3,622 cf

Pond DMH9: DMH9 Peak Elev=695.90' Inflow=1.40 cfs 5,561 cf
12.0" Round Culvert n=0.013 L=39.0' S=0.0051 '/' Outflow=1.40 cfs 5,561 cf

Pond OWS1: O/W SEP-1 Peak Elev=695.72' Inflow=0.72 cfs 2,503 cf
6.0" Round Culvert n=0.010 L=10.0' S=0.0100 '/' Outflow=0.72 cfs 2,503 cf

Pond OWS2: O/W SEP-2 Peak Elev=696.40' Inflow=0.69 cfs 2,080 cf
6.0" Round Culvert n=0.010 L=9.0' S=0.0111 '/' Outflow=0.69 cfs 2,080 cf

Pond OWS3: O/W SEP-3 Peak Elev=696.41' Inflow=0.68 cfs 3,475 cf
6.0" Round Culvert n=0.010 L=10.0' S=0.0100 '/' Outflow=0.68 cfs 3,475 cf

Link 1L: WETLANDS NORTH
Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Link 2L: WETLANDS SOUTH
Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Link DP1: DESIGN POINT #1 (UNNAMED STREAM CULVERT)
Inflow=4.36 cfs 14,050 cf
Primary=4.36 cfs 14,050 cf

Link DP2: DESIGN POINT #2 (RTE 15)
Inflow=0.24 cfs 688 cf
Primary=0.24 cfs 688 cf

Total Runoff Area = 250,180 sf Runoff Volume = 17,722 cf Average Runoff Depth = 0.85"
59.81% Pervious = 149,637 sf 40.19% Impervious = 100,543 sf

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: TO CB1 Runoff Area=7,453 sf 80.64% Impervious Runoff Depth=3.00"
Flow Length=71' Slope=0.0110 '/' Tc=3.9 min CN=86 Runoff=0.64 cfs 1,865 cf

Subcatchment 2S: TO CB2 Runoff Area=6,613 sf 100.00% Impervious Runoff Depth=4.26"
Flow Length=75' Slope=0.0130 '/' Tc=0.9 min CN=98 Runoff=0.80 cfs 2,350 cf

Subcatchment 3S: TO CB3 Runoff Area=3,948 sf 97.97% Impervious Runoff Depth=4.15"
Flow Length=50' Slope=0.0200 '/' Tc=0.2 min CN=97 Runoff=0.48 cfs 1,365 cf

Subcatchment 4S: TO CB4 Runoff Area=13,963 sf 52.41% Impervious Runoff Depth=1.53"
Flow Length=91' Tc=3.6 min CN=68 Runoff=0.60 cfs 1,783 cf

Subcatchment 5S: TO CB5 Runoff Area=8,407 sf 96.76% Impervious Runoff Depth=4.04"
Flow Length=20' Slope=0.0400 '/' Tc=2.1 min CN=96 Runoff=0.96 cfs 2,827 cf

Subcatchment 6S: TO CB6 Runoff Area=7,184 sf 91.83% Impervious Runoff Depth=3.71"
Flow Length=140' Slope=0.0210 '/' Tc=1.1 min CN=93 Runoff=0.81 cfs 2,220 cf

Subcatchment 7S: TO CB7 Runoff Area=7,828 sf 66.15% Impervious Runoff Depth=2.29"
Flow Length=155' Tc=3.4 min CN=78 Runoff=0.53 cfs 1,496 cf

Subcatchment 8S: TO CB8 Runoff Area=1,108 sf 100.00% Impervious Runoff Depth=4.26"
Flow Length=63' Slope=0.0440 '/' Tc=0.4 min CN=98 Runoff=0.14 cfs 394 cf

Subcatchment 9S: TO CB9 Runoff Area=6,065 sf 92.28% Impervious Runoff Depth=3.71"
Flow Length=116' Tc=2.4 min CN=93 Runoff=0.65 cfs 1,874 cf

Subcatchment 10S: TO CB10 Runoff Area=8,203 sf 96.04% Impervious Runoff Depth=4.04"
Flow Length=113' Tc=2.5 min CN=96 Runoff=0.92 cfs 2,759 cf

Subcatchment 11S: TO CB11 Runoff Area=9,680 sf 47.10% Impervious Runoff Depth=1.46"
Flow Length=162' Tc=4.1 min CN=67 Runoff=0.39 cfs 1,181 cf

Subcatchment 12S: TO CB12 Runoff Area=14,516 sf 28.88% Impervious Runoff Depth=0.80"
Flow Length=189' Tc=4.0 min CN=56 Runoff=0.25 cfs 962 cf

Subcatchment 13S: TO CB13 Runoff Area=25,264 sf 62.23% Impervious Runoff Depth=2.13"
Flow Length=270' Tc=4.6 min CN=76 Runoff=1.52 cfs 4,484 cf

Subcatchment 15S: ROOF Runoff Area=7,426 sf 100.00% Impervious Runoff Depth=4.26"
Tc=0.0 min CN=98 Runoff=0.91 cfs 2,639 cf

Subcatchment 16S: CANOPY Runoff Area=4,048 sf 100.00% Impervious Runoff Depth=4.26"
Tc=0.0 min CN=98 Runoff=0.50 cfs 1,438 cf

Subcatchment 17S: CANOPY Runoff Area=1,465 sf 100.00% Impervious Runoff Depth=4.26"
Tc=0.0 min CN=98 Runoff=0.18 cfs 521 cf

Subcatchment 100S: TO WETLANDS Runoff Area=58,071 sf 0.00% Impervious Runoff Depth=0.07"
Flow Length=315' Slope=0.0200 '/' Tc=5.4 min CN=37 Runoff=0.01 cfs 320 cf

Subcatchment 200S: TO WETLANDS Runoff Area=55,956 sf 3.30% Impervious Runoff Depth=0.05"
Flow Length=110' Slope=0.0450 '/' Tc=6.6 min CN=36 Runoff=0.01 cfs 222 cf

Subcatchment 400S: TO ROADWAY Runoff Area=2,982 sf 100.00% Impervious Runoff Depth=4.26"
Flow Length=57' Slope=0.0400 '/' Tc=0.4 min CN=98 Runoff=0.36 cfs 1,060 cf

Reach 1R: DMH12 Inflow=1.52 cfs 4,706 cf
Outflow=1.52 cfs 4,706 cf

Reach 2R: DMH11 Inflow=1.52 cfs 4,706 cf
Outflow=1.52 cfs 4,706 cf

Reach 3R: DMH10 Inflow=4.89 cfs 15,591 cf
Outflow=4.89 cfs 15,591 cf

Reach 4R: DMH5 Inflow=6.39 cfs 20,201 cf
Outflow=6.39 cfs 20,201 cf

Reach 5R: DMH2 Inflow=8.07 cfs 25,782 cf
Outflow=8.07 cfs 25,782 cf

Pond 1P: BASIN1 Peak Elev=698.21' Storage=1,674 cf Inflow=1.59 cfs 4,598 cf
Discarded=0.17 cfs 4,598 cf Secondary=0.00 cfs 0 cf Outflow=0.17 cfs 4,598 cf

Pond CB1: CB1 Peak Elev=696.24' Inflow=0.64 cfs 1,865 cf
12.0" Round Culvert n=0.013 L=133.0' S=0.0053 '/' Outflow=0.64 cfs 1,865 cf

Pond CB10: CB10 Peak Elev=697.54' Inflow=0.92 cfs 2,759 cf
12.0" Round Culvert n=0.013 L=63.0' S=0.0048 '/' Outflow=0.92 cfs 2,759 cf

Pond CB111: CB11 Peak Elev=698.25' Inflow=0.39 cfs 1,181 cf
12.0" Round Culvert n=0.013 L=11.0' S=0.0091 '/' Outflow=0.39 cfs 1,181 cf

Pond CB12: CB12 Peak Elev=698.58' Inflow=0.25 cfs 962 cf
12.0" Round Culvert n=0.013 L=85.0' S=0.0059 '/' Outflow=0.25 cfs 962 cf

Pond CB13: CB13 Peak Elev=697.58' Inflow=1.52 cfs 4,484 cf
12.0" Round Culvert n=0.013 L=24.0' S=0.0062 '/' Outflow=1.52 cfs 4,484 cf

Pond CB2: CB2 Peak Elev=696.50' Inflow=0.80 cfs 2,350 cf
12.0" Round Culvert n=0.013 L=29.0' S=0.0086 '/' Outflow=0.80 cfs 2,350 cf

Pond CB3: CB3 Peak Elev=696.90' Inflow=0.48 cfs 1,365 cf
12.0" Round Culvert n=0.013 L=37.0' S=0.0054 '/' Outflow=0.48 cfs 1,365 cf

Pond CB4: CB4 Peak Elev=696.68' Inflow=0.60 cfs 1,783 cf
12.0" Round Culvert n=0.013 L=103.0' S=0.0053 '/' Outflow=0.60 cfs 1,783 cf

Pond CB5: CB5 Peak Elev=697.11' Inflow=0.96 cfs 2,827 cf
12.0" Round Culvert n=0.013 L=19.0' S=0.0053 '/' Outflow=0.96 cfs 2,827 cf

Pond CB6: CB6 Peak Elev=697.26' Inflow=0.81 cfs 2,220 cf
12.0" Round Culvert n=0.013 L=80.0' S=0.0050 '/' Outflow=0.81 cfs 2,220 cf

Pond CB7: CB7 Peak Elev=697.73' Inflow=0.53 cfs 1,496 cf
12.0" Round Culvert n=0.013 L=15.0' S=0.0067 '/' Outflow=0.53 cfs 1,496 cf

Pond CB8: CB8 Peak Elev=699.69' Inflow=0.14 cfs 394 cf
12.0" Round Culvert n=0.013 L=15.0' S=0.0100 '/' Outflow=0.14 cfs 394 cf

Pond CB9: CB9 Peak Elev=697.50' Inflow=0.65 cfs 1,874 cf
12.0" Round Culvert n=0.013 L=10.0' S=0.0050 '/' Outflow=0.65 cfs 1,874 cf

Pond DMH1: DMH1 Peak Elev=695.57' Inflow=1.34 cfs 4,215 cf
12.0" Round Culvert n=0.009 L=70.0' S=0.0057 '/' Outflow=1.34 cfs 4,215 cf

Pond DMH13: DMH13 Peak Elev=698.67' Inflow=0.68 cfs 1,959 cf
12.0" Round Culvert n=0.013 L=111.0' S=0.0050 '/' Outflow=0.68 cfs 1,959 cf

Pond DMH14: DMH14 Peak Elev=698.30' Inflow=1.59 cfs 4,598 cf
12.0" Round Culvert n=0.013 L=90.0' S=0.0050 '/' Outflow=1.59 cfs 4,598 cf

Pond DMH3: DMH3 Peak Elev=696.60' Inflow=1.51 cfs 4,611 cf
Primary=0.75 cfs 4,292 cf Secondary=0.78 cfs 318 cf Outflow=1.51 cfs 4,611 cf

Pond DMH4: DMH4 Peak Elev=695.40' Inflow=1.51 cfs 4,611 cf
12.0" Round Culvert n=0.013 L=20.0' S=0.0050 '/' Outflow=1.51 cfs 4,611 cf

Pond DMH6: DMH6 Peak Elev=697.18' Inflow=1.27 cfs 3,715 cf
Primary=0.72 cfs 3,504 cf Secondary=0.57 cfs 211 cf Outflow=1.27 cfs 3,715 cf

Pond DMH7: DMH7 Peak Elev=697.47' Inflow=1.57 cfs 4,633 cf
12.0" Round Culvert n=0.013 L=82.0' S=0.0049 '/' Outflow=1.57 cfs 4,633 cf

Pond DMH8: DMH8 Peak Elev=697.23' Inflow=2.14 cfs 6,776 cf
Primary=0.72 cfs 5,895 cf Secondary=1.42 cfs 881 cf Outflow=2.14 cfs 6,776 cf

Pond DMH9: DMH9 Peak Elev=696.09' Inflow=1.98 cfs 9,610 cf
12.0" Round Culvert n=0.013 L=39.0' S=0.0051 '/' Outflow=1.98 cfs 9,610 cf

Pond OWS1: O/W SEP-1 Peak Elev=696.00' Inflow=0.75 cfs 4,292 cf
6.0" Round Culvert n=0.010 L=10.0' S=0.0100 '/' Outflow=0.75 cfs 4,292 cf

Pond OWS2: O/W SEP-2 Peak Elev=696.64' Inflow=0.72 cfs 3,504 cf
6.0" Round Culvert n=0.010 L=9.0' S=0.0111 '/' Outflow=0.72 cfs 3,504 cf

Pond OWS3: O/W SEP-3 Peak Elev=696.66' Inflow=0.72 cfs 5,895 cf
6.0" Round Culvert n=0.010 L=10.0' S=0.0100 '/' Outflow=0.72 cfs 5,895 cf

Link 1L: WETLANDS NORTH
Inflow=0.01 cfs 320 cf
Primary=0.01 cfs 320 cf

Link 2L: WETLANDS SOUTH
Inflow=0.01 cfs 222 cf
Primary=0.01 cfs 222 cf

Link DP1: DESIGN POINT #1 (UNNAMED STREAM CULVERT)
Inflow=8.07 cfs 26,102 cf
Primary=8.07 cfs 26,102 cf

Link DP2: DESIGN POINT #2 (RTE 15)
Inflow=0.36 cfs 1,060 cf
Primary=0.36 cfs 1,060 cf

Total Runoff Area = 250,180 sf Runoff Volume = 31,759 cf Average Runoff Depth = 1.52"
59.81% Pervious = 149,637 sf 40.19% Impervious = 100,543 sf

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: TO CB1 Runoff Area=7,453 sf 80.64% Impervious Runoff Depth=4.89"
Flow Length=71' Slope=0.0110 '/' Tc=3.9 min CN=86 Runoff=1.03 cfs 3,035 cf

Subcatchment 2S: TO CB2 Runoff Area=6,613 sf 100.00% Impervious Runoff Depth=6.26"
Flow Length=75' Slope=0.0130 '/' Tc=0.9 min CN=98 Runoff=1.16 cfs 3,451 cf

Subcatchment 3S: TO CB3 Runoff Area=3,948 sf 97.97% Impervious Runoff Depth=6.14"
Flow Length=50' Slope=0.0200 '/' Tc=0.2 min CN=97 Runoff=0.70 cfs 2,021 cf

Subcatchment 4S: TO CB4 Runoff Area=13,963 sf 52.41% Impervious Runoff Depth=3.01"
Flow Length=91' Tc=3.6 min CN=68 Runoff=1.23 cfs 3,503 cf

Subcatchment 5S: TO CB5 Runoff Area=8,407 sf 96.76% Impervious Runoff Depth=6.03"
Flow Length=20' Slope=0.0400 '/' Tc=2.1 min CN=96 Runoff=1.40 cfs 4,221 cf

Subcatchment 6S: TO CB6 Runoff Area=7,184 sf 91.83% Impervious Runoff Depth=5.68"
Flow Length=140' Slope=0.0210 '/' Tc=1.1 min CN=93 Runoff=1.20 cfs 3,398 cf

Subcatchment 7S: TO CB7 Runoff Area=7,828 sf 66.15% Impervious Runoff Depth=4.02"
Flow Length=155' Tc=3.4 min CN=78 Runoff=0.93 cfs 2,625 cf

Subcatchment 8S: TO CB8 Runoff Area=1,108 sf 100.00% Impervious Runoff Depth=6.26"
Flow Length=63' Slope=0.0440 '/' Tc=0.4 min CN=98 Runoff=0.20 cfs 578 cf

Subcatchment 9S: TO CB9 Runoff Area=6,065 sf 92.28% Impervious Runoff Depth=5.68"
Flow Length=116' Tc=2.4 min CN=93 Runoff=0.97 cfs 2,869 cf

Subcatchment 10S: TO CB10 Runoff Area=8,203 sf 96.04% Impervious Runoff Depth=6.03"
Flow Length=113' Tc=2.5 min CN=96 Runoff=1.35 cfs 4,119 cf

Subcatchment 11S: TO CB11 Runoff Area=9,680 sf 47.10% Impervious Runoff Depth=2.91"
Flow Length=162' Tc=4.1 min CN=67 Runoff=0.81 cfs 2,350 cf

Subcatchment 12S: TO CB12 Runoff Area=14,516 sf 28.88% Impervious Runoff Depth=1.90"
Flow Length=189' Tc=4.0 min CN=56 Runoff=0.74 cfs 2,298 cf

Subcatchment 13S: TO CB13 Runoff Area=25,264 sf 62.23% Impervious Runoff Depth=3.82"
Flow Length=270' Tc=4.6 min CN=76 Runoff=2.73 cfs 8,033 cf

Subcatchment 15S: ROOF Runoff Area=7,426 sf 100.00% Impervious Runoff Depth=6.26"
Tc=0.0 min CN=98 Runoff=1.33 cfs 3,875 cf

Subcatchment 16S: CANOPY Runoff Area=4,048 sf 100.00% Impervious Runoff Depth=6.26"
Tc=0.0 min CN=98 Runoff=0.72 cfs 2,112 cf

Subcatchment 17S: CANOPY Runoff Area=1,465 sf 100.00% Impervious Runoff Depth=6.26"
Tc=0.0 min CN=98 Runoff=0.26 cfs 764 cf

Subcatchment 100S: TO WETLANDS Runoff Area=58,071 sf 0.00% Impervious Runoff Depth=0.48"
Flow Length=315' Slope=0.0200 '/' Tc=5.4 min CN=37 Runoff=0.25 cfs 2,303 cf

Subcatchment 200S: TO WETLANDS Runoff Area=55,956 sf 3.30% Impervious Runoff Depth=0.42"
Flow Length=110' Slope=0.0450 '/' Tc=6.6 min CN=36 Runoff=0.19 cfs 1,951 cf

Subcatchment 400S: TO ROADWAY Runoff Area=2,982 sf 100.00% Impervious Runoff Depth=6.26"
Flow Length=57' Slope=0.0400 '/' Tc=0.4 min CN=98 Runoff=0.53 cfs 1,556 cf

Reach 1R: DMH12 Inflow=2.73 cfs 9,983 cf
Outflow=2.73 cfs 9,983 cf

Reach 2R: DMH11 Inflow=2.73 cfs 9,983 cf
Outflow=2.73 cfs 9,983 cf

Reach 3R: DMH10 Inflow=8.46 cfs 28,221 cf
Outflow=8.46 cfs 28,221 cf

Reach 4R: DMH5 Inflow=11.01 cfs 35,945 cf
Outflow=11.01 cfs 35,945 cf

Reach 5R: DMH2 Inflow=13.53 cfs 44,451 cf
Outflow=13.53 cfs 44,451 cf

Pond 1P: BASIN1 Peak Elev=698.72' Storage=2,675 cf Inflow=2.31 cfs 6,751 cf
Discarded=0.22 cfs 6,752 cf Secondary=0.00 cfs 0 cf Outflow=0.22 cfs 6,752 cf

Pond CB1: CB1 Peak Elev=696.40' Inflow=1.03 cfs 3,035 cf
12.0" Round Culvert n=0.013 L=133.0' S=0.0053 '/' Outflow=1.03 cfs 3,035 cf

Pond CB10: CB10 Peak Elev=698.38' Inflow=1.35 cfs 4,119 cf
12.0" Round Culvert n=0.013 L=63.0' S=0.0048 '/' Outflow=1.35 cfs 4,119 cf

Pond CB111: CB11 Peak Elev=698.43' Inflow=0.81 cfs 2,350 cf
12.0" Round Culvert n=0.013 L=11.0' S=0.0091 '/' Outflow=0.81 cfs 2,350 cf

Pond CB12: CB12 Peak Elev=698.79' Inflow=0.74 cfs 2,298 cf
12.0" Round Culvert n=0.013 L=85.0' S=0.0059 '/' Outflow=0.74 cfs 2,298 cf

Pond CB13: CB13 Peak Elev=697.98' Inflow=2.73 cfs 8,033 cf
12.0" Round Culvert n=0.013 L=24.0' S=0.0062 '/' Outflow=2.73 cfs 8,033 cf

Pond CB2: CB2 Peak Elev=696.62' Inflow=1.16 cfs 3,451 cf
12.0" Round Culvert n=0.013 L=29.0' S=0.0086 '/' Outflow=1.16 cfs 3,451 cf

Pond CB3: CB3 Peak Elev=697.00' Inflow=0.70 cfs 2,021 cf
12.0" Round Culvert n=0.013 L=37.0' S=0.0054 '/' Outflow=0.70 cfs 2,021 cf

Pond CB4: CB4 Peak Elev=697.06' Inflow=1.23 cfs 3,503 cf
12.0" Round Culvert n=0.013 L=103.0' S=0.0053 '/' Outflow=1.23 cfs 3,503 cf

Pond CB5: CB5 Peak Elev=697.26' Inflow=1.40 cfs 4,221 cf
12.0" Round Culvert n=0.013 L=19.0' S=0.0053 '/' Outflow=1.40 cfs 4,221 cf

Pond CB6: CB6 Peak Elev=697.53' Inflow=1.20 cfs 3,398 cf
12.0" Round Culvert n=0.013 L=80.0' S=0.0050 '/' Outflow=1.20 cfs 3,398 cf

Pond CB7: CB7 Peak Elev=697.89' Inflow=0.93 cfs 2,625 cf
12.0" Round Culvert n=0.013 L=15.0' S=0.0067 '/' Outflow=0.93 cfs 2,625 cf

Pond CB8: CB8 Peak Elev=699.73' Inflow=0.20 cfs 578 cf
12.0" Round Culvert n=0.013 L=15.0' S=0.0100 '/' Outflow=0.20 cfs 578 cf

Pond CB9: CB9 Peak Elev=698.30' Inflow=0.97 cfs 2,869 cf
12.0" Round Culvert n=0.013 L=10.0' S=0.0050 '/' Outflow=0.97 cfs 2,869 cf

Pond DMH1: DMH1 Peak Elev=695.77' Inflow=2.03 cfs 6,485 cf
12.0" Round Culvert n=0.009 L=70.0' S=0.0057 '/' Outflow=2.03 cfs 6,485 cf

Pond DMH13: DMH13 Peak Elev=698.92' Inflow=0.98 cfs 2,877 cf
12.0" Round Culvert n=0.013 L=111.0' S=0.0050 '/' Outflow=0.98 cfs 2,877 cf

Pond DMH14: DMH14 Peak Elev=698.73' Inflow=2.31 cfs 6,751 cf
12.0" Round Culvert n=0.013 L=90.0' S=0.0050 '/' Outflow=2.31 cfs 6,751 cf

Pond DMH3: DMH3 Peak Elev=696.89' Inflow=2.56 cfs 7,724 cf
Primary=0.76 cfs 6,528 cf Secondary=1.84 cfs 1,196 cf Outflow=2.56 cfs 7,724 cf

Pond DMH4: DMH4 Peak Elev=695.75' Inflow=2.56 cfs 7,724 cf
12.0" Round Culvert n=0.013 L=20.0' S=0.0050 '/' Outflow=2.56 cfs 7,724 cf

Pond DMH6: DMH6 Peak Elev=697.41' Inflow=2.03 cfs 6,023 cf
Primary=0.72 cfs 5,274 cf Secondary=1.35 cfs 749 cf Outflow=2.03 cfs 6,023 cf

Pond DMH7: DMH7 Peak Elev=698.24' Inflow=2.32 cfs 6,988 cf
12.0" Round Culvert n=0.013 L=82.0' S=0.0049 '/' Outflow=2.32 cfs 6,988 cf

Pond DMH8: DMH8 Peak Elev=697.72' Inflow=3.75 cfs 11,636 cf
Primary=0.77 cfs 8,952 cf Secondary=2.99 cfs 2,684 cf Outflow=3.75 cfs 11,636 cf

Pond DMH9: DMH9 Peak Elev=696.41' Inflow=2.80 cfs 14,976 cf
12.0" Round Culvert n=0.013 L=39.0' S=0.0051 '/' Outflow=2.80 cfs 14,976 cf

Pond OWS1: O/W SEP-1 Peak Elev=696.33' Inflow=0.76 cfs 6,528 cf
6.0" Round Culvert n=0.010 L=10.0' S=0.0100 '/' Outflow=0.76 cfs 6,528 cf

Pond OWS2: O/W SEP-2 Peak Elev=696.92' Inflow=0.72 cfs 5,274 cf
6.0" Round Culvert n=0.010 L=9.0' S=0.0111 '/' Outflow=0.72 cfs 5,274 cf

Pond OWS3: O/W SEP-3 Peak Elev=697.07' Inflow=0.77 cfs 8,952 cf
6.0" Round Culvert n=0.010 L=10.0' S=0.0100 '/' Outflow=0.77 cfs 8,952 cf

Link 1L: WETLANDS NORTH Inflow=0.25 cfs 2,303 cf
Primary=0.25 cfs 2,303 cf

Link 2L: WETLANDS SOUTH Inflow=0.19 cfs 1,951 cf
Primary=0.19 cfs 1,951 cf

Link DP1: DESIGN POINT #1 (UNNAMED STREAM CULVERT) Inflow=13.53 cfs 46,754 cf
Primary=13.53 cfs 46,754 cf

Link DP2: DESIGN POINT #2 (RTE 15) Inflow=0.53 cfs 1,556 cf
Primary=0.53 cfs 1,556 cf

Total Runoff Area = 250,180 sf Runoff Volume = 55,062 cf Average Runoff Depth = 2.64"
59.81% Pervious = 149,637 sf 40.19% Impervious = 100,543 sf

Summary for Subcatchment 1S: TO CB1

Runoff = 0.64 cfs @ 12.06 hrs, Volume= 1,865 cf, Depth= 3.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
996	39	>75% Grass cover, Good, HSG A
447	30	Woods, Good, HSG A
6,010	98	Paved parking, HSG A
7,453	86	Weighted Average
1,443		19.36% Pervious Area
6,010		80.64% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.5	20	0.0110	0.09		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.4	51	0.0110	2.13		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.9	71	Total			

Summary for Subcatchment 2S: TO CB2

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.80 cfs @ 12.01 hrs, Volume= 2,350 cf, Depth= 4.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
6,613	98	Paved parking, HSG A
6,613		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	25	0.0130	0.85		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
0.4	50	0.0130	2.31		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.9	75	Total			

Summary for Subcatchment 3S: TO CB3

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.48 cfs @ 12.00 hrs, Volume= 1,365 cf, Depth= 4.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
3,868	98	Paved parking, HSG A
80	39	>75% Grass cover, Good, HSG A
3,948	97	Weighted Average
80		2.03% Pervious Area
3,868		97.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	25	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	25	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.2	50	Total			

Summary for Subcatchment 4S: TO CB4

Runoff = 0.60 cfs @ 12.06 hrs, Volume= 1,783 cf, Depth= 1.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
2,733	30	Woods, Good, HSG A
3,912	39	>75% Grass cover, Good, HSG A
7,318	98	Paved parking, HSG A
13,963	68	Weighted Average
6,645		47.59% Pervious Area
7,318		52.41% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.2	25	0.1600	0.13		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
0.1	12	0.1600	2.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.2	35	0.0570	3.84		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.1	19	0.0300	3.52		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.6	91	Total			

Summary for Subcatchment 5S: TO CB5

Runoff = 0.96 cfs @ 12.03 hrs, Volume= 2,827 cf, Depth= 4.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
272	39	>75% Grass cover, Good, HSG A
8,135	98	Paved parking, HSG A
8,407	96	Weighted Average
272		3.24% Pervious Area
8,135		96.76% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.1	20	0.0400	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"

Summary for Subcatchment 6S: TO CB6

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.81 cfs @ 12.02 hrs, Volume= 2,220 cf, Depth= 3.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
587	39	>75% Grass cover, Good, HSG A
6,597	98	Paved parking, HSG A
7,184	93	Weighted Average
587		8.17% Pervious Area
6,597		91.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	25	0.0210	1.03		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
0.7	115	0.0210	2.94		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.1	140	Total			

Summary for Subcatchment 7S: TO CB7

Runoff = 0.53 cfs @ 12.05 hrs, Volume= 1,496 cf, Depth= 2.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
2,650	39	>75% Grass cover, Good, HSG A
5,178	98	Paved parking, HSG A
7,828	78	Weighted Average
2,650		33.85% Pervious Area
5,178		66.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.6	25	0.0360	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.3	50	0.0360	3.05		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.5	80	0.0190	2.80		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.4	155	Total			

Summary for Subcatchment 8S: TO CB8

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.14 cfs @ 12.01 hrs, Volume= 394 cf, Depth= 4.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
1,108	98	Paved parking, HSG A
1,108		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	25	0.0440	1.38		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
0.1	38	0.0440	4.26		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.4	63	Total			

Summary for Subcatchment 9S: TO CB9

Runoff = 0.65 cfs @ 12.03 hrs, Volume= 1,874 cf, Depth= 3.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
468	39	>75% Grass cover, Good, HSG A
5,597	98	Paved parking, HSG A
6,065	93	Weighted Average
468		7.72% Pervious Area
5,597		92.28% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	17	0.0500	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.7	99	0.0150	2.49		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
2.4	116	Total			

Summary for Subcatchment 10S: TO CB10

Runoff = 0.92 cfs @ 12.04 hrs, Volume= 2,759 cf, Depth= 4.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
325	39	>75% Grass cover, Good, HSG A
7,878	98	Paved parking, HSG A
8,203	96	Weighted Average
325		3.96% Pervious Area
7,878		96.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.9	20	0.0500	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.6	93	0.0160	2.57		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
2.5	113	Total			

Summary for Subcatchment 11S: TO CB11

Runoff = 0.39 cfs @ 12.07 hrs, Volume= 1,181 cf, Depth= 1.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
5,121	39	>75% Grass cover, Good, HSG A
4,559	98	Paved parking, HSG A
9,680	67	Weighted Average
5,121		52.90% Pervious Area
4,559		47.10% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.3	25	0.0200	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.5	75	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.3	62	0.0300	3.52		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
4.1	162	Total			

Summary for Subcatchment 12S: TO CB12

Runoff = 0.25 cfs @ 12.08 hrs, Volume= 962 cf, Depth= 0.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
10,324	39	>75% Grass cover, Good, HSG A
4,192	98	Paved parking, HSG A
14,516	56	Weighted Average
10,324		71.12% Pervious Area
4,192		28.88% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0	25	0.0270	0.14		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.6	100	0.0270	2.65		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.4	64	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
4.0	189	Total			

Summary for Subcatchment 13S: TO CB13

Runoff = 1.52 cfs @ 12.07 hrs, Volume= 4,484 cf, Depth= 2.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
9,541	39	>75% Grass cover, Good, HSG A
15,723	98	Paved parking, HSG A
25,264	76	Weighted Average
9,541		37.77% Pervious Area
15,723		62.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.1	25	0.0250	0.14		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
0.7	105	0.0250	2.55		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.8	140	0.0230	3.08		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
4.6	270	Total			

Summary for Subcatchment 15S: ROOF

[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 0.91 cfs @ 12.00 hrs, Volume= 2,639 cf, Depth= 4.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
7,426	98	Roofs, HSG A
7,426		100.00% Impervious Area

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

Summary for Subcatchment 16S: CANOPY

[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 0.50 cfs @ 12.00 hrs, Volume= 1,438 cf, Depth= 4.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
4,048	98	Roofs, HSG A
4,048		100.00% Impervious Area

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

Summary for Subcatchment 17S: CANOPY

[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 0.18 cfs @ 12.00 hrs, Volume= 521 cf, Depth= 4.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
1,465	98	Roofs, HSG A
1,465		100.00% Impervious Area

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

Summary for Subcatchment 100S: TO WETLANDS NORTH

Runoff = 0.01 cfs @ 15.27 hrs, Volume= 320 cf, Depth= 0.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
14,482	30	Woods, Good, HSG A
43,589	39	>75% Grass cover, Good, HSG A
58,071	37	Weighted Average
58,071		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.3	25	0.0200	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.00"
2.1	290	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
5.4	315	Total			

Summary for Subcatchment 200S: TO WETLANDS SOUTH

Runoff = 0.01 cfs @ 15.64 hrs, Volume= 222 cf, Depth= 0.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
33,603	30	Woods, Good, HSG A
1,846	98	Paved parking, HSG A
20,507	39	>75% Grass cover, Good, HSG A
55,956	36	Weighted Average
54,110		96.70% Pervious Area
1,846		3.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.3	25	0.0450	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.00"
1.3	85	0.0450	1.06		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
6.6	110	Total			

Summary for Subcatchment 400S: TO ROADWAY

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.36 cfs @ 12.01 hrs, Volume= 1,060 cf, Depth= 4.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
2,982	98	Paved parking, HSG A
2,982		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	25	0.0400	1.33		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.00"
0.1	32	0.0400	4.06		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.4	57	Total			

Summary for Reach 1R: DMH12

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

Inflow Area = 81,220 sf, 21.63% Impervious, Inflow Depth = 0.70" for 10-yr event
Inflow = 1.52 cfs @ 12.07 hrs, Volume= 4,706 cf
Outflow = 1.52 cfs @ 12.07 hrs, Volume= 4,706 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Summary for Reach 2R: DMH11

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

Inflow Area = 81,220 sf, 21.63% Impervious, Inflow Depth = 0.70" for 10-yr event
Inflow = 1.52 cfs @ 12.07 hrs, Volume= 4,706 cf
Outflow = 1.52 cfs @ 12.07 hrs, Volume= 4,706 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Summary for Reach 3R: DMH10

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

Inflow Area = 135,804 sf, 38.79% Impervious, Inflow Depth = 1.38" for 10-yr event
Inflow = 4.89 cfs @ 12.05 hrs, Volume= 15,591 cf
Outflow = 4.89 cfs @ 12.05 hrs, Volume= 15,591 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Summary for Reach 4R: DMH5

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

Inflow Area = 158,174 sf, 43.07% Impervious, Inflow Depth = 1.53" for 10-yr event
Inflow = 6.39 cfs @ 12.05 hrs, Volume= 20,201 cf
Outflow = 6.39 cfs @ 12.05 hrs, Volume= 20,201 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Summary for Reach 5R: DMH2

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

Inflow Area = 176,188 sf, 48.03% Impervious, Inflow Depth = 1.76" for 10-yr event
Inflow = 8.07 cfs @ 12.04 hrs, Volume= 25,782 cf
Outflow = 8.07 cfs @ 12.04 hrs, Volume= 25,782 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Summary for Pond 1P: BASIN1

[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=217)

Inflow Area = 12,939 sf,100.00% Impervious, Inflow Depth = 4.26" for 10-yr event
Inflow = 1.59 cfs @ 12.00 hrs, Volume= 4,598 cf
Outflow = 0.17 cfs @ 12.49 hrs, Volume= 4,598 cf, Atten= 90%, Lag= 29.7 min
Discarded = 0.17 cfs @ 12.49 hrs, Volume= 4,598 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 698.21' @ 12.49 hrs Surf.Area= 1,748 sf Storage= 1,674 cf
Flood Elev= 700.00' Surf.Area= 3,442 sf Storage= 6,236 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 87.6 min (831.9 - 744.3)

Volume	Invert	Avail.Storage	Storage Description
#1	697.00'	6,236 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
697.00	1,079	147.0	0	0	1,079
698.00	1,587	179.0	1,325	1,325	1,925
700.00	3,442	235.0	4,911	6,236	3,816

Device	Routing	Invert	Outlet Devices
#1	Secondary	698.75'	**10.0' long x 6.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.37 2.51 2.70 2.68 2.68 2.67 2.65 2.65 2.65 2.65 2.66 2.66 2.67 2.69 2.72 2.76 2.83
#2	Discarded	697.00'	**2.410 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 695.00'

Discarded OutFlow Max=0.17 cfs @ 12.49 hrs HW=698.21' (Free Discharge)
↑—**2=Exfiltration** (Controls 0.17 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=697.00' TW=0.00' (Dynamic Tailwater)
↑—**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond CB1: CB1

Inflow Area = 7,453 sf, 80.64% Impervious, Inflow Depth = 3.00" for 10-yr event
Inflow = 0.64 cfs @ 12.06 hrs, Volume= 1,865 cf
Outflow = 0.64 cfs @ 12.06 hrs, Volume= 1,865 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.64 cfs @ 12.06 hrs, Volume= 1,865 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 696.24' @ 12.05 hrs
Flood Elev= 700.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	695.75'	**12.0" Round Culvert** L= 133.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 695.75' / 695.05' S= 0.0053 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.65 cfs @ 12.06 hrs HW=696.24' TW=695.55' (Dynamic Tailwater)
↑—**1=Culvert** (Outlet Controls 0.65 cfs @ 2.50 fps)

Summary for Pond CB10: CB10

Inflow Area = 8,203 sf, 96.04% Impervious, Inflow Depth = 4.04" for 10-yr event
Inflow = 0.92 cfs @ 12.04 hrs, Volume= 2,759 cf
Outflow = 0.92 cfs @ 12.04 hrs, Volume= 2,759 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.92 cfs @ 12.04 hrs, Volume= 2,759 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 697.54' @ 12.05 hrs
Flood Elev= 700.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	696.30'	**12.0" Round Culvert** L= 63.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 696.30' / 696.00' S= 0.0048 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.60 cfs @ 12.04 hrs HW=697.49' TW=697.46' (Dynamic Tailwater)
↑—**1=Culvert** (Outlet Controls 0.60 cfs @ 0.81 fps)

Summary for Pond CB111: CB11

Inflow Area = 9,680 sf, 47.10% Impervious, Inflow Depth = 1.46" for 10-yr event
Inflow = 0.39 cfs @ 12.07 hrs, Volume= 1,181 cf
Outflow = 0.39 cfs @ 12.07 hrs, Volume= 1,181 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.39 cfs @ 12.07 hrs, Volume= 1,181 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 698.25' @ 12.07 hrs
Flood Elev= 702.10'

Device	Routing	Invert	Outlet Devices
#1	Primary	697.90'	**12.0" Round Culvert** L= 11.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 697.90' / 697.80' S= 0.0091 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.39 cfs @ 12.07 hrs HW=698.25' TW=697.20' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 0.39 cfs @ 2.36 fps)

Summary for Pond CB12: CB12

Inflow Area = 14,516 sf, 28.88% Impervious, Inflow Depth = 0.80" for 10-yr event
Inflow = 0.25 cfs @ 12.08 hrs, Volume= 962 cf
Outflow = 0.25 cfs @ 12.08 hrs, Volume= 962 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.25 cfs @ 12.08 hrs, Volume= 962 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 698.58' @ 12.08 hrs
Flood Elev= 702.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	698.30'	**12.0" Round Culvert** L= 85.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 698.30' / 697.80' S= 0.0059 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.25 cfs @ 12.08 hrs HW=698.58' TW=697.17' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 0.25 cfs @ 2.12 fps)

Summary for Pond CB13: CB13

Inflow Area = 25,264 sf, 62.23% Impervious, Inflow Depth = 2.13" for 10-yr event
Inflow = 1.52 cfs @ 12.07 hrs, Volume= 4,484 cf
Outflow = 1.52 cfs @ 12.07 hrs, Volume= 4,484 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.52 cfs @ 12.07 hrs, Volume= 4,484 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 697.58' @ 12.07 hrs
Flood Elev= 701.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	696.80'	**12.0" Round Culvert** L= 24.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 696.80' / 696.65' S= 0.0062 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.52 cfs @ 12.07 hrs HW=697.58' TW=0.00' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 1.52 cfs @ 3.20 fps)

Summary for Pond CB2: CB2

Inflow Area = 6,613 sf,100.00% Impervious, Inflow Depth = 4.26" for 10-yr event
Inflow = 0.80 cfs @ 12.01 hrs, Volume= 2,350 cf
Outflow = 0.80 cfs @ 12.01 hrs, Volume= 2,350 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.80 cfs @ 12.01 hrs, Volume= 2,350 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 696.50' @ 12.01 hrs
Flood Elev= 700.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	696.00'	**12.0" Round Culvert** L= 29.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 696.00' / 695.75' S= 0.0086 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.79 cfs @ 12.01 hrs HW=696.50' TW=695.57' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 0.79 cfs @ 2.98 fps)

Summary for Pond CB3: CB3

Inflow Area = 3,948 sf, 97.97% Impervious, Inflow Depth = 4.15" for 10-yr event
Inflow = 0.48 cfs @ 12.00 hrs, Volume= 1,365 cf
Outflow = 0.48 cfs @ 12.00 hrs, Volume= 1,365 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.48 cfs @ 12.00 hrs, Volume= 1,365 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 696.90' @ 12.00 hrs
Flood Elev= 700.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	696.50'	**12.0" Round Culvert** L= 37.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 696.50' / 696.30' S= 0.0054 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.48 cfs @ 12.00 hrs HW=696.90' TW=0.00' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 0.48 cfs @ 2.38 fps)

Summary for Pond CB4: CB4

Inflow Area = 13,963 sf, 52.41% Impervious, Inflow Depth = 1.53" for 10-yr event
Inflow = 0.60 cfs @ 12.06 hrs, Volume= 1,783 cf
Outflow = 0.60 cfs @ 12.06 hrs, Volume= 1,783 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.60 cfs @ 12.06 hrs, Volume= 1,783 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 696.68' @ 12.05 hrs
Flood Elev= 700.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	695.80'	**12.0" Round Culvert** L= 103.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 695.80' / 695.25' S= 0.0053 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.65 cfs @ 12.06 hrs HW=696.67' TW=696.58' (Dynamic Tailwater)
↑—**1=Culvert** (Outlet Controls 0.65 cfs @ 1.19 fps)

Summary for Pond CB5: CB5

Inflow Area = 8,407 sf, 96.76% Impervious, Inflow Depth = 4.04" for 10-yr event
Inflow = 0.96 cfs @ 12.03 hrs, Volume= 2,827 cf
Outflow = 0.96 cfs @ 12.03 hrs, Volume= 2,827 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.96 cfs @ 12.03 hrs, Volume= 2,827 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 697.11' @ 12.03 hrs
Flood Elev= 700.70'

Device	Routing	Invert	Outlet Devices
#1	Primary	696.50'	**12.0" Round Culvert** L= 19.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 696.50' / 696.40' S= 0.0053 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.96 cfs @ 12.03 hrs HW=697.11' TW=696.59' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 0.96 cfs @ 2.75 fps)

Summary for Pond CB6: CB6

Inflow Area = 7,184 sf, 91.83% Impervious, Inflow Depth = 3.71" for 10-yr event
Inflow = 0.81 cfs @ 12.02 hrs, Volume= 2,220 cf
Outflow = 0.81 cfs @ 12.02 hrs, Volume= 2,220 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.81 cfs @ 12.02 hrs, Volume= 2,220 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 697.26' @ 12.03 hrs
Flood Elev= 700.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	696.30'	**12.0" Round Culvert** L= 80.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 696.30' / 695.90' S= 0.0050 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.70 cfs @ 12.02 hrs HW=697.24' TW=697.17' (Dynamic Tailwater)
↑—**1=Culvert** (Outlet Controls 0.70 cfs @ 1.17 fps)

Summary for Pond CB7: CB7

Inflow Area = 7,828 sf, 66.15% Impervious, Inflow Depth = 2.29" for 10-yr event
Inflow = 0.53 cfs @ 12.05 hrs, Volume= 1,496 cf
Outflow = 0.53 cfs @ 12.05 hrs, Volume= 1,496 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.53 cfs @ 12.05 hrs, Volume= 1,496 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 697.73' @ 12.05 hrs
Flood Elev= 701.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	697.30'	**12.0" Round Culvert** L= 15.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 697.30' / 697.20' S= 0.0067 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.53 cfs @ 12.05 hrs HW=697.73' TW=697.15' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 0.53 cfs @ 2.44 fps)

Summary for Pond CB8: CB8

Inflow Area = 1,108 sf,100.00% Impervious, Inflow Depth = 4.26" for 10-yr event
Inflow = 0.14 cfs @ 12.01 hrs, Volume= 394 cf
Outflow = 0.14 cfs @ 12.01 hrs, Volume= 394 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.14 cfs @ 12.01 hrs, Volume= 394 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 699.69' @ 12.01 hrs
Flood Elev= 703.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	699.50'	**12.0" Round Culvert** L= 15.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 699.50' / 699.35' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.13 cfs @ 12.01 hrs HW=699.69' TW=0.00' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 0.13 cfs @ 1.94 fps)

Summary for Pond CB9: CB9

Inflow Area = 6,065 sf, 92.28% Impervious, Inflow Depth = 3.71" for 10-yr event
Inflow = 0.65 cfs @ 12.03 hrs, Volume= 1,874 cf
Outflow = 0.65 cfs @ 12.03 hrs, Volume= 1,874 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.65 cfs @ 12.03 hrs, Volume= 1,874 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 697.50' @ 12.05 hrs
Flood Elev= 700.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	696.30'	**12.0" Round Culvert** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 696.30' / 696.25' S= 0.0050 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 12.03 hrs HW=697.44' TW=697.45' (Dynamic Tailwater)
↑—**1=Culvert** (Controls 0.00 cfs)

Summary for Pond DMH1: DMH1

Inflow Area = 14,066 sf, 89.74% Impervious, Inflow Depth = 3.60" for 10-yr event
Inflow = 1.34 cfs @ 12.02 hrs, Volume= 4,215 cf
Outflow = 1.34 cfs @ 12.02 hrs, Volume= 4,215 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.34 cfs @ 12.02 hrs, Volume= 4,215 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 695.57' @ 12.02 hrs
Flood Elev= 700.90'

Device	Routing	Invert	Outlet Devices
#1	Primary	694.95'	**12.0" Round Culvert** L= 70.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 694.95' / 694.55' S= 0.0057 '/' Cc= 0.900 n= 0.009 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.33 cfs @ 12.02 hrs HW=695.57' TW=0.00' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 1.33 cfs @ 3.70 fps)

Summary for Pond DMH13: DMH13

Inflow Area = 5,513 sf,100.00% Impervious, Inflow Depth = 4.26" for 10-yr event
Inflow = 0.68 cfs @ 12.00 hrs, Volume= 1,959 cf
Outflow = 0.68 cfs @ 12.00 hrs, Volume= 1,959 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.68 cfs @ 12.00 hrs, Volume= 1,959 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 698.67' @ 12.00 hrs
Flood Elev= 702.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	698.10'	**12.0" Round Culvert** L= 111.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 698.10' / 697.55' S= 0.0050 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.65 cfs @ 12.00 hrs HW=698.66' TW=698.29' (Dynamic Tailwater)
↑—**1=Culvert** (Outlet Controls 0.65 cfs @ 2.07 fps)

Summary for Pond DMH14: DMH14

Inflow Area = 12,939 sf,100.00% Impervious, Inflow Depth = 4.26" for 10-yr event
Inflow = 1.59 cfs @ 12.00 hrs, Volume= 4,598 cf
Outflow = 1.59 cfs @ 12.00 hrs, Volume= 4,598 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.59 cfs @ 12.00 hrs, Volume= 4,598 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 698.30' @ 12.00 hrs
Flood Elev= 700.60'

Device	Routing	Invert	Outlet Devices
#1	Primary	697.45'	**12.0" Round Culvert** L= 90.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 697.45' / 697.00' S= 0.0050 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.54 cfs @ 12.00 hrs HW=698.29' TW=697.77' (Dynamic Tailwater)
↑—**1=Culvert** (Outlet Controls 1.54 cfs @ 2.94 fps)

Summary for Pond DMH3: DMH3

[80] Warning: Exceeded Pond CB4 by 0.02' @ 11.96 hrs (0.14 cfs 7 cf)

Inflow Area =	22,370 sf,	69.08% Impervious,	Inflow Depth =	2.47"	for 10-yr event
Inflow =	1.51 cfs @	12.04 hrs, Volume=	4,611 cf		
Outflow =	1.51 cfs @	12.04 hrs, Volume=	4,611 cf,	Atten= 0%,	Lag= 0.0 min
Primary =	0.75 cfs @	12.01 hrs, Volume=	4,292 cf		
Secondary =	0.78 cfs @	12.04 hrs, Volume=	318 cf		

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 696.60' @ 12.04 hrs
Flood Elev= 700.95'

Device	Routing	Invert	Outlet Devices
#1	Primary	695.15'	**6.0" Round Culvert** L= 17.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 695.15' / 695.05' S= 0.0059 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.20 sf
#2	Secondary	696.15'	**12.0" Round Culvert** L= 33.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 696.15' / 694.70' S= 0.0439 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.73 cfs @ 12.01 hrs HW=696.53' TW=695.94' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 0.73 cfs @ 3.70 fps)

Secondary OutFlow Max=0.78 cfs @ 12.04 hrs HW=696.60' TW=695.40' (Dynamic Tailwater)
↑—**2=Culvert** (Inlet Controls 0.78 cfs @ 2.28 fps)

Summary for Pond DMH4: DMH4

Inflow Area =	22,370 sf,	69.08% Impervious,	Inflow Depth =	2.47"	for 10-yr event
Inflow =	1.51 cfs @	12.04 hrs, Volume=	4,611 cf		
Outflow =	1.51 cfs @	12.04 hrs, Volume=	4,611 cf,	Atten= 0%,	Lag= 0.0 min
Primary =	1.51 cfs @	12.04 hrs, Volume=	4,611 cf		

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 695.40' @ 12.04 hrs
Flood Elev= 701.40'

Device	Routing	Invert	Outlet Devices
#1	Primary	694.60'	**12.0" Round Culvert** L= 20.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 694.60' / 694.50' S= 0.0050 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.51 cfs @ 12.04 hrs HW=695.40' TW=0.00' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 1.51 cfs @ 3.07 fps)

Summary for Pond DMH6: DMH6

[80] Warning: Exceeded Pond CB6 by 0.01' @ 11.95 hrs (0.12 cfs 4 cf)

Inflow Area =	15,012 sf,	78.44% Impervious,	Inflow Depth =	2.97"	for 10-yr event
Inflow =	1.27 cfs @	12.03 hrs, Volume=	3,715 cf		
Outflow =	1.27 cfs @	12.03 hrs, Volume=	3,715 cf,	Atten= 0%,	Lag= 0.0 min
Primary =	0.72 cfs @	12.01 hrs, Volume=	3,504 cf		
Secondary =	0.57 cfs @	12.03 hrs, Volume=	211 cf		

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 697.18' @ 12.03 hrs
Flood Elev= 701.70'

Device	Routing	Invert	Outlet Devices
#1	Primary	695.80'	**6.0" Round Culvert** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 695.80' / 695.50' S= 0.0300 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.20 sf
#2	Secondary	696.80'	**12.0" Round Culvert** L= 28.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 696.80' / 695.15' S= 0.0589 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.69 cfs @ 12.01 hrs HW=697.15' TW=696.61' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 0.69 cfs @ 3.53 fps)

Secondary OutFlow Max=0.57 cfs @ 12.03 hrs HW=697.18' TW=696.09' (Dynamic Tailwater)
↑—**2=Culvert** (Inlet Controls 0.57 cfs @ 2.09 fps)

Summary for Pond DMH7: DMH7

[80] Warning: Exceeded Pond CB10 by 0.01' @ 12.02 hrs (0.25 cfs 9 cf)
[80] Warning: Exceeded Pond CB9 by 0.06' @ 12.02 hrs (0.91 cfs 208 cf)

Inflow Area =	14,268 sf,	94.44% Impervious,	Inflow Depth =	3.90"	for 10-yr event
Inflow =	1.57 cfs @	12.04 hrs, Volume=	4,633 cf		
Outflow =	1.57 cfs @	12.04 hrs, Volume=	4,633 cf,	Atten= 0%,	Lag= 0.0 min
Primary =	1.57 cfs @	12.04 hrs, Volume=	4,633 cf		

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 697.47' @ 12.04 hrs
Flood Elev= 700.65'

Device	Routing	Invert	Outlet Devices
#1	Primary	696.00'	**12.0" Round Culvert** L= 82.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 696.00' / 695.60' S= 0.0049 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.50 cfs @ 12.04 hrs HW=697.46' TW=697.23' (Dynamic Tailwater)
↑—**1=Culvert** (Outlet Controls 1.50 cfs @ 1.91 fps)

Summary for Pond DMH8: DMH8

Inflow Area =	38,464 sf,	57.78% Impervious,	Inflow Depth =	2.11" for 10-yr event
Inflow =	2.14 cfs @	12.04 hrs, Volume=	6,776 cf	
Outflow =	2.14 cfs @	12.04 hrs, Volume=	6,776 cf,	Atten= 0%, Lag= 0.0 min
Primary =	0.72 cfs @	12.02 hrs, Volume=	5,895 cf	
Secondary =	1.42 cfs @	12.04 hrs, Volume=	881 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 697.23' @ 12.04 hrs
Flood Elev= 702.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	695.60'	**6.0" Round Culvert** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 695.60' / 695.50' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.20 sf
#2	Secondary	696.60'	**12.0" Round Culvert** L= 55.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 696.60' / 694.95' S= 0.0300 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.70 cfs @ 12.02 hrs HW=697.19' TW=696.65' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 0.70 cfs @ 3.55 fps)

Secondary OutFlow Max=1.41 cfs @ 12.04 hrs HW=697.23' TW=0.00' (Dynamic Tailwater)
↑—**2=Culvert** (Inlet Controls 1.41 cfs @ 2.71 fps)

Summary for Pond DMH9: DMH9

Inflow Area =	53,476 sf,	63.58% Impervious,	Inflow Depth =	2.16" for 10-yr event
Inflow =	1.98 cfs @	12.03 hrs, Volume=	9,610 cf	
Outflow =	1.98 cfs @	12.03 hrs, Volume=	9,610 cf,	Atten= 0%, Lag= 0.0 min
Primary =	1.98 cfs @	12.03 hrs, Volume=	9,610 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 696.09' @ 12.03 hrs
Flood Elev= 701.95'

Device	Routing	Invert	Outlet Devices
#1	Primary	695.15'	**12.0" Round Culvert** L= 39.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 695.15' / 694.95' S= 0.0051 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.98 cfs @ 12.03 hrs HW=696.09' TW=0.00' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 1.98 cfs @ 3.36 fps)

Summary for Pond OWS1: O/W SEP-1

Inflow Area = 22,370 sf, 69.08% Impervious, Inflow Depth = 2.30" for 10-yr event
Inflow = 0.75 cfs @ 12.01 hrs, Volume= 4,292 cf
Outflow = 0.75 cfs @ 12.01 hrs, Volume= 4,292 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.75 cfs @ 12.01 hrs, Volume= 4,292 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 696.00' @ 12.04 hrs
Flood Elev= 701.40'

Device	Routing	Invert	Outlet Devices
#1	Primary	694.80'	**6.0" Round Culvert** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 694.80' / 694.70' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.20 sf

Primary OutFlow Max=0.73 cfs @ 12.01 hrs HW=695.94' TW=695.34' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 0.73 cfs @ 3.73 fps)

Summary for Pond OWS2: O/W SEP-2

Inflow Area = 15,012 sf, 78.44% Impervious, Inflow Depth = 2.80" for 10-yr event
Inflow = 0.72 cfs @ 12.01 hrs, Volume= 3,504 cf
Outflow = 0.72 cfs @ 12.01 hrs, Volume= 3,504 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.72 cfs @ 12.01 hrs, Volume= 3,504 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 696.64' @ 12.03 hrs
Flood Elev= 702.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	695.25'	**6.0" Round Culvert** L= 9.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 695.25' / 695.15' S= 0.0111 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.20 sf

Primary OutFlow Max=0.70 cfs @ 12.01 hrs HW=696.61' TW=696.07' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 0.70 cfs @ 3.55 fps)

Summary for Pond OWS3: O/W SEP-3

Inflow Area = 38,464 sf, 57.78% Impervious, Inflow Depth = 1.84" for 10-yr event
Inflow = 0.72 cfs @ 12.02 hrs, Volume= 5,895 cf
Outflow = 0.72 cfs @ 12.02 hrs, Volume= 5,895 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.72 cfs @ 12.02 hrs, Volume= 5,895 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 696.66' @ 12.04 hrs
Flood Elev= 702.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	695.25'	**6.0" Round Culvert** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 695.25' / 695.15' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.20 sf

Primary OutFlow Max=0.71 cfs @ 12.02 hrs HW=696.65' TW=696.09' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 0.71 cfs @ 3.60 fps)

Summary for Link 1L: WETLANDS NORTH

Inflow Area = 71,010 sf, 18.22% Impervious, Inflow Depth = 0.05" for 10-yr event
Inflow = 0.01 cfs @ 15.27 hrs, Volume= 320 cf
Primary = 0.01 cfs @ 15.27 hrs, Volume= 320 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Summary for Link 2L: WETLANDS SOUTH

Inflow Area = 55,956 sf, 3.30% Impervious, Inflow Depth = 0.05" for 10-yr event
Inflow = 0.01 cfs @ 15.64 hrs, Volume= 222 cf
Primary = 0.01 cfs @ 15.64 hrs, Volume= 222 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Summary for Link DP1: DESIGN POINT #1 (UNNAMED STREAM CULVERT)

Inflow Area = 247,198 sf, 39.47% Impervious, Inflow Depth = 1.27" for 10-yr event
Inflow = 8.07 cfs @ 12.04 hrs, Volume= 26,102 cf
Primary = 8.07 cfs @ 12.04 hrs, Volume= 26,102 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

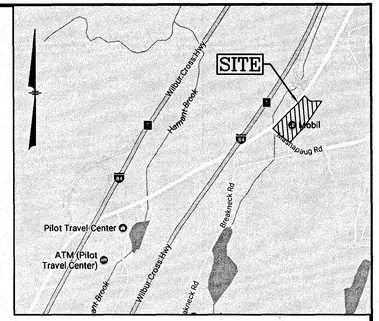
Summary for Link DP2: DESIGN POINT #2 (RTE 15)

Inflow Area = 2,982 sf,100.00% Impervious, Inflow Depth = 4.26" for 10-yr event
Inflow = 0.36 cfs @ 12.01 hrs, Volume= 1,060 cf
Primary = 0.36 cfs @ 12.01 hrs, Volume= 1,060 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

LEGEND

MONUMENT	⊡	BITUMINOUS	BIT.
IRON PIPE	○	CONCRETE	CONC.
DRAIN MANHOLE	●DMH	INVERT	INV.
ELECTRIC MANHOLE	Ⓔ	REINFORCED CONCRETE PIPE	RCP
CATCH BASIN	■CB	POLYVINYL CHLORIDE PIPE	PVC
UTILITY POLE		HIGH DENSITY PLASTIC	HDPE
GUY WIRE	GUY	IRON PIPE	I.P.
BENCH MARK		FOUND	FND.
CHAIN LINK FENCE	x	BOLLARD	BOL.
WOOD / STOCKADE FENCE	□	SEWER MANHOLE	SMH
DRAIN LINE	D	DRAINAGE MANHOLE	DMH
OVERHEAD WIRES	OHW	WATER GATE	WG
CONTOUR 5' INTERVAL		HYDRANT	HYD.
CONTOUR 1' INTERVAL		UTILITY POLE	UP
SPOT GRADE	X 69.33'	GUY WIRE	GUY
PROP. CLEANOUT	C.O.	PROP. CONTOUR ELEVATION	330
PROP. CATCH BASIN	CB–1	PROP. SILT FENCE	
PROP. DRAIN MANHOLE	DMH–1	TOP OF WALL ELEV.	T.W.
PROP. SEWER MANHOLE	SMH–1	BOTTOM OF WALL ELEV.	B.W.
MEET EXISTING GRADE	MEG	PROP. GATE VALVE	
PROP. SPOT ELEVATION	331.25		



LOCATION MAP
(NOT TO SCALE)

S46°58'11"W 294.92'
25' NO DISTURB BUFFER
50' STRUCTURE SETBACK
S37°52'05"W 451.72
Wetland "C" Series Bordering Vegetated Wetland Flagged By EcoTec Inc. 1/2015
N43°50'10"W 123.19'
100' Buffer
S85°29'28"E 176.40'
100S
200S
300S
400S
MASHAPAUG ROAD
N/F
10 Mashapaug Road
Sturbridge LLC
DB 53799 PG 237
Parcel 1
PB 346 PL 5
AP: 552–04126–228
8.36 Acres
S47°52'30"E 146.51'
N43°50'10"W 150.39'
Wetland "C" Series Bordering Vegetated Wetland Flagged By EcoTec Inc. 1/2015
N34°01'29"E 158.95'
N46°58'11"E 300.00'
N46°58'11"E 184.74'
200' Local Buffer
DESIGN POINT #1
DESIGN POINT #2
HAYNES STREET (ROUTE 15)

WATERSHED LEGEND:

(1) SUBCATCHMENT: A relatively homogeneous area of land that drains into a single reach or pond. Each subcatchment generates a runoff hydrograph. (A subcatchment may also be used to account for the rain falling directly on the surface of a pond.)

[1] REACH: A uniform stream, channel, or pipe that conveys water from one point to another reach or pond. The outflow of each reach is determined by a hydrograph routing calculation.

(1) POND: A pond, swamp, dam, or other impoundment that fills with water from one or more sources and empties in a manner determined by a weir, culvert, or other device(s) at its outlet. The outflow(s) of each pond is determined by a hydrograph routing calculation. The primary and/or secondary outflow may drain into a reach or into another pond.

Time of Concentration Path (Tc)

GRAPHIC SCALE
20 0 10 20 40 80
(IN FEET)
1 inch = 20 ft.

GRAPHIC SCALE
30 0 15 30 60 120
(IN FEET)
1 inch = 30 ft.

811 DigSafe MA.ME.NH.RI.VT

NO.	DESCRIPTION	BY	DATE

REVISIONS

PRE DEVELOPMENT DRAINAGE PLAN

PARCELS 552-04135-236, 552-04136-234, 552-04126-228 & 423-04136-010
234 & 236 HAYNES STREET (ROUTE 15)
STURBRIDGE, MA
PREPARED FOR:
PETROGAS GROUP NEW ENGLAND INC.
168 NORTH MAIN STREET
ANDOVER, MA 01810

MHF Design Consultants, Inc.
44 Stiles Road, Suite One
Salem, New Hampshire 03079
(603) 893-0720
ENGINEERS • PLANNERS • SURVEYORS
www.mhfdesign.com

SCALE: 1"=20'	DATE: FEBRUARY 20, 2018		DRAWING NO. 4192PrePost.dwg
DRAWN BY:	CHECKED BY:	PROJECT NO.	SHEET NO.
PWM	FCM	419217	1 OF 1

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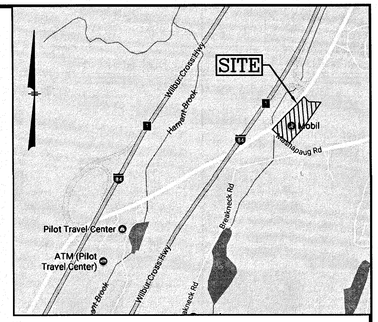
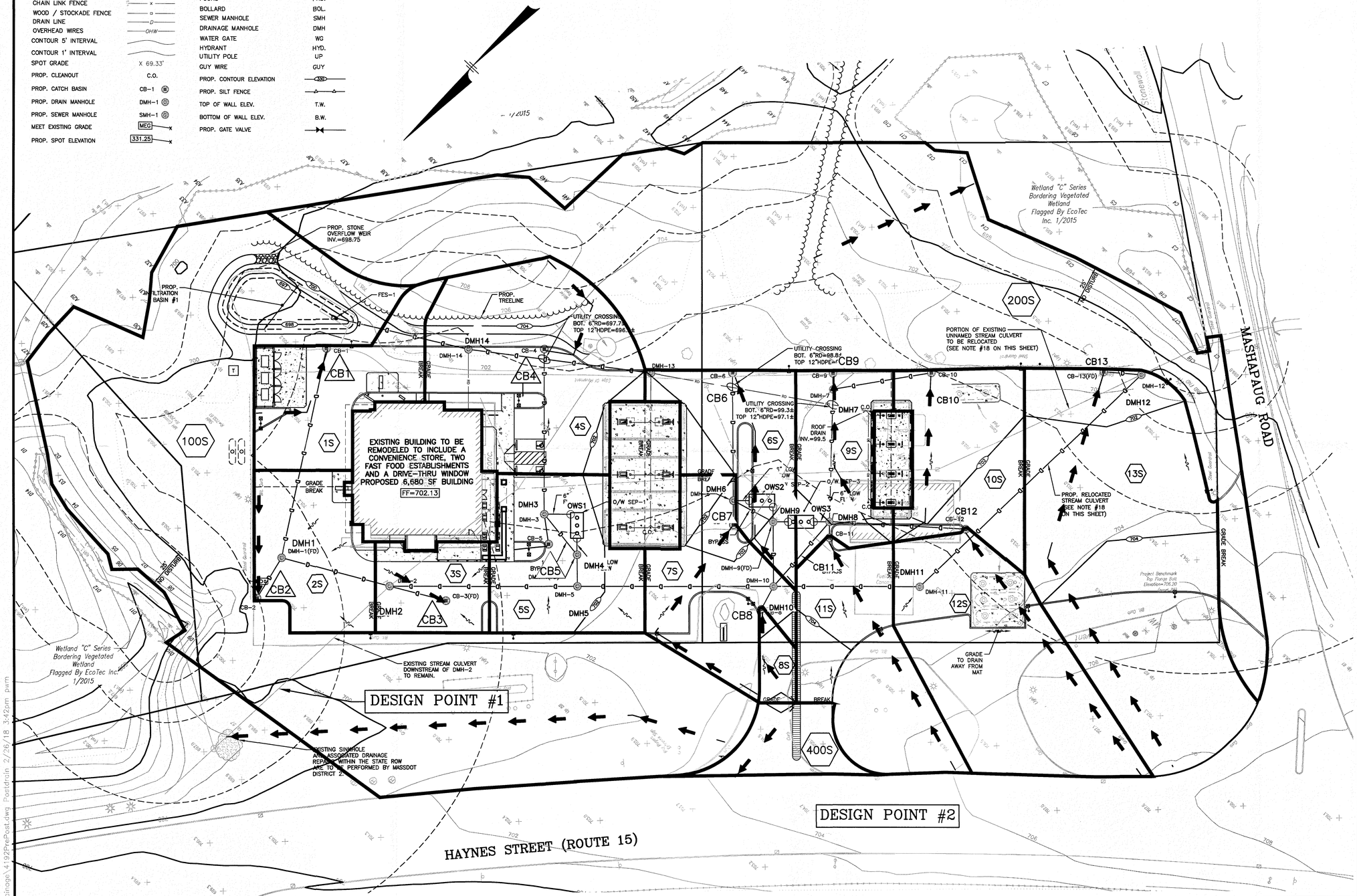
LEGEND

MONUMENT	□	BITUMINOUS	BIT.
IRON PIPE	○	CONCRETE	CONC.
DRAIN MANHOLE	●DMH	INVERT	INV.
ELECTRIC MANHOLE	Ⓔ	REINFORCED CONCRETE PIPE	RCP
CATCH BASIN	■CB	POLYVINYL CHLORIDE PIPE	PVC
UTILITY POLE		HIGH DENSITY PLASTIC	HDPE
GUY WIRE	GUY	IRON PIPE	I.P.
BENCH MARK		FOUND	FND.
CHAIN LINK FENCE	x	BOLLARD	BOL.
WOOD / STOCKADE FENCE	□	SEWER MANHOLE	SMH
DRAIN LINE	D	DRAINAGE MANHOLE	DMH
OVERHEAD WIRES	OHW	WATER GATE	WG
CONTOUR 5' INTERVAL		HYDRANT	HYD.
CONTOUR 1' INTERVAL		UTILITY POLE	UP
SPOT GRADE	X 69.33'	GUY WIRE	GUY
PROP. CLEANOUT	C.O.	PROP. CONTOUR ELEVATION	
PROP. CATCH BASIN	CB-1	PROP. SILT FENCE	
PROP. DRAIN MANHOLE	DMH-1	TOP OF WALL ELEV.	T.W.
PROP. SEWER MANHOLE	SMH-1	BOTTOM OF WALL ELEV.	B.W.
MEET EXISTING GRADE	MEG	PROP. GATE VALVE	
PROP. SPOT ELEVATION	331.25		



LOCATION MAP
(NOT TO SCALE)



WATERSHED LEGEND:

1 — SUBCATCHMENT: A relatively homogeneous area of land that drains into a single reach or pond. Each subcatchment generates a runoff hydrograph. (A subcatchment may also be used to account for the rain falling directly on the surface of a pond.)

1 — REACH: A uniform stream, channel, or pipe that conveys water from one point to another reach or pond. The outflow of each reach is determined by a hydrograph routing calculation.

1 — POND: A pond, swamp, dam, or other impoundment that fills with water from one or more sources and empties in a manner determined by a weir, culvert, or other device(s) at its outlet. The outflow(s) of each pond is determined by a hydrograph routing calculation. The primary and/or secondary outflow may drain into a reach or into another pond.

Time of Concentration Path (Tc)

GRAPHIC SCALE
20 0 10 20 40 80
(IN FEET)
1 inch = 20 ft.

GRAPHIC SCALE
30 0 15 30 60 120
(IN FEET)
1 inch = 30 ft.

811 DigSafe MA-ME-NH-RI-VT

NO.	DESCRIPTION	BY	DATE

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POST DEVELOPMENT DRAINAGE PLAN

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PWM	FCM	419217	1 OF 1

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OPERATION & MAINTENANCE PLAN
And
LONG TERM POLLUTION PREVENTION PLAN
For
STORMWATER MANAGEMENT SYSTEMS

234 & 236 Haynes Street
Sturbridge, MA

Prepared for:

Petrogas Group New England, Inc.
168 North Main Street
Andover, MA 01810

February 20, 2018

MHF Design Consultants, Inc.
44 Stiles Road, Suite One
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MHF Project # 419217

OPERATION & MAINTENANCE PLAN AND LONG TERM POLLUTION PREVENTION PLAN

The Stormwater Policy developed by the Massachusetts Department of Environmental Protection and Office of Coastal Zone Management requires that an Operation and Maintenance Plan (O&M) and a Long Term Pollution Prevention Plan (LTPPP) be submitted for review and approval. As suggested in the Stormwater Handbook these plans have been combined to provide one focal point for the control of stormwater quality and quantity from the site. The plans shall include the parties responsible for scheduling inspections and maintenance, routine and non-routine maintenance tasks, nutrient source control procedures and provisions for appropriate access and maintenance easements surrounding controls and extending to the public right-of-way.

The owner of record shall be responsible for the installation, operation, and maintenance of all stormwater management systems after construction and for the implementation of the LTPPP. Logs of inspections and cleanings shall be maintained by the owner of record and annual BMP inspection forms shall be filed with the Town of Sturbridge, as required. Copies will need to be kept for the most recent three years and made available to the Stormwater Authority upon request. An annual summary (in log form) of the Inspection and Maintenance performed on site shall also be included as part of the submittal.

OPERATION AND MAINTENANCE PLAN

Documentation
A maintenance log shall be kept summarizing inspections, maintenance and any corrective actions taken. The log shall include the date on which each inspection or maintenance task was performed, a description of the inspection findings or maintenance completed, and the name of the inspector or maintenance personnel performing the task. If a maintenance task requires the clean out of any sediments or debris, the location where the sediment and debris was disposed after removal will be indicated. Disposal of the accumulated sediment and hydrocarbons must be in accordance with applicable local, state, and federal guidelines and regulations. The logs shall be made accessible to department staff and a copy provided to the department upon request.

Inspection and Maintenance Frequency and Corrective Measures
The following areas, facilities and measures will be inspected and the identified deficiencies will be corrected. Clean out must include the removal and legal disposal of any accumulated sediments and debris in accordance with applicable local, state, and federal guidelines and regulations.

1. Street Sweeping
Sweeping should be conducted a minimum of once per month (primarily during spring and fall). Sweeping shall be done once in the early fall and then immediately following spring snowmelt to remove sand and other debris. Pavement surfaces shall be swept at other times such as in the fall after leaves have dropped to remove accumulated debris. Since contaminants typically accumulate within 12 inches of the curbline, street cleaning operations should concentrate in cleaning curb and gutter lines for maximum pollutant removal efficiency. Other areas shall also be swept periodically when visual buildup of debris is apparent. Once removed from paved surfaces, the sweeping must

be handled and disposed of properly. In accordance with MassDEP's Bureau of Waste Prevention, the reuse and disposal of sweepings can be used in three ways: In one of the ways already approved by MassDEP (e.g. daily cover in a landfill, additive to compost, fill in a public way); if approved under a Beneficial Use Determination; disposed in a landfill.

2. Deep Sump Hooded Catch Basins

Inspect catch basins at least 4 times per year and at the end of the foliage and snow removal seasons (preferably in spring and fall) to ensure that the catch basins are working in their intended fashion and that they are free of debris. Sediment must also be removed 4 times per year of whenever the depth of deposits is greater than or equal to one half the depth form the bottom of the invert of the lowest pipe in the basin. If the basin outlet is designed with a hood to trap floatable materials check to ensure watertight seal is working. At a minimum, remove floating debris and hydrocarbons at the time of the inspection. Sediment and debris can be removed by a clamshell bucket; however a vacuum truck is preferred. A vacuum truck must be used at a minimum of once per year for sediment removal. Disposal of the accumulated sediment and hydrocarbons must be in accordance with applicable local, state, and federal guidelines and regulations.

3. Vegetated Areas

Inspect slopes and embankments early in the growing season to identify active or potential erosion problems. Replant bare areas or areas with sparse growth. Where rill erosion is evident, armor the area with an appropriate lining or divert the erosive flows to on-site areas able to withstand the concentrated flows.

4. Infiltration Basin

Periodic mowings of the embankment shall be performed. Inspect slope and embankments at least twice annually. Woody vegetation shall be removed from fill embankments. Sediment and debris removal should be through the use of truck mounted vacuum equipment. Outlet pipes should be flushed to point of discharge on the same frequency as mentioned above. Disposal of the accumulated sediment and hydrocarbons must be in accordance with applicable local, state, and federal guidelines and regulations.

The inlets of the basin should be checked periodically to ensure that flow structures are not blocked by debris. All pipes connecting the structures to the basin should be checked for debris that may obstruct flow.

5. Hydrodynamic Separator (First Defense Units)

Initial maintenance to be performed twice a year for the first year after the unit is online and operational. A vacuum truck must be used at a minimum of once per year for sediment removal. Refer to the attached First Defense Maintenance Guide for operation and maintenance procedures and schedules thereafter.

6. Oil/Water Separator

The system should initially be inspected within the first three months after completion of the site's construction and after any rainfall greater than 1-inch. The units should be inspected after every major storm but at least on a monthly basis. Cleaning of the units should be done at least twice a year and should include the following:

1. Removal of accumulated oil and grease and sediment by using a vacuum truck or similar catch basin cleaning device.
2. Visually inspect, and clean as needed, inlet and outlets including tees during each inspection.
3. At a minimum, remove any floating debris at the time of the inspection.

Disposal of the accumulated sediment and hydrocarbons must be in accordance with applicable local, state, and federal guidelines and regulations.

7. Riprap Apron

Inspect at least once annually for damage and deterioration. Repair damages immediately.

8. Snow Storage and Removal

Proposed snow storage areas are as shown, on the Site Plans prepared for Petrogas Group New England, Inc., and any excess snow is to be trucked offsite. During the winter months all snow is to be stored such that snowmelt is controlled. In the event the amount of snow exceeds such capacity, it is to be removed off-site. The minimum amount of deicing chemicals needed is to be used. Avoid disposing of snow on top of storm drain catch basins or in stormwater drainage swales or ditches.
For questions and additional information regarding snow storage or disposal, please contact the Mass DEP's Central Regional Office in Worcester at 508-792-7650.

LONG TERM POLLUTION PREVENTION PLAN

In accordance with DEP Stormwater Standard #4 the development and implementation of suitable practices for source control and pollution prevention shall be incorporated in a Long Term Pollution Prevention Plan (LTPPP). The primary focus of the LTPPP is to establish procedures and controls for limiting the potential sources of pollutants, including nutrients that may contribute to excessive contaminant levels in the site's stormwater runoff. To this end the following source controls and procedures will be in place at the site:

- **Good House Keeping** – It shall be the responsibility of the property owner to keep the site clean at all times. Refuse disposal and pickup shall occur on a regular basis and all material shall be disposed of in the specified dumpster location area on the Site Development Plans.
- **Storing Material and waste products inside or under cover** – No material storage is to take place outside the proposed facility on either paved or lawn areas. All material stored on site will conform with all storage requirements of local, state and federal agencies.
- **Vehicle washing** – Vehicle washing is not allowed to take place on premises. Rinsing with a hose is allowed on impervious surfaces.
- **Routine inspections and maintenance of stormwater BMP's** – Refer to the Operation and Maintenance procedures for each BMP as described in the O&M Plan as described herein.
- **Spill prevention and response** – A Spill Prevention and Response Plan is incorporated for the development including an appropriately sized spill recovery kit and access to an emergency cleanup vendor.
- **Maintenance of lawns, gardens and other landscaped areas** – All landscaping and maintenance to be performed by an authorized company chosen by the property owner.

- **Storage and use of fertilizers, herbicides and pesticides** – All landscape maintenance will be conducted by an authorized company chosen by the property owner. Any application of herbicides or pesticides will be applied by a licensed applicator.
- **Proper management of deicing chemicals and snow** – Deicing chemicals and snow removal shall primarily be the responsibility of the property owner additional information can be found in the O&M Plan as described herein.
- **Nutrient management plan**- The goal of the nutrient management plan is to minimize the potential sources of excess nutrients on the site and the release of nutrients in the stormwater from the site. This minimization relates both to infiltrated water and runoff. In general the nature of the site use will tend to reduce the nutrients in the stormwater. Further, procedures indicated above or in the O&M Plan related to deicing procedures, BMP maintenance procedures, and street sweeping will act to reduce the levels of nutrients in the stormwater, and the nutrients entering the adjacent wetland and the groundwater.

419217 Stormwater Inspection and Maintenance Log

General Information			
Project Name			
NPDES Tracking No.		**Location**	
Date of Inspection		**Start/End Time**	
Inspector's Name(s)			
Inspector's Title(s)			
Inspector's Contact Information			
Describe present phase of construction			
Type of Inspection ☐ **Regular** ☐ **Post-storm event**			
Weather Information			
Current Conditions:			
Do you suspect that discharges may have occurred since the last inspection? ☐ Yes ☐ No			
Are there any discharges at the time of inspection? ☐ Yes ☐ No			

Site-specific BMPs

	Temporary (Construction Phase) BMP Description	BMP Installed and Operating Properly?	Corrective Action Needed	Party contacted / Method of contact
A	Overall Site Construction Activities	☐ Yes ☐ No		
B	Silt Fence	☐ Yes ☐ No		
C	Construction entrance	☐ Yes ☐ No		
D	Stockpiles	☐ Yes ☐ No		
E	Silt bags – on-site	☐ Yes ☐ No		
F	Temporary Dewatering Basins	☐ Yes ☐ No		

	Permanent (Post Construction) BMP Description	BMP Installed and Operating Properly?	Corrective Action Needed	Party contacted / Method of contact
1	Street Sweeping	☐ Yes ☐ No		
	• Evidence of oil grease	☐ Yes ☐ No		
2	Deep Sump Catch Basin/Trench Drain	☐ Yes ☐ No		
	• Grates clear of debris	☐ Yes ☐ No		
	• Inlet and outlet clear of debris	☐ Yes ☐ No		
	• Evidence of oil grease	☐ Yes ☐ No		
	• Observance of accumulated sediment	☐ Yes ☐ No		
	• Evidence of structural deterioration	☐ Yes ☐ No		
	• Evidence of spalling or cracking of structural parts	☐ Yes ☐ No		
	• Evidence of flow bypassing facility	☐ Yes ☐ No		
3	Hydrodynamic Separators & O/W Separators	☐ Yes ☐ No		
	• Grates clear of debris	☐ Yes ☐ No		
	• Inlet and outlet clear of debris	☐ Yes ☐ No		
	• Observance of accumulated sediment	☐ Yes ☐ No		
	• Evidence of oil grease	☐ Yes ☐ No		
	• Evidence of flow bypassing facility	☐ Yes ☐ No		
4	Stone Lined Outlet Protection Area	☐ Yes ☐ No		
	• Inlet/Inflow pipes clear of debris	☐ Yes ☐ No		
	• Overflow spillway clear of debris	☐ Yes ☐ No		
	• Outlet clear of debris	☐ Yes ☐ No		
	• Evidence subsidence	☐ Yes ☐ No		
	• Tree growth	☐ Yes ☐ No		
	• Other (specify)	☐ Yes ☐ No		
5	Ditches, swales & channels & Bio-Retention Areas	☐ Yes ☐ No		
	• Inlet/Outlet clear of debris	☐ Yes ☐ No		
	• Bottom surface clear of debris	☐ Yes ☐ No		
	• Evidence of rilling or gullying	☐ Yes ☐ No		
	• Observance of accumulated sediment	☐ Yes ☐ No		
	• Bottom dewaters between storms	☐ Yes ☐ No		
	• Vegetation healthy and growing	☐ Yes ☐ No		
	• Standing water or wet spots	☐ Yes ☐ No		
	• Tree growth	☐ Yes ☐ No		
	• Other (specify)	☐ Yes ☐ No		

ADDITIONAL COMMENTS

Overall Site Issues

	BMP/activity	Implemented?	Maintained?	Corrective Action	Party contacted / Method of contact
1	Are all slopes and disturbed areas not actively being worked properly stabilized?	☐ Yes ☐ No	☐ Yes ☐ No		
2	Are natural resource areas (e.g., streams, wetlands, mature trees, etc.) protected with barriers or similar BMPs?	☐ Yes ☐ No	☐ Yes ☐ No		
3	Are perimeter controls and sediment barriers adequately installed (keyed into substrate) and maintained?	☐ Yes ☐ No	☐ Yes ☐ No		
4	Are discharge points and receiving waters free of sediment deposits?	☐ Yes ☐ No	☐ Yes ☐ No		
5	Are storm drain inlets properly protected?	☐ Yes ☐ No	☐ Yes ☐ No		
6	Is there evidence of sediment being tracked into the street?	☐ Yes ☐ No	☐ Yes ☐ No		
7	Is trash/litter from work areas collected and placed in covered dumpsters?	☐ Yes ☐ No	☐ Yes ☐ No		
8	Are washout facilities (e.g., paint, stucco, concrete) available, clearly marked, and maintained?	☐ Yes ☐ No	☐ Yes ☐ No		
9	Are vehicle and equipment fueling, cleaning, and maintenance areas free of spills, leaks, or any other deleterious material?	☐ Yes ☐ No	☐ Yes ☐ No		
10	Are materials that are potential stormwater contaminants stored inside or under cover?	☐ Yes ☐ No	☐ Yes ☐ No		
11	Are non-stormwater discharges (e.g., wash water, dewatering) properly controlled?	☐ Yes ☐ No	☐ Yes ☐ No		

Certification statement:

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Print name: _____

Signature: _____ Date: _____

Copies to:

☐ Owner: _____

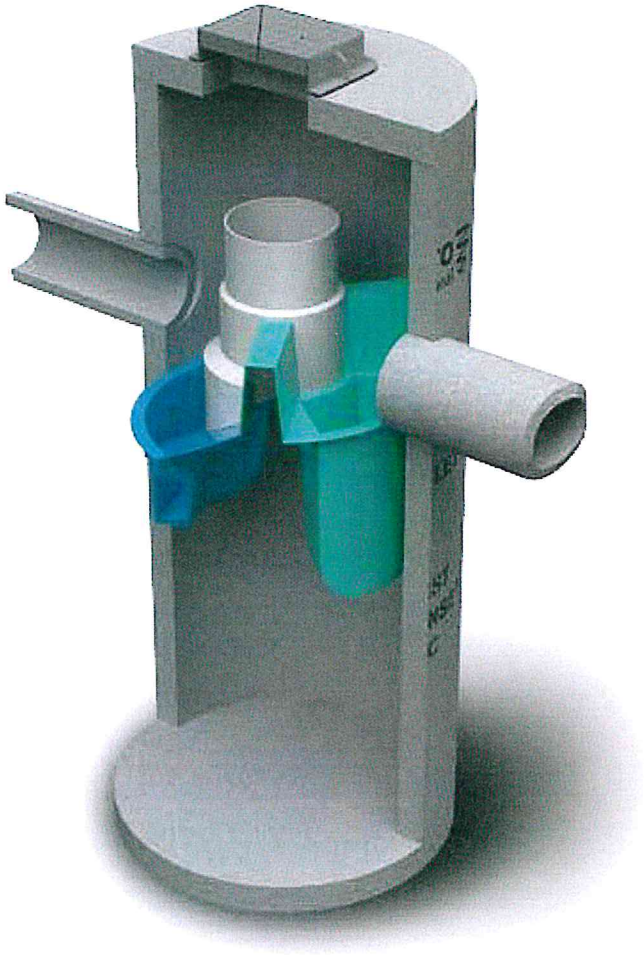
☐ Contractor: _____

☐ Conservation Commission: _____

☐ MHF Project Manager: _____

☐ Other: _____

Hydro International



Operation and Maintenance Manual

First Defense® and First Defense®-HC

Vortex Separator for Stormwater Treatment

Stormwater Solutions

Turning Water Around ...®

Table of Contents

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

I. First Defense® by Hydro International

Introduction

The First Defense® is an enhanced vortex separator that combines an effective and economical stormwater treatment chamber with an integral peak flow bypass. It efficiently removes total suspended solids (TSS), trash and hydrocarbons from stormwater runoff without washing out previously captured pollutants. The First Defense® is available in several model configurations (refer to *Section II. Model Sizes & Configurations*, page 4) to accommodate a wide range of pipe sizes, peak flows and depth constraints.

Operation

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

Pollutant Capture and Retention

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

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

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

Applications

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

Advantages

- Inlet options include surface grate or multiple inlet pipes
- Integral high capacity bypass conveys large peak flows without the need for "offline" arrangements using separate junction manholes
- Proven to prevent pollutant washout at up to 500% of its treatment flow
- Long flow path through the device ensures a long residence time within the treatment chamber, enhancing pollutant settling
- Delivered to site pre-assembled and ready for installation

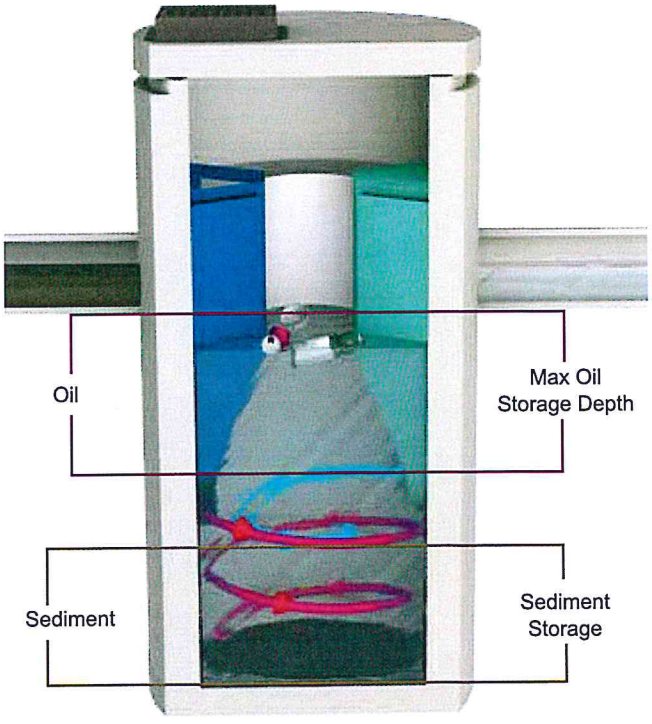


Fig.1 Pollutant storage volumes in the First Defense®.

II. Model Sizes & Configurations

The First Defense® inlet and internal bypass arrangements are available in several model sizes and configurations. The components of the First Defense®-4HC and First Defense®-6HC have modified geometries as to allow greater design flexibility needed to accommodate various site constraints.

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

First Defense® Components

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

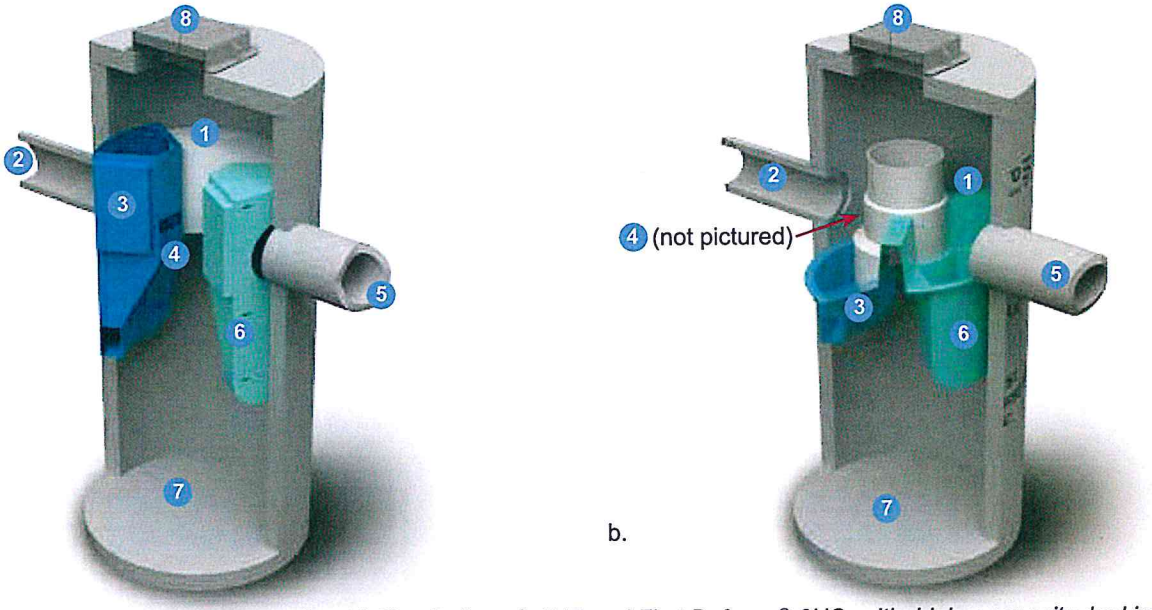


Fig.2a) First Defense®-4 and First Defense®-6; b) First Defense®-4HC and First Defense®-6HC, with higher capacity dual internal bypass and larger maximum pipe diameter.

Table 1. First Defense® Pollutant Storage Capacities and Maximum Clean out Depths

First Defense® Model Number	Diameter	Oil Storage Capacity	Oil Clean Out Depth	Maximum Sediment Storage Capacity[1]		Recommended Sediment Clean-out Capacity	
				Volume	Depth	Volume	Depth
	(ft / m)	(gal / L)	(in / cm)	(yd^3 / m^3)	(in / cm)	(yd^3 / m^3)	(in / cm)
FD-4	4 / 1.2	180 / 681	<23.5 / 60	1.3 / 1.0	33 / 84	0.7 / 0.5	18 / 46
FD-4HC		191 / 723	<24.4 / 62				
FD-6	6 / 1.8	420 / 1,590	<23.5 / 60	3.3 / 2.5	37.5 / 95	1.3 / 1.0	15 / 38
FD-6HC		496 / 1,878	<28.2 / 72				

NOTE

[1] Sediment storage capacity and clean out depth may vary, as larger sediment storage sump volumes are provided when required.

III. Maintenance

Overview

The First Defense® protects the environment by removing a wide range of pollutants from stormwater runoff. Periodic removal of these captured pollutants is essential to the continuous, long-term functioning of the First Defense®. The First Defense® will capture and retain sediment and oil until the sediment and oil storage volumes are full to capacity. When sediment and oil storage capacities are reached, the First Defense® will no longer be able to store removed sediment and oil. Maximum pollutant storage capacities are provided in Table 1.

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

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

Maintenance Equipment Considerations

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

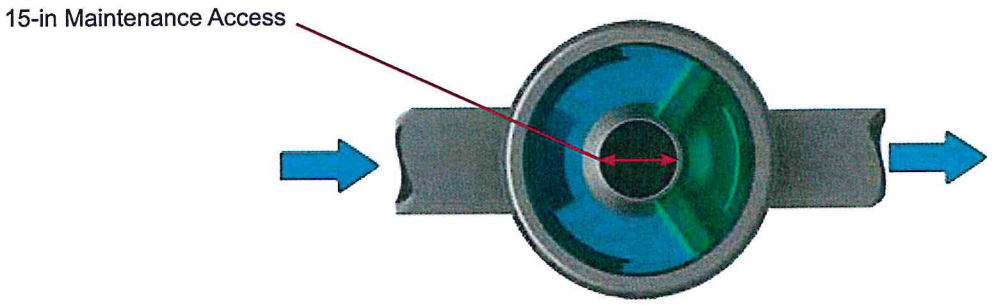


Fig.3 The central opening to the sump of the First Defense®-HC is 15 inches in diameter.

Determining Your Maintenance Schedule

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

The vactor procedure, including both sediment and oil / flotables removal, for a 6-ft First Defense® typically takes less than 30 minutes and removes a combined water/oil volume of about 765 gallons.

Inspection Procedures

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

2. Remove the grate or lid to the manhole.

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

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

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

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

7. Securely replace the grate or lid.

8. Take down safety equipment.

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

Floatables and Sediment Clean Out

Floatables clean out is typically done in conjunction with sediment removal. A commercially or municipally owned sump-vac is used to remove captured sediment and floatables (Fig.5).

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

Scheduling

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

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

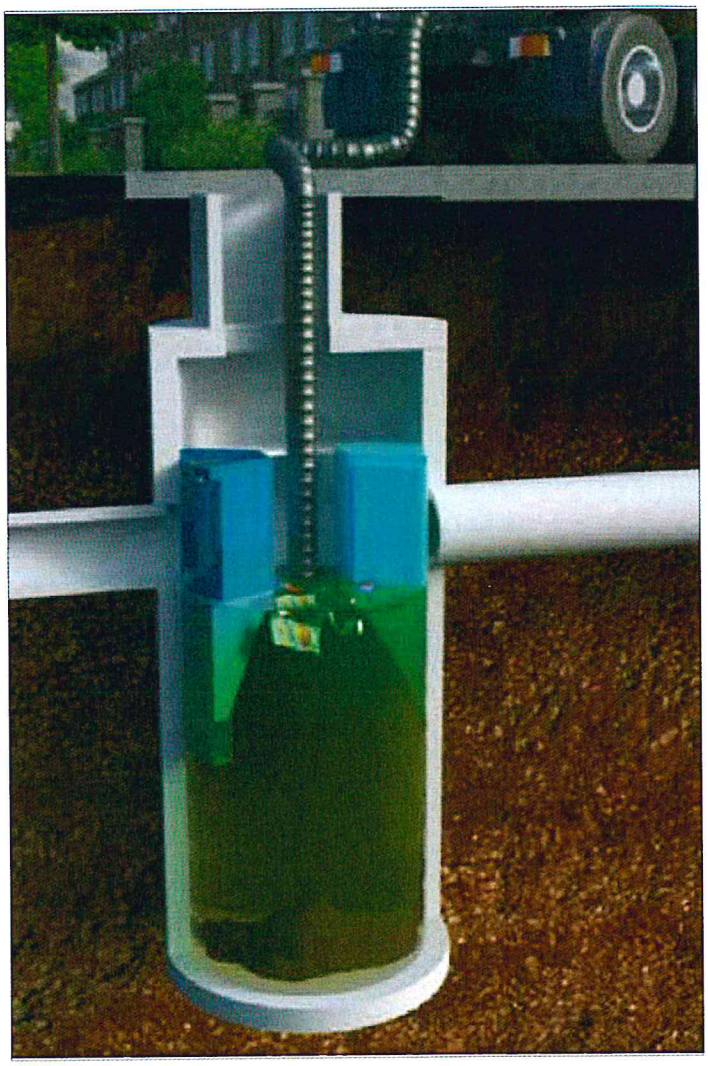


Fig.4 Floatables are removed with a vactor hose (First Defense model FD-4, shown).

Recommended Equipment

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

Floatables and sediment Clean Out Procedures

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

2. Remove the grate or lid to the manhole.

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

4. Remove oil and floatables stored on the surface of the water with the vactor hose (Fig.5) or with the skimmer or net (not pictured).

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

6. Once all floatables have been removed, drop the vactor hose to the base of the sump. Vactor out the sediment and gross debris off the sump floor (Fig.5).

7. Retract the vactor hose from the vessel.

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

9. Securely replace the grate or lid.

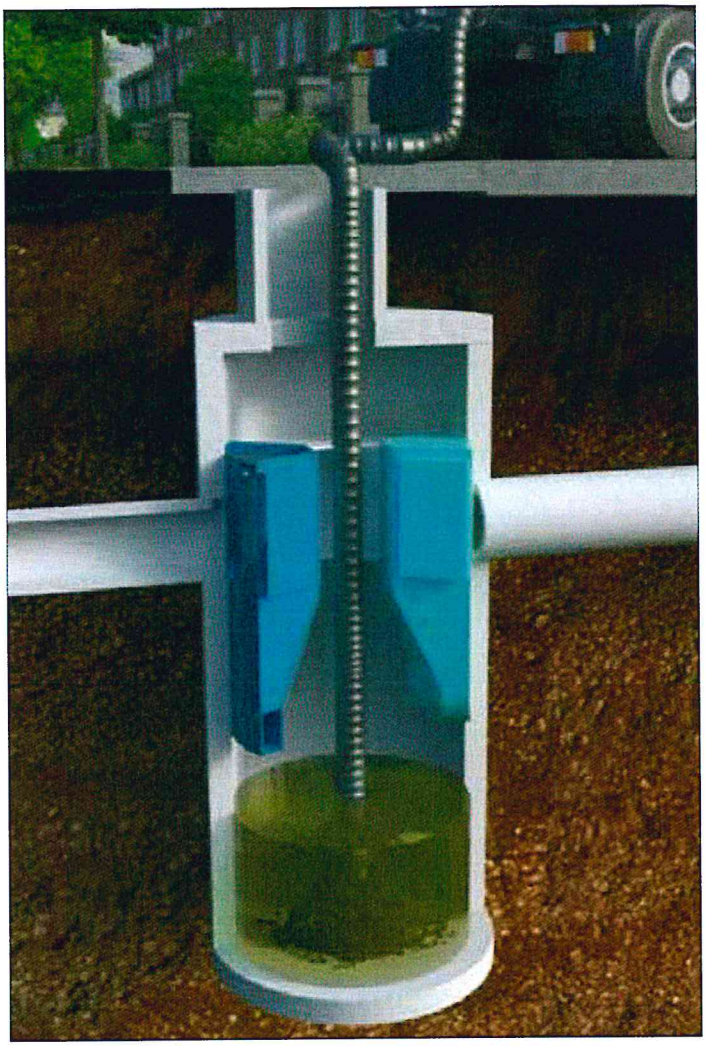


Fig.5 Sediment is removed with a vactor hose (First Defense model FD-4, shown).

Maintenance at a Glance

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

First Defense® Installation Log

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

INSTALLATION DATE: / /

MODEL SIZE (CIRCLE ONE): **FD-4** **FD-4HC** **FD-6** **FD-6HC**

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

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

Hydro International®

First Defense® Inspection and Maintenance Log

Date	Initials	Depth of Floatables and Oils	Sediment Depth Measured	Volume of Sediment Removed	Site Activity and Comments

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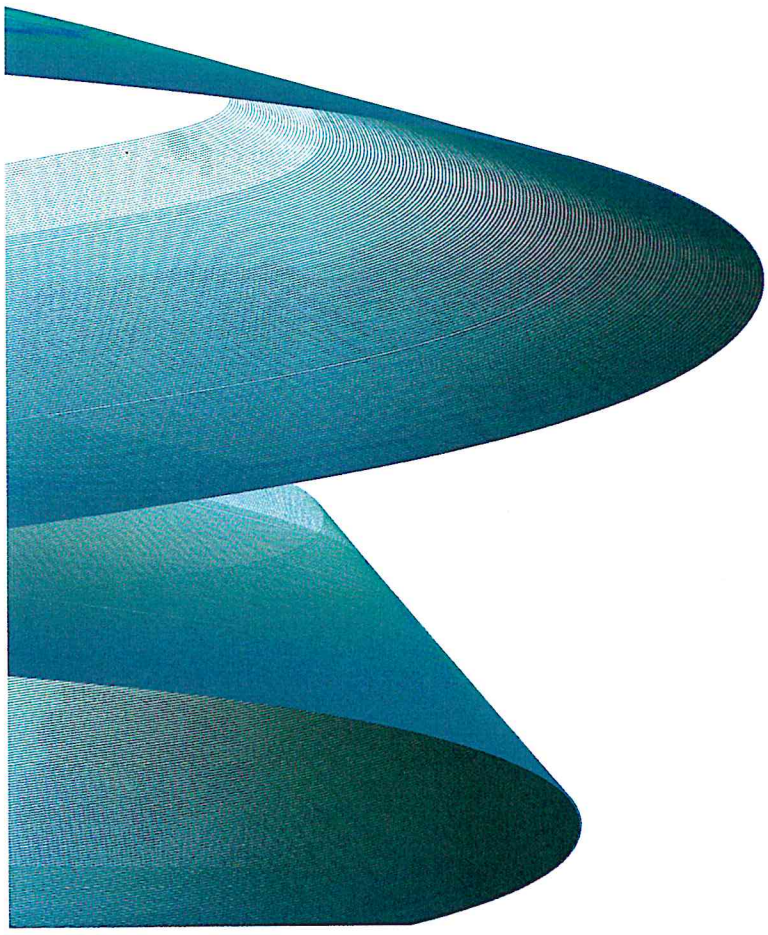
What is HX?

HX is Hydro Experience, it is the essence of Hydro. It's interwoven into every strand of Hydro's story, from our products to our people, our engineering pedigree to our approach to business and problem-solving.

HX is a stamp of quality and a mark of our commitment to optimum process performance. A Hydro solution is tried, tested and proven.

There is no equivalent to Hydro HX.



Stormwater Solutions

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