Special Permit Application
for
Northgate Resort Ventures, LLC

212 Longview Avenue
Hinsdale, MA 01235

June 2021

White Engineering, Inc.
55 South Merriam Street
Pittsfield, MA 01201
(P) 413-443-8011
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bwhite@whiteeng.com

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Town of Hinsdale

39 South Street
Hinsdale, MA 01235

Zoning Board of Appeals
413-655-2300, x359
zba @hinsdalemass.gov

To: **The Zoning Board of Appeals**

From: Northgate Resort Ventures, LLC
Chelsea Bossenbroek, Authorized Agent of Owner Date: 06/16/2021

Address: c/o White Engineering, Inc.

55 South Merriam Street, Pittsfield, MA 01201

Home: 413-443-8011 - Office Cell: _____ Email: bwhite@whiteeng.com

The undersigned hereby petitions the Zoning Board of Appeals for a:

Variance ☐ Special Permit ☒

from the terms of the Zoning Bylaw(s) of the Town of Hinsdale, at the following premises:

212 Longview Avenue

_____;

in the following respect:

To expand the campground in the R5 district.

_____

_____;

or any limitations, extension, change, alteration or modification of use, or method of use may at hearing appear as necessary or proper in the premises.

Signature Chelsea Bossenbroek Inc. Date 06/16/2021

Please attach appropriate plans, specifications, and other relevant supporting materials.

Thank you.

Introduction

Camp Emerson, currently owned by Camp Tanglelake, Inc., and located at 212 Longview Avenue Hinsdale, MA, is a 155-acre campus that has operated continuously as a summer camp for 52 years. The property is serviced by municipal water and sewer, with electricity throughout, as well as high-speed internet. Amenities include a 400-person capacity dining hall with a commercial kitchen that is compliant with the Americans with Disabilities Act (ADA), heated shower houses, several indoor recreational spaces, 25 wooden cabins for campers, private staff and director housing, numerous ball fields and courts throughout the property, and a heated swimming pool. Along with the main property, the camp also owns a parcel on Michaels Road for their marina on Plunkett Lake which boasts a floating dock system. The camp has historically hosted an overnight summer camp for children aged 7-15 as well as adult and family camps, and a successful group rental operation. Currently Camp Tanglelake, Inc., is under contract to sell Camp Emerson to Northgate Resort Ventures, LLC (Northgate), contingent on the ability to obtain a Special Permit to operate the campground.

Northgate, a family-owned company, currently owns and operates 19 successful campgrounds throughout the United States, including a camp in Carver, MA, as well as multiple parks in neighboring New York and New Hampshire. The focus is on developing and operating campgrounds with a family atmosphere and incorporating water features in natural settings. The Camp Emerson facility provides an excellent opportunity of an established property with an existing campground use that will allow Northgate to expand the property and provide a continued valuable asset to the Town of Hinsdale and the Berkshires.

Proposed Conditions

The proposed project calls for Northgate to redevelop the existing campground to operate where patrons will make reservations to stay in either recreational vehicles that they will drive to the campground or rent a park model recreational vehicle that will remain on the premises permanently. The plan is for 100 park model units to be available at the property for customers to rent. Other amenities on site will include a centrally located splash pad, a miniature golf course, and store to complement the existing facilities and natural features. The typical reservation for the camp will be 3 to 4 days long. The typical season will last from May-October of each year with the possibility for other events just beyond that timeline. The applicant will not allow for arrivals on Saturday. Each RV site will be provided with a water, sewer and electric hook connection as well as a fire pit that will likely be incorporated into the concrete patio for each site. The applicant will seek to obtain a license to serve alcohol on the property from the Town of Hinsdale and the Massachusetts Alcohol Beverages Control Commission (ABCC). That application will be sought once the facility is under construction and when the person who will serve as manager has been selected. While the applicant will acquire the marina property on Plunkett Reservoir, the plans for how that parcel will be made available to guests has not yet been solidified. To operate this facility the applicant plans to hire 8 to 10 full-time employees and up to 60 seasonal employees.

The applicant and White Engineering, Inc. (WEI) have been working closely with MDM Transportation Consultants, Inc. (MDM) who have prepared the traffic study for the project and consulted on the reconfiguration of the driveway. Under separate cover will be the complete traffic study and analysis prepared by MDM. The following narrative will discuss the proposed improvements to the property:

Driveway & Internal Road Network

The subject property is served by an existing curb cut on Longview Avenue that is noted to have insufficient site distance as well as an abrupt change in grade coming from Longview Avenue. The applicant proposes to relocate the curb cut of the main driveway as well as completing grading work at the curb cut to improve accessibility to and from the site for types of vehicles entering and exiting while also providing adequate site distance making the driveway safer for users of the property as well as vehicles travelling on Longview Avenue. From numerous discussions with the applicant as well as town officials, we believe this is a significant improvement for the site. The road network on the property will be expanded to accommodate the new layout of sites. The plans look to reuse much of the existing road network as well as incorporating the access road to the reservoir for which the Town of Hinsdale retains an easement to maintain. The road network includes a number of loops which has been a successful layout pattern at the other facilities Northgate owns. One of the benefits of the loop network is the fact that emergency vehicles would be able to access the property via the main driveway or the reservoir access road providing redundancy for emergency services to access the property from Longview Avenue, if necessary. The other benefit is it provides more ways for emergency vehicles to access points within the campground. To accommodate this road expansion, there will be removal of many existing bunk buildings while preserving as many of the existing buildings as possible. The applicant will plan to install stop signs and a turn off area on each side of the access road where the road crosses Welch Brook to allow vehicles space to move over for a vehicle travelling in the opposite direction or to make way for an emergency vehicle. While each RV site will have a parking space for each individual, there will also be an overflow parking lot toward the front of the property.

Utilities

The property is currently served by an existing 8" water service off of the main in Longview Avenue. An 8" line has provided sufficient service to the camp for years and is easily expanded to provide water to the RV sites throughout the camp as well as the splash pad. One of the concerns raised during pre-permitting meetings was the potential water demands of the splash pad. The splash pad utilizes a recycling and treatment system that has a minimal backwash to the sewage system but does serve as an on-going use of fresh water the entire time the pad is operational. Final construction documents for the splash pad will meet all requirements of the Massachusetts Building and Plumbing codes as well as Department of Public Health regulations.

The existing sewer system on the property utilizes a series of gravity manholes and lines that ultimately tie into the gravity line in Longview Avenue. To assist us in locating and evaluating the existing sewage collection system, WEI retained Hill Engineers, Architects and Planners, Inc., as their firm designed and was very familiar with the system. Along with obtaining their assistance on the system, we had the opportunity to discuss the proposed sewage system with town officials who noted concerns that the increase in sewage generation would have the potential to overwhelm the gravity sewer main in Longview Avenue with peak flow conditions from the subject property conflicting with peak flow from the remaining properties tied into this section of the sewer system.

Based upon the topography of the site and the sites on the West side of Welch Brook, we intend to use a series of e-One low pressure grinding pump stations to get collect sewage from the proposed layout and work to address existing deficiencies in the sewage system with the placement of new sewer manholes. The model we plan to use throughout the park is the e-One DH 502 grinder pump station.

The main pump station to control the entire facility will be a custom design, working with FR Mahoney Associates, Inc., who is the local distributor for the e-One grinder pump stations. In this instance they will work with us to configure a pump station utilizing a duplex- or quad-configuration of pumps, pump basin, and equalization tanks. Upon completion of the work on site, the applicant and their contractors will work with the Town of Hinsdale departments to coordinate the final sewer connection in Longview Avenue.

Stormwater

One of the critical elements of this site development will be the proper management of stormwater runoff. In an order to determine the potential impacts of runoff, we worked to first determine the pre-existing drainage patterns from the property, the post-construction conditions in those areas, as well as determining the increase in runoff from the expanded road next work and RV sites throughout the property. The strategy to handle the catchment areas on the outer limits of the work area included directing runoff through a series of deep sump catch basins, proprietary Stormceptor chambers and rain gardens to promote filtration, peak rate attenuation, and groundwater recharge. The majority of improvements at the center of the property involve the use of deep sump catch basins, proprietary Stormceptor chambers, and the use of subsurface chamber beds that serve to store runoff for peak rate attenuation while also promoting recharge of runoff directly back into the ground. In light of the concerns raised about the potential impact of runoff, we have taken a conservative approach of designing the proposed stormwater management system. Specifically, we have called for Stormceptor units that provide the required total suspended solids (TSS). The proposed chamber bed best management practices (BMPs) can store approximately 50% of all runoff from the proposed 100-year storm event prior to accounting for infiltration or overflow. The capacity of the chamber beds and crushed stone was determined utilizing the HydroCAD Chamber Wizard function. The rain gardens designed for the smaller catchments are 2' deep and are 50% of the impervious area draining to them allowing the rain garden to store nearly the entire capacity of the 100-year storm prior to any infiltration or surface overflow during successive events. The rain gardens serve multiple functions in that they help not only manage runoff from the increase in impervious area but help to provide additional natural vegetation to account for work that occurs within the 100' buffer zone to wetland resource areas delineated on the property. Enclosed with this report is a summary of the stormwater calculations.

Special Permit Findings

In order for a Special Permit to be granted, the Special Permit Granting Authority (SPGA), in this case the Select Board, is required to make a number of findings with respect to the project. Please find below the required findings in italics and the response to those findings beyond it:

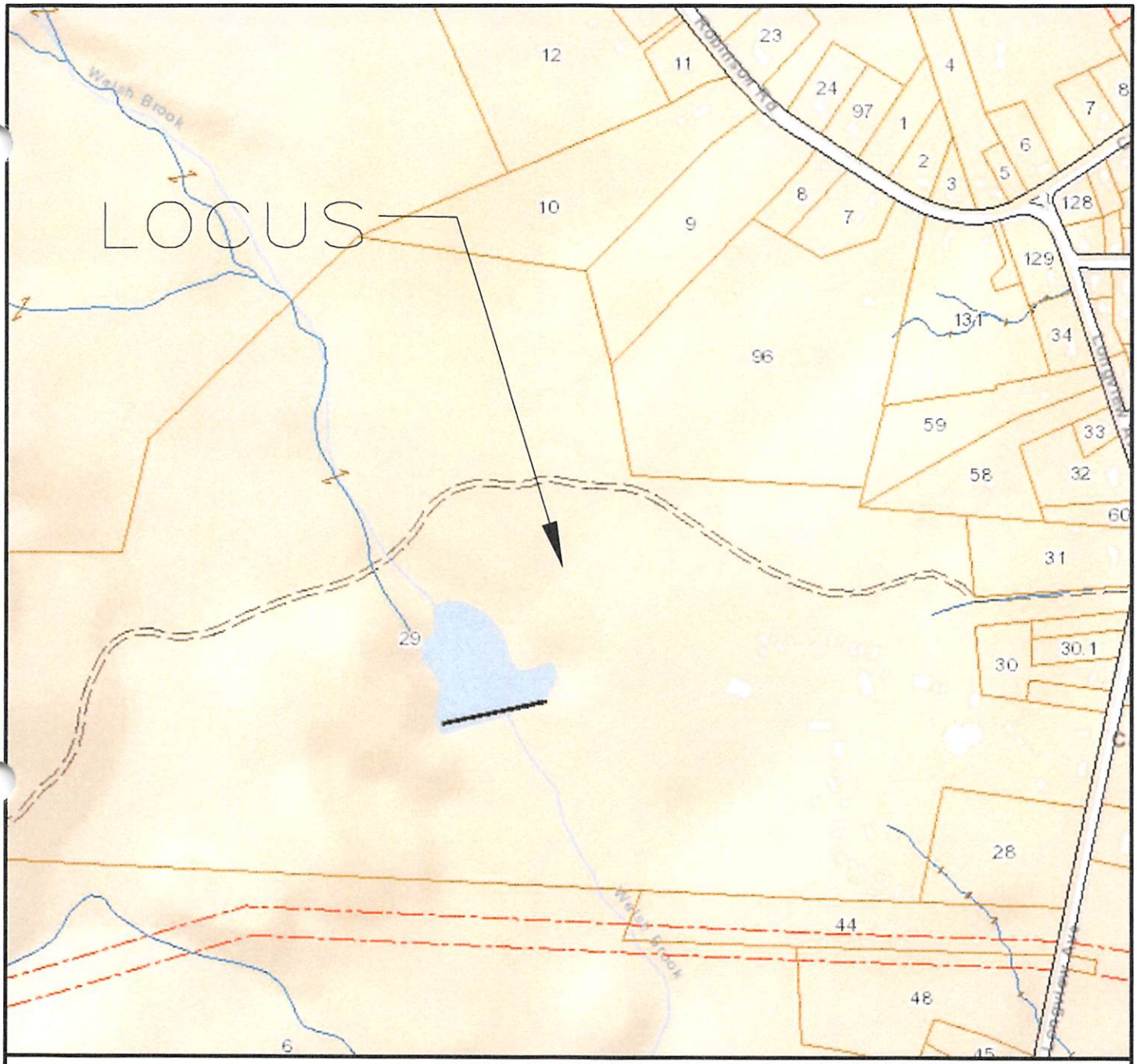
a. *Is in compliance with all other provisions and requirements of this By-law, and in harmony with its general intent and purpose.*
The application is in compliance with the provisions of the By-law and by making this application seeks to establish proper authority to expand the property as a campground in the R-5 district. All other required permits will be applied for with the Town of Hinsdale and the Commonwealth of Massachusetts to permit this operation.

b. *Will not be detrimental to adjacent uses or to the established or planned future character of the neighborhood.*

The proposed use will not be detrimental to adjacent uses or the character of the neighborhood for a number of reasons. The first is that the use as a campground has already been established at this property for over 50 years which, in the opinion of the applicant, preserves the character of this property and neighborhood as being home to summer camps and recreational uses. One direct benefit the neighborhood will receive is the reconfiguration of the entrance driveway which will make it safer for all travelers along Longview Avenue to enter, exit, or drive past the subject property with greater visibility of vehicles entering and exiting the property.

c. *Will not create undue traffic congestion, or unduly impair pedestrian safety.*
The report prepared by MDM will clearly identify that the proposed redevelopment of this property will not cause undue traffic congestion on Longview Avenue or Michaels Road. As previously noted, the reconfiguration of the driveway will not only make existing traffic patterns safer, but the configuration of the curb cut will allow recreational vehicles to more easily enter and exit the property, alleviating any concerns of traffic congestion or any potential impacts to pedestrian traffic. Upon approval of the Special Permit, the applicant and their team are happy to work with town officials and the Massachusetts Department of Transportation (DOT) for the installation of way-finding signs along the Route 8 corridor in each direction to alleviate concerns of recreational vehicles trying to reach the property through the downtown.

d. *Will not overload any public water, drainage or sewer system or any other municipal facility to such an extent that the proposed use or any existing use in the immediate area or in any other area of the town will be unduly subjected to the hazards affecting public health, safety or general welfare.*
The applicant has identified there is sufficient water capacity within the town water system to handle the proposed development and noting that the splash pad, which seemed to be of particular concern to some town officials, will treat and recycle water, reducing the water demand from the site. While the property currently has a gravity connection, in response to concerns by town officials, the applicant has proposed to utilize a series of pre-engineered e-One grinder pump stations throughout the subject property as well as have the entire property connect to the municipal sewer through a pumped connection. Due to the facility size, this will be a customized pump station incorporating redundant pumps as well as equalization tanks to provide a more consistent and longer duration pumping of sewage in an effort to reduce any potential impacts of peak flow from the campground on the municipal system. The MDM traffic analysis will more specifically address the conditions of the roadway and the minimal impact from the proposed development.



TOWN ASSESSORS MAP
FOR
NORTHGATE RESORT VENTURES

212 LONGVIEW ROAD HINSDALE, MA

WHITE ENGINEERING INC.
CIVIL & ENVIRONMENTAL
55 SOUTH MERRIAM STREET, PITTSFIELD, MA 01201
PHONE (413) 443-8011 E-MAIL: SBOOMSMA@WHITEENG.COM FAX (413) 443-8012

DATE: JUNE 16, 2021	DR'N: AJB	APVD: SDB/BMW	DWG NO: 21-03-04
DS'GN: SDB	CK'D: SDB/BMW	SCALE: N.T.S	

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ORTHO PHOTO
FOR
NORTHGATE RESORT VENTURES

212 LONGVIEW ROAD — HINSDALE, MA

WHITE ENGINEERING INC.
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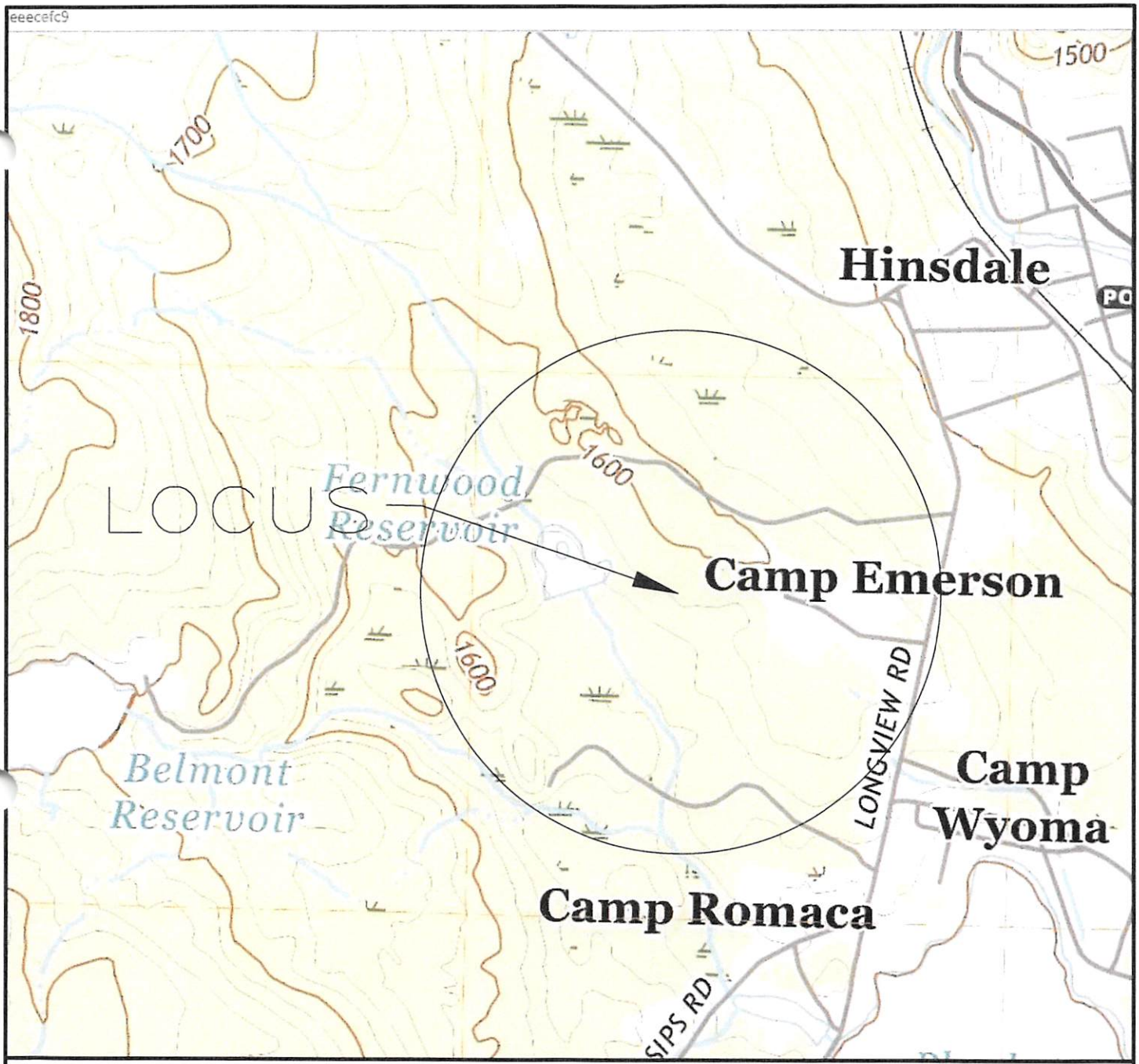

USGS MAP
FOR
NORTHGATE RESORT VENTURES

212 LONGVIEW ROAD — HINSDALE, MA

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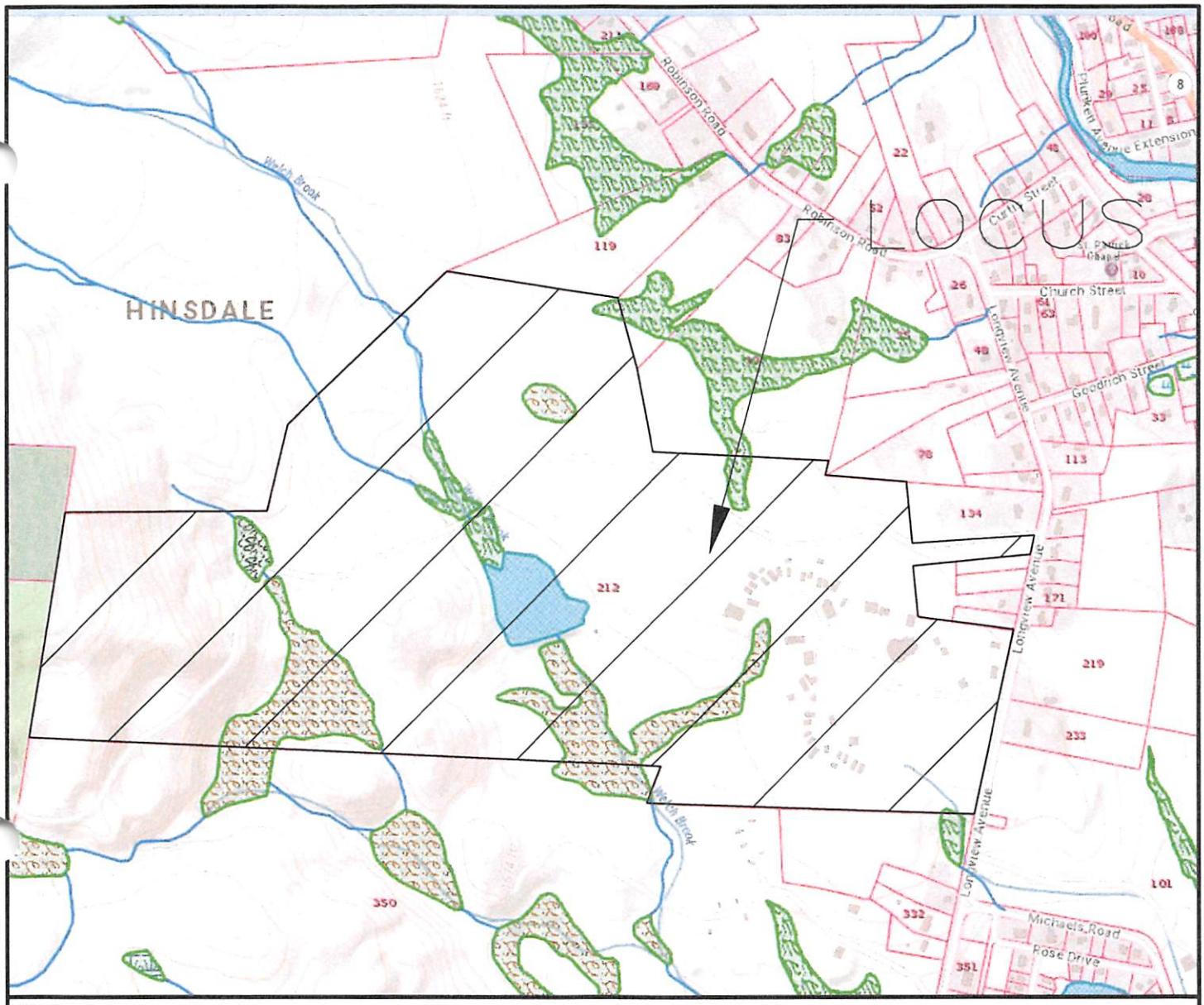

WETLANDS 12 K MAP FOR NORTHGATE RESORT VENTURES

212 LONGVIEW ROAD HINSDALE, MA

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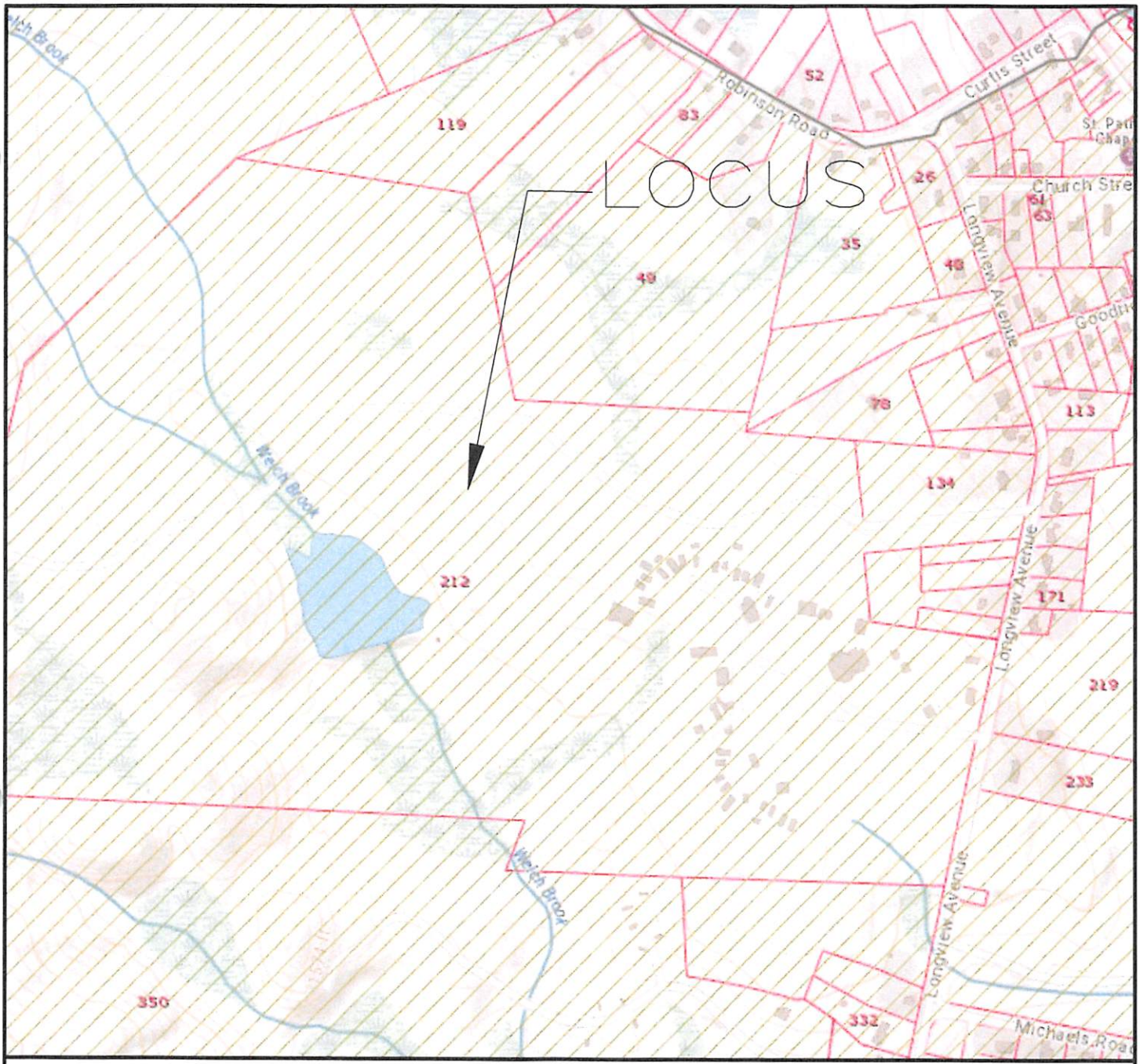

— AREA OF CRITICAL ENVIRONMENTAL CONCERN

ACEC MAP FOR NORTHGATE RESORT VENTURES

212 LONGVIEW ROAD

HINSDALE, MA

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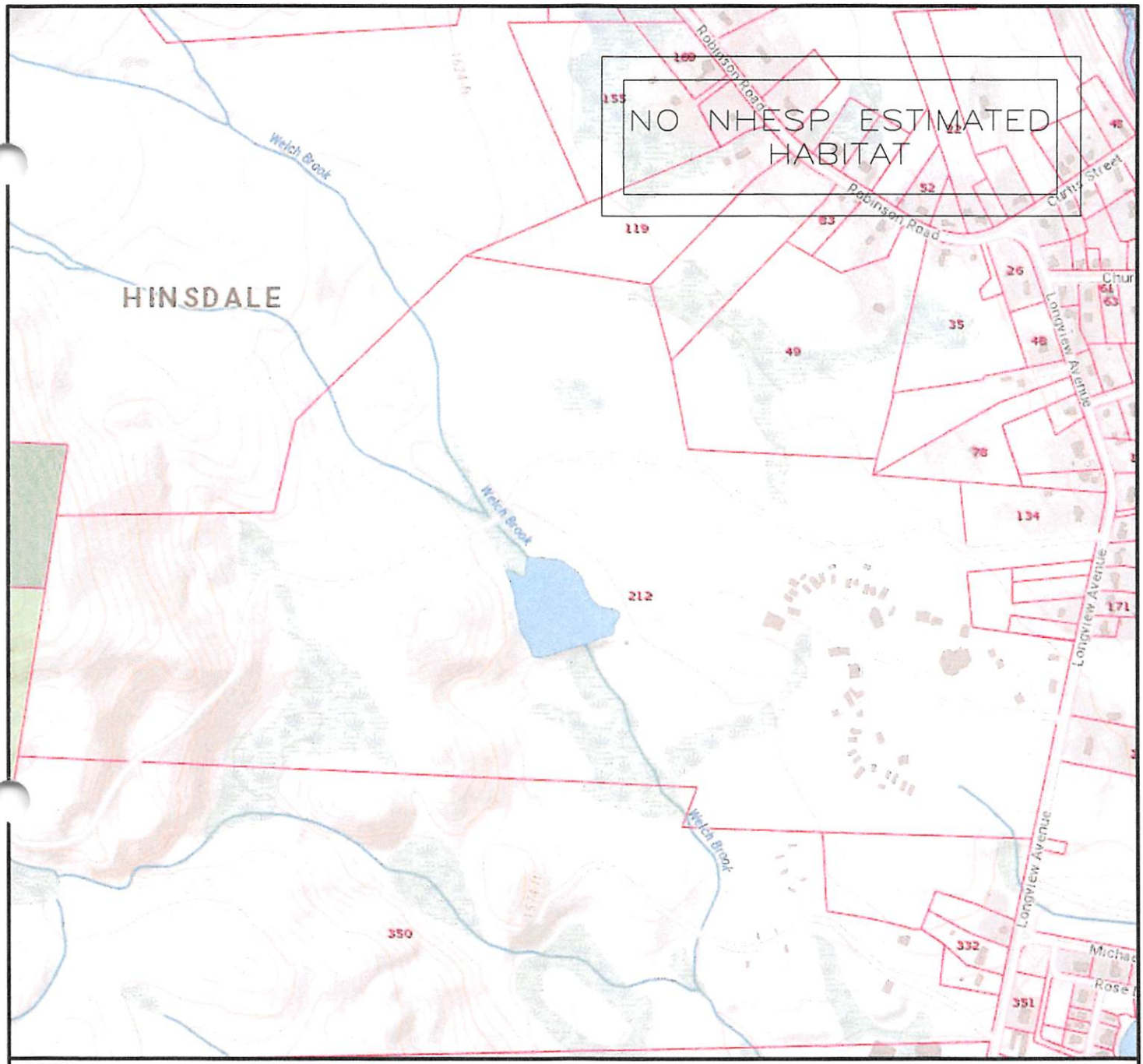

LEGEND:

— NHESP ESTIMATED HABITATS OF RARE WILDLIFE

NHESP ESTIMATED HABITATS FOR NORTHGATE RESORT VENTURES

212 LONGVIEW ROAD — HINSDALE, MA

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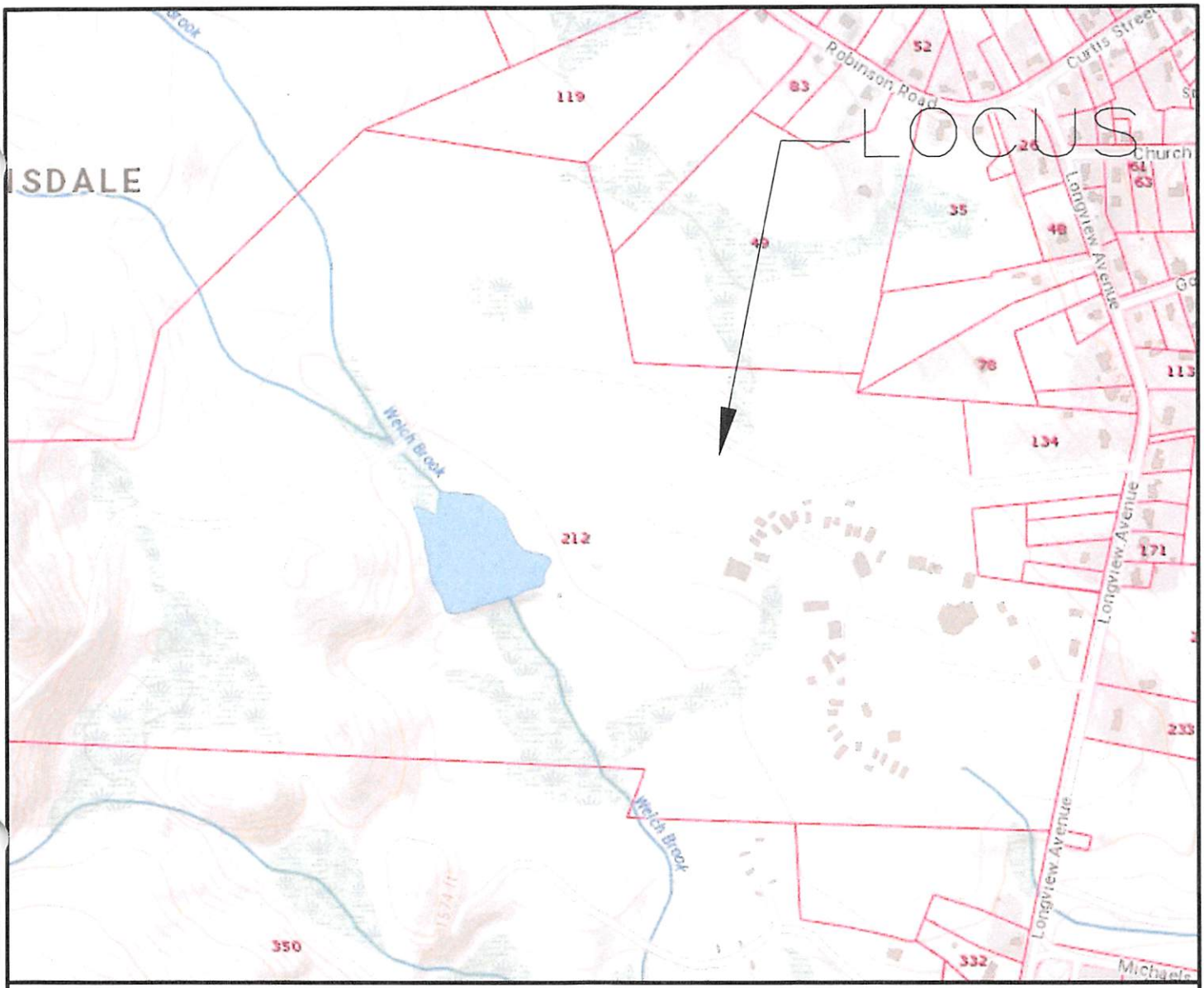

LEGEND:

- A
- AE
- AE Floodway
- AH
- AO
- D
- VE
- Area Not Included
- X500

FEMA FLOOD ZONES FOR NORTHGATE RESORT VENTURES

212 LONGVIEW ROAD HINSDALE, MA

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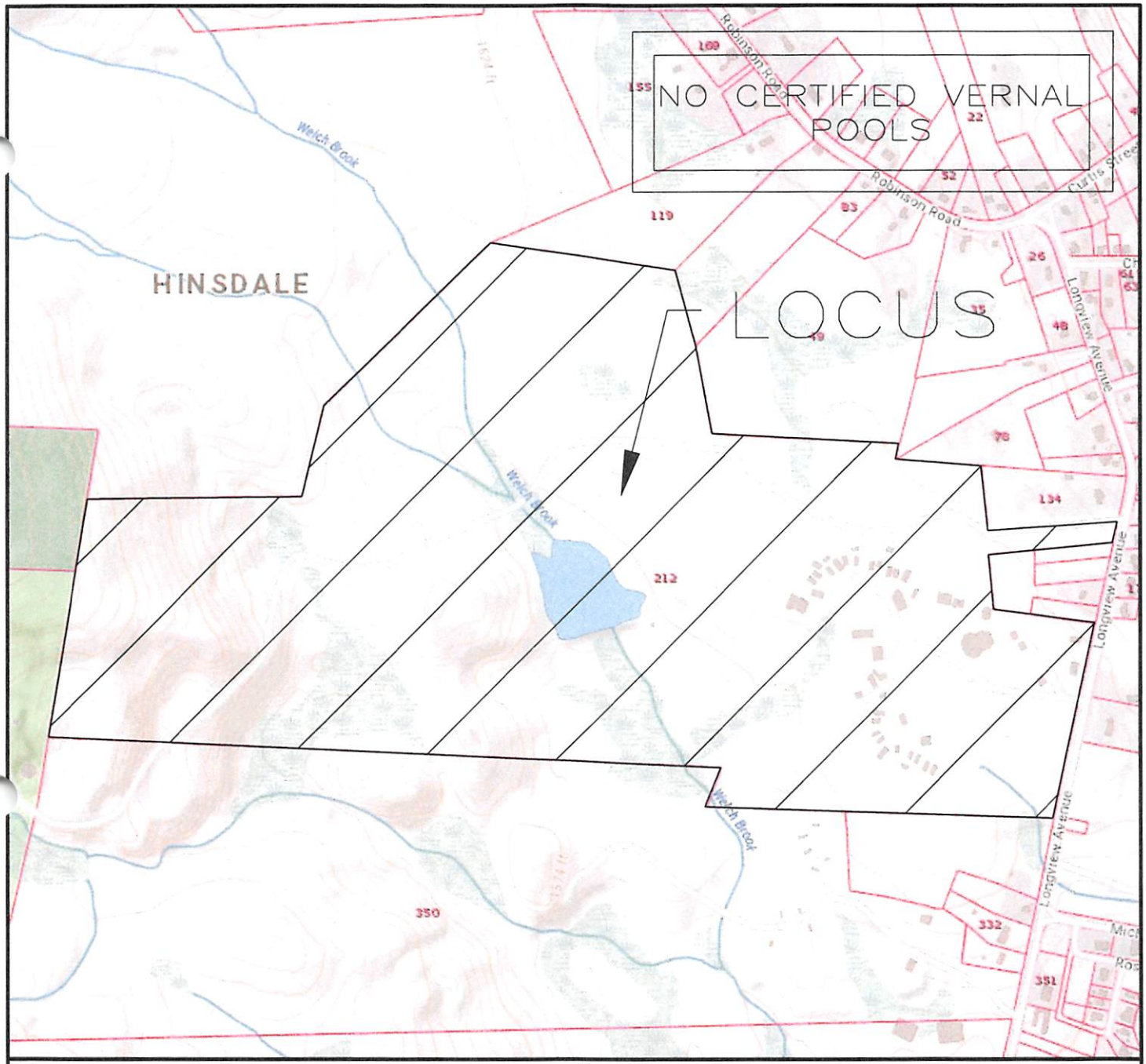

CERTIFIED VERNAL POOL

CERTIFIED VERNAL POOLS FOR NORTHGATE RESORT VENTURES

212 LONGVIEW ROAD — HINSDALE, MA

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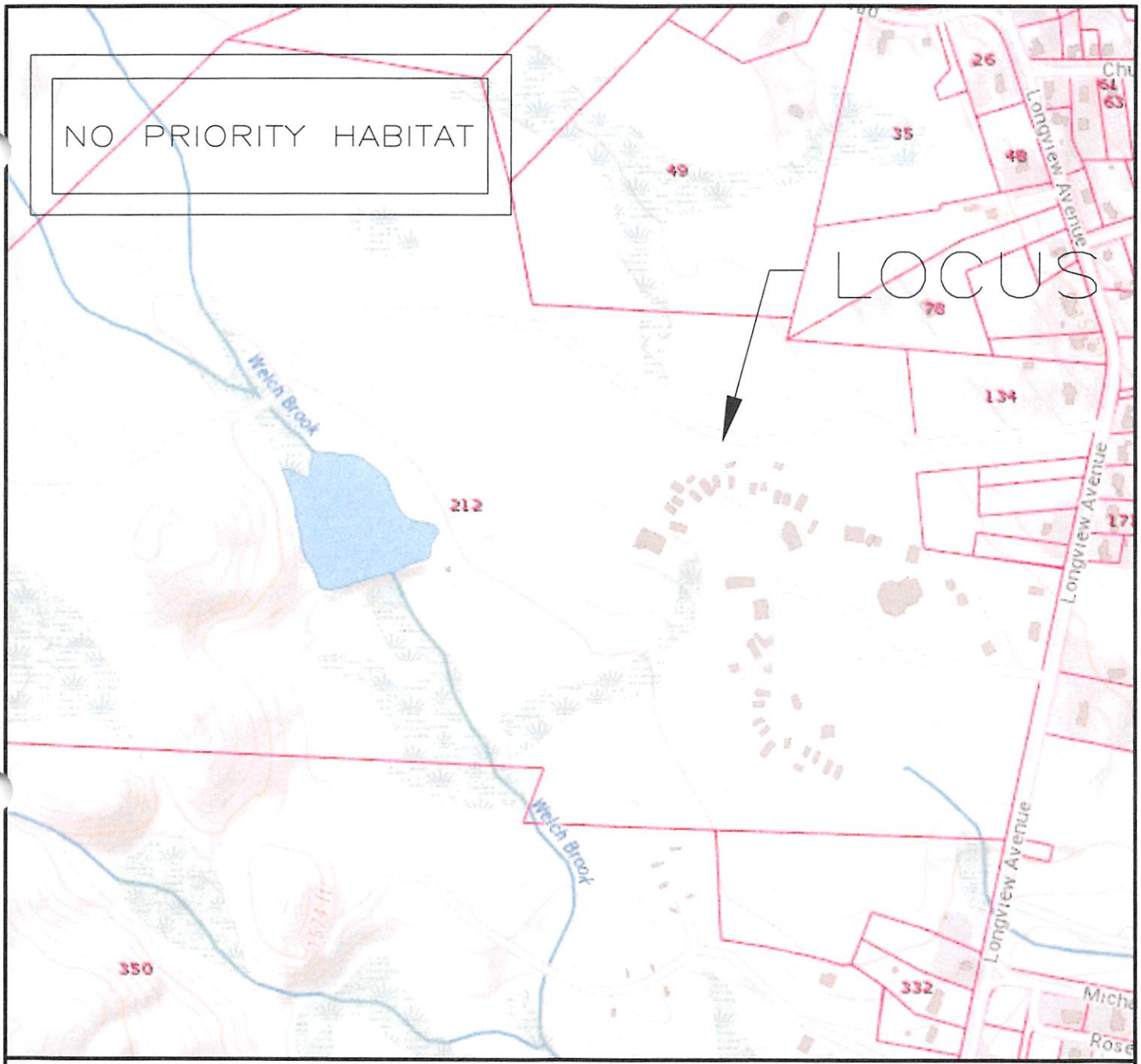

LEGEND:

—— NHESP PRIORITY HABITATS FOR STATE PROTECTED RARE SPECIES

NHESP PRIORITY HABITATS FOR NORTHGATE RESORT VENTURES

212 LONGVIEW ROAD

HINSDALE, MA

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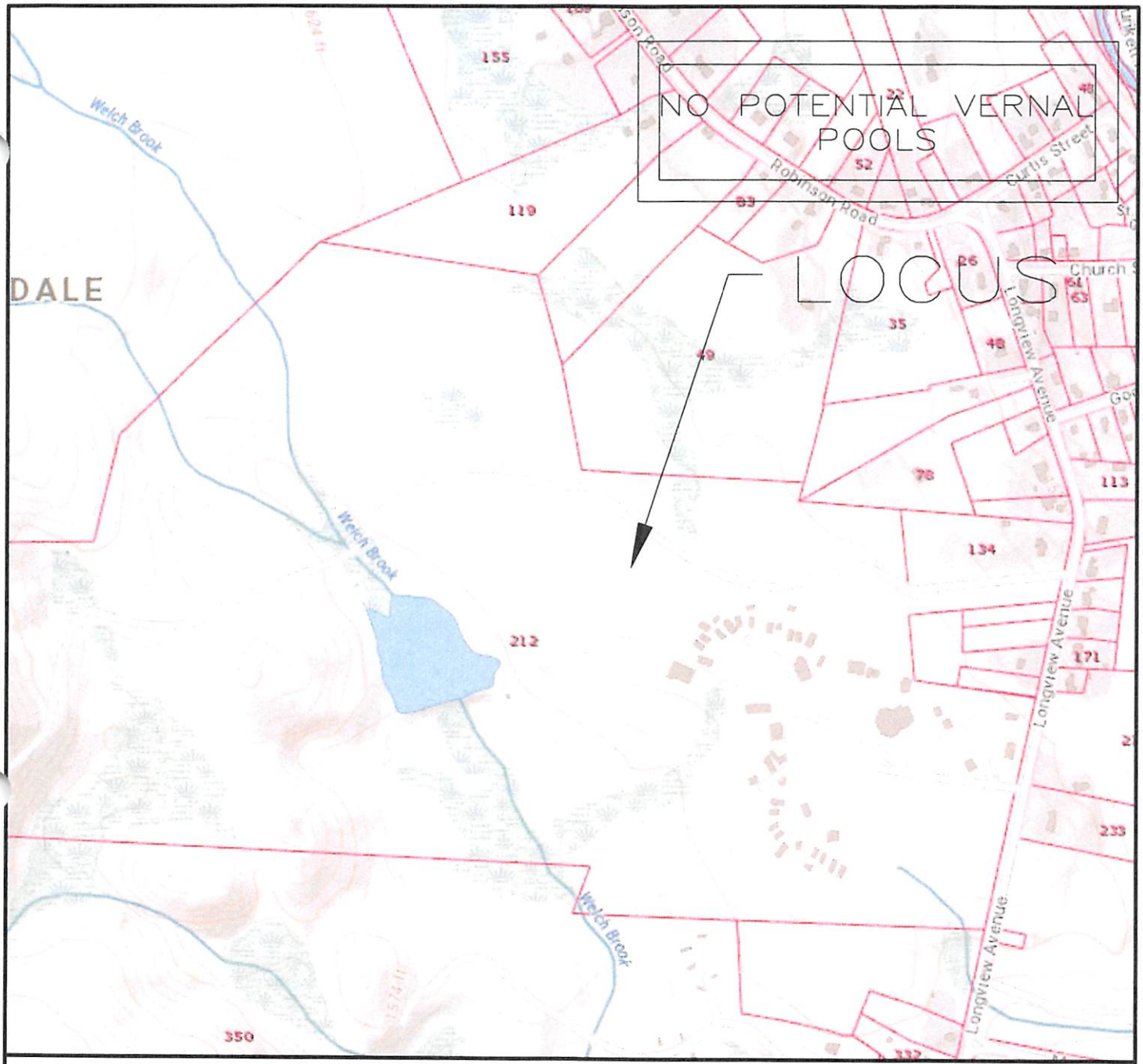

NHESP POTENTIAL VERNAL POOLS FOR NORTHGATE RESORT VENTURES

212 LONGVIEW ROAD

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Sewer Systems

Grinder Pumps

D-Series | DH502 & DR502 Grinder Pump Station

The E/One model DH502/DR502 duplex (2 pumps) grinder pump station is an ideal choice for multiple single-family homes and light commercial applications. Grinder pumps collect wastewater from the building and send it to the central sewer and/or treatment system through small-diameter pipes.

This model was previously known as the Model GP 2016.

Drawings & Installation Instructions

DH502/DR502 Drawings (PDF, 1 mb)

DH502/DR502 Drawings (zipped DXF, 1 mb)

Extreme Series Pump Curve (PDF)

DH502/DR502 Installation Instructions (PDF, 2 mb)

Specification — with "Wired" Level Sensor (DOC)

Specification — with "Wireless" Level Sensor (DOC)

Features

The DH502/DR502 grinder pump station consists of two pumps and a tank with a dry accessway. The grinder pumps use integrated level-sensing pressure switches instead of floats — the "core"-style pump is compact and easily removed for service if needed.

- The DH502 is the "hardwired," or "wired," model where a cable connects the motor controls to the level controls through watertight penetrations.
- The DR502 is the "radio frequency identification" (RFID), or "wireless," model that uses wireless technology to communicate between the level controls and the motor controls.

The tank is made from tough, corrosion-resistant FRP and provides 500 gallons of capacity. A single DH502/DR502 can be used for nine average, single-family homes, and up to 24 homes where codes allow and with consent of the factory. The DH502/DR502 can accommodate flows of 6000 gallons per day.

Stations are available for indoor and outdoor installations. Outdoor stations accommodate depths from 102 inches to 160 inches (see drawings, above).

E/One requires the installation of its stainless steel UNI-LATERAL to prevent backflow from the sewer system from entering the grinder pump station.

Inlet Connections: 4" inlet grommet standard for DWV pipe. Other inlet configurations available.

Discharge Connections: Pump discharge terminates in 1-1/4" NPT female thread. Can easily be adapted to 1-1/4" PVC pipe or any other material required by local codes.

Discharge:

15 gpm at 0 psig

11 gpm at 40 psig

7.8 gpm at 80 psig

Recommended Alarm Panel

E/One Sentry Protect Plus

Additional alarm panel options are available, including remote monitoring.

E/One Grinder Pump Operational and Electrical Information

Overview

Builders

Engineers

Municipalities

Homeowners

Knowledge Center

Design Center

Sales & Service

Product Catalog

- E/One Grinder Pump
- Grinder Pump Systems
  - D-Series: Wetwell/Drywell
    - Model DH071
    - Model DH151
    - Model DH152

- Model DH272
- Model DH502

- W-Series: Open Wetwell Tanks
- Gatorgrinder
- Basement Grinder Pump | IH091
- Upgrade: Replacement Grinder Pump
- Pump Curve
- Alarm Panels
- Extreme Series Accessories
- Lateral Kits
- Explosionproof Grinder Pump
- Air Release Station
- Legacy Product: 2000 Series

- Case Studies
- Article Reprints
- Request More Information
- Distributor Connection
- SO 9001:2015

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Stormwater Management Report
for
Northgate Resort Ventures, LLC

June 2021

White Engineering, Inc.
55 South Merriam Street
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bwhite@whiteeng.com

Introduction:

The applicant proposed to expand the existing campground know as Camp Emerson to provide accommodations for recreational vehicles to travel to the site as well as have park model units available for customers to rent. In order to accomplish this the road network will be expanded throughout the park along with extending the water, sewer and electric utilities as well as proper stormwater management to accommodate the proposed improvements.

To manage the runoff generated from the proposed driveways and expansion of the road within the park the project the campground was divided into smaller drainage areas based upon topography. In an effort to achieve our total suspended solids removal requirements we propose to utilize deep sump catch basins and proprietary Stormceptor units. The discharge from those units will discharge to either a subsurface chamber bed of ADS Stormtech chambers or rain gardens. To provide a conservative design we have proposed the chamber beds would have the ability to physically store approximately 50% of all runoff from the 100 year storm prior to accounting for any infiltration or overflow. The rain gardens have been designed to store 100% of the 100 year storm runoff from the impervious areas prior to accounting for infiltration or overflow.

Conclusion:

The proposed stormwater management plan and attached plans and documentation will properly manage the stormwater runoff generated from the expansion of the subject property

Summary of Stormwater Report Checklist

Included in the Appendix of this report is a copy of the Department of Environmental Protection (DEP) Checklist for Stormwater Report. Below is a narrative and calculations describing the compliance with each of the standard.

Standard 1- There are no untreated discharges proposed.

Standard 2- Calculations are shown that the peak rate of runoff for the 2, 10, 25 and 100 Year storms will not increase with the proposed work based upon the proposed storage of runoff from the 100 year storm.

Standard 3- Soil analysis was completed on the site as well as review of the Soil Survey and it was determined the soils are well drained and capable of infiltration and the reason the subsurface infiltration chamber and rain garden BMP's were chosen. The underlying soils in the work area are Hydrologic Group B.

Standard 4- A Long Term Pollution Prevention Plan is enclosed as a portion of the Appendix and the requirements are met

Standard 5- The property is not a Land Use with Higher Potential Pollutant Loads (LUHPPL's)

Standard 6- There are no impacts to Critical Areas as a part of the proposed development.

Standard 7- The project complies with the stormwater management standards.

Standard 8- A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan is included.

Standard 9- A Post Construction Operation and Maintenance Plan is included.

Standard 10- The Long Term Pollution Prevention Plan includes measures to prevent illicit discharges and an Illicit Discharge Statement is included.

Supplemental Items to this report:

1. Stormwater Pollution Prevention Plan (including blank inspection form)
2. Mass DEP Stormwater Checklist
3. Excel Worksheet showing catchment area calculations
4. Stormceptor Chamber data sheet
5. HydroCAD worksheet for subsurface chamber configuration
6. Soil Survey map and soils description

Stormwater Pollution Prevention Plan (SWPPP)

For

Northgate Resort Ventures, LLC

June 2021

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Stormwater Pollution Prevention Plan
Prepared for
Northgate Resort Ventures, LLC

This project involves expansion of an existing campground. Scope of work will include constructing a new road loop network, prepare sites for RV's, expansion of the water, sewer and electrical utilities, construction of a splash pad and miniature golf course

The order of activities will be as follows:

1. Install all required silt fencing and straw bales, coordination of required preconstruction inspections with conservation agent
2. Tree clearing and rough grading of the proposed road and RV sites
3. Preparation of the road base and concrete pads for the home sites
4. Installation of water, sewer and drainage infrastructure
5. Construction of the splash pad
6. Installation of final subsurface chamber beds
7. Make final connection of sewage pump station to town sewer within Longview Avenue
8. Final planting of proposed rain gardens
9. Re-seed and stabilize all disturbed areas on the property

Of the disturbed areas on-site, a stockpile area shall have additional straw bales placed around the base of the stockpiles and be tarped.

Illicit Discharge Statement

There will be no illicit discharges on-site and into the stormwater management system.

Controls:

Temporary Stabilization - Topsoil stockpile areas and disturbed portions of the site where construction activity temporarily ceases for at least 21 days will be stabilized with temporary seed and mulch no later than 7 days from the last construction activity in that area. The temporary seed shall be erosion seed mix, as specified in Mass Highway Standard Specifications for Highways and Bridges, M6.03.1, applied at the rate of 100 pounds per acre. After seeding, each area shall be mulched with 4,000 pounds per acre of straw. Areas of the site which are to be paved will be temporarily stabilized by applying geotextile fabric and stone sub-base until bituminous pavement can be applied.

Permanent Stabilization - Disturbed portions of the site where construction activities permanently cease shall be stabilized with permanent seed no later than 7 days after the last construction activity. The permanent seed shall be seed mix for grassplots and islands, as specified in Mass Highway Standard Specifications for Highways and Bridges, M6.03.0, applied at the rate of 100 pounds per acre. After seeding, each area shall be mulched with 4,000 pounds per acre of straw.

Construction Entrance - A stabilized construction entrance shall be installed in the gravel driveway just beyond the curb cut into the site to the site to help reduce vehicle tracking of sediments onto public ways. Streets adjacent to the site entrance will be inspected weekly, and swept monthly to remove any excess mud, dirt or rock tracked from the site. Should the weekly inspections reveal excess accumulation on abutting roadways, the roadways will be swept within one week from the date of discovery. Dump trucks hauling material from the construction site will be covered with a tarpaulin to prevent fugitive materials.

Storm Water Management - Runoff, including that which will be generated from the installation of new impervious surfaces as well as that which will be intercepted by the placement of impervious surfaces including roadways, structures and driveways, will flow through a series of deep sump catch basins, proprietary Stormceptor units and ultimately to a subsurface chamber infiltration bed or rain garden. Annual recharge rates at the site are improved by the roof runoff being filtered through splash breaks and the inclusion of stormwater BMP's. The ability to maintain or exceed current recharge rates will be achieved by the infiltration of treated runoff in the infiltration bed as well as the stone drip edges around the proposed houses.

The stormwater management system is designed to remove 80% of the average annual load of total suspended solids. This standard will be met by deep sump catch basin units, Stormceptor, subsurface chamber beds and rain gardens.

Erosion and sedimentation controls shall be installed prior to commencement of work to prevent impacts during construction. Throughout construction it is likely that portions of silt fence, bales and wattles may need to have sediments accumulated against them to be removed and the barriers replaced.

Other Controls:

Waste Materials - All waste will be collected, stored and disposed of properly so as not to pollute the construction site. Any such disposal shall be removed by a licensed solid waste management company. If deemed required, a dumpster shall be located at the site and shall meet all local and state regulations. The dumpster will be emptied a minimum of once a week or more often, if necessary. No construction waste material shall be permitted to be buried on site. All personnel will be instructed regarding the correct procedure for waste disposal. Notices stating these practices will be posted in the site trailer and the individual who manages the day-to-day on-site operations will be responsible for seeing that these practices are followed.

Hazardous Waste - All hazardous waste materials will be disposed of in a manner specified by local or state regulations or by the manufacturer. Site personnel will be instructed in these practices and the individual who manages day-to-day site operations will be responsible for seeing that these practices are followed.

Sanitary Waste - All sanitary waste will be collected from the portable units a minimum of once per week by a licensed sanitary waste management contractor as required by local regulation.

Maintenance and Inspections - The following are the minimum requirements for maintenance and inspection of the above controls to ensure that they are functioning properly as intended and to ensure that if additional measures are required, they are installed when the need arises.

- All control measures will be inspected at least once each week and following any storm event of 0.5 inches or greater. If no rain gauge is present on-site, then inspections shall be following any storm event.
- All measures will be maintained in good working order; if a repair is necessary, it will be initiated within 24 hours of report. Sufficient stockpiles of controls shall be kept on-site in reserve in the event that immediate repair is required.
- Built up sediment will be removed from silt fence when it has reached a 6-inch height of the fence. In the case of hay bale barriers, it is preferable to place a second row of bales or fence upstream of the first row when the sediment reaches the specified level.
- Silt fence/straw bale barriers will be inspected for depth of sediment, tears, gaps, etc. and to see if the fabric or bales are secure and firmly in the ground.
- Temporary and permanent seeding and planting will be inspected for bare spots, washouts and healthy growth initially on a daily basis until growth is established and weekly thereafter until fully established.
- Maintenance and inspection reports shall be kept and a copy of the report retained on-site. The form shall state the date of inspection or maintenance with a sketch of the area and activity along with responsibility of required actions and follow up dates, and completion due dates.

- Individuals shall be designated responsible for inspections, maintenance, repair activities, and filling out the inspection and maintenance report. These individuals shall be properly trained in the designated areas.

Inventory for Pollution Prevention Plan:

The materials or substances listed below are expected to be present onsite during construction:

- Petroleum base products
- Solvents
- Adhesives
- Concrete

Material Management Practices:

The following are the material management practices that will be used to reduce the risk of spills or other accidental exposure of materials and substances to storm water runoff.

Good Housekeeping:

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

- An effort will be made to store only enough product required to do the job.
- All materials stored onsite will be stored in a neat, orderly manner in their appropriate containers and, if possible, under a roof or other enclosure.
- Products will be kept in their original containers with the original manufacturer's label.
- Substances will not be mixed with one another unless recommended by the manufacturer.
- Whenever possible, all of a product will be used up before disposing of the container.
- Manufacturer's recommendations for proper use and disposal will be followed.
- The onsite superintendent will inspect daily to ensure proper use and disposal of materials onsite.

Hazardous Products:

These practices are used to reduce the risk associated with hazardous materials.

- Products will be kept in original containers unless they are not resealable.
- Original labels and material safety data will be retained; they contain important product information. MSDS's will be available onsite in the event of an emergency. If materials are transferred to another container, it will be labeled accordingly.
- If surplus product must be disposed of, manufacturers' or local and state recommended methods for proper disposal will be followed.

Product Specific Practices:

The following product specific practices will be followed onsite:

Petroleum Products:

All onsite vehicles will be monitored for leaks and receive regular preventive maintenance to reduce the chance of leakage. Petroleum products will be stored in tightly sealed containers which are clearly labeled. Any asphalt substance used onsite will be applied according to the manufacturer's recommendations.

Spill Control Practices:

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

- Manufacturer's recommended methods for spill cleanup will be clearly posted and site personnel will be made aware of the procedures and the location of the information and cleanup supplies.
- Materials and equipment necessary for spill cleanup will be kept in the material storage area onsite. Equipment and materials will include but not limited to brooms, dust pans, mops, rags, gloves, goggles, kitty liter, sand, sawdust, and plastic and metal trash containers specifically for this purpose
- All spills will be cleaned up immediately after discovery.
- The spill area will be kept well ventilated, and personnel will wear appropriate protective clothing to prevent injury from contact with a hazardous substance
- Spills of a toxic or hazardous material will be reported to the appropriate State or local government agency, regardless of the size.
- The spill prevention plan will be adjusted to include measures to prevent this type of spill from reoccurring and how to clean up the spill if there is another one. A description of the spill, what caused it, and the cleanup measures will also be included.
- The site superintendent responsible for the day-to-day site operations will be the spill prevention and cleanup coordinator. He/She will designate at least three other site personnel who will receive spill prevention and cleanup training. These individuals will each become responsible for a particular phase of prevention and cleanup. The names of responsible spill personnel will be posted in the material storage area and in the office trailer onsite.

Post Construction Requirements:

Northgate Resort Ventures, LLC will be responsible for the ongoing maintenance and inspection of the proposed system. Ongoing tasks that they will be responsible for include:

- Periodic cleaning of the deep sump catch basins, Stormceptors. Inspections shall occur quarterly for the first year to determine appropriate ongoing cleaning schedule. Periodically sediment will need to be removed from the rain gardens and mulch placed back.

After any single rain event which yields the 2 Year Storm (2.9 inches in 24 hours) or any series of rain events within a short period of time, the rain gardens should be inspected and cleaned if necessary. If for some reason this amount of rain has not occurred, the sumps shall be inspected quarterly at least for the first year to determine appropriate cleaning schedule. Without this cleaning, the rain garden will become clogged and eventually fail.

Any questions with regard to this plan may be directed to Brent M. White, MCE, PE, at White Engineering, Inc.

Included with this document are the following:

- Final Design Drawing Set
- Blank Inspection Report
- Stormwater Management Report

Construction Inspection Form for Northgate Venture Resorts, LLC

Prepared By:

White Engineering, Inc.

Inspector:_____
Date:_____
Weather Conditions:_____

Purpose for
Inspection:_____
_____

Items/Activity
Inspected:_____
_____

Items Found in
Compliance:_____
_____

Items Found needing
Repair:_____
_____

If Yes, was corrective action taken: Y / N

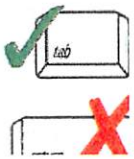
If No, expected timeline for completion of
tasks:_____
_____

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.

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

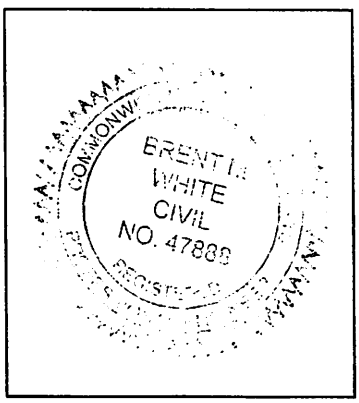
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature



6/16/11

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): Utilizing Stormceptor proprietary basins

Standard 1: No New Untreated Discharges

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☐ Static ☒ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

☒ An Illicit Discharge Compliance Statement is attached;

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

Northgate Resort Ventures, LLC Catchment Area Summary

212 Longview Avenue Hinsdale, MA

Prepared By: White Engineering, Inc.

Area 1- Beyond Welch Brook

Existing Conditions

Surface	Area (sf)	Area (acre)
Gravel Road	10,484	0.24
Wooded Area	1377846	31.63
Total =	1,388,330	31.87

Proposed Conditions

Surface	Area (sf)	Area (acre)
Gravel Road	69785	1.60
Wooded Area	1227741	28.19
RV Pad Sites	90804	2.08
Total =	1388330	31.87

Area 2- North of Access Road to Reservoir

Existing Conditions

Surface	Area (sf)	Area (acre)
Gravel Road	7472	0.17
Wooded Area	654245	15.02
Total =	661717	15.19

Proposed Conditions

Surface	Area (sf)	Area (acre)
Gravel Road	36747	0.84
Wooded Area	583892	13.40
RV Pad Sites	30400	0.70
Parking Area	10678	0.25
Total =	661717	15.19

Area 3- Center Mass of New RV Sites

Existing Conditions

Surface	Area (sf)	Area (acre)
Gravel Road	5648	0.13
Wooded Area	542720	12.46
Lawn	26179	0.60
Pool Area	8365	0.19
		0.00
Total =	582912	13.38

Proposed Conditions

Surface	Area (sf)	Area (acre)
Gravel Road	103429	2.37
Wooded Area	345491	7.93
RV Pad Sites	78400	1.80
Parking Area	21048	0.48
Lawn	34544	0.79
Total =	582912	13.38

Area 4- South of the Pool Sites

Existing Conditions

Surface	Area (sf)	Area (acre)
Gravel Road	103429	2.37
Wooded Area	290978	6.68
Lawn	14542	0.33
Total =	408949	9.39

Proposed Conditions

Surface	Area (sf)	Area (acre)
Gravel Road	103429	2.37
Wooded Area	131116	3.01
RV Pad Sites	78400	1.80
Parking Area	21048	0.48
Lawn	74956	1.72
Total =	408949	9.39

Area 5- Boys Section

Existing Conditions

Surface	Area (sf)	Area (acre)
Gravel Road	1522	0.03
Wooded Area	233587	5.36
Lawn	78966	1.81
Ex Structures	21562	0.49
Total =	335,637	7.71

Proposed Conditions

Surface	Area (sf)	Area (acre)
Gravel Road	10134	0.23
Wooded Area	217337	4.99
RV Pad Sites	20800	0.48
Parking Area	7280	0.17
Ex Structure	1528	0.04
Lawn	78558	1.80
Total =	335637	7.71

Area 6- Front Area

Existing Conditions

Surface	Area (sf)	Area (acre)
Gravel Road	24,079	0.55
Wooded Area	25,687	0.59
Lawn	143,280	3.29
Ex Structures	24,648	0.57
Paved Road	10263	0.24
total =	227,957	5.23

Proposed Conditions

Surface	Area (sf)	Area (acre)
Gravel Road	17,489	0.40
Wooded Area	25,687	0.59
Pro Building	6000	0.14
Paved Parking Area	23,957	0.55
Ex Structure	17,811	0.41
Lawn	137,013	3.15
Total =	227,957	5.23

Area 7- Center & Girl Section

Existing Conditions

Surface	Area (sf)	Area (acre)
Gravel Road	30,523	0.70
Wooded Area	432,017	9.92
Lawn	220,517	5.06
Ex Structures	68,950	1.58
Paved Road	2897	0.07
total =	754,904	17.33

Proposed Conditions

Surface	Area (sf)	Area (acre)
Gravel Road	59,112	1.36
Wooded Area	411,166	9.44
Pro Building	25,600	0.59
Parking Area	8,960	0.21
Ex Structure	33,207	0.76
Splash Pad	35,050	0.80
Lawn	181,809	4.17
Total =	754,904	17.33

Area 8- Athletic Fields

Existing Conditions

Surface	Area (sf)	Area (acre)
Wooded Area	71,359	1.64
Lawn	213,827	4.91
Total	285,186	6.55

Proposed Conditions

Surface	Area (sf)	Area (acre)
Gravel Road	12,898	0.30
Wooded Area	62,743	1.44
Pro Building	11,200	0.26
Parking Area	3,080	0.07
Mini Golf	20,000	0.46
Lawn	175,265	4.02
Total =	285,186	6.55

Area 9- Northeast Corner

Existing Conditions		
Surface	Area (sf)	Area (acre)
Gravel Access Road	9,750	0.22
Wooded Area	273,756	6.28
Total	283,506	6.51
*No proposed work		

Rain Garden Sizing by Imprevious Area

Catchment Area	Total Size (SF)	Rain Garen Size needed (SF)	Proposed Size
Area 1 Beyond Welch Brook	160589	80294.5	86018.88
Area 2 North of Access Road to Res	77825	38912.5	39215.7
Area 4 South of Pool	202877	101438.5	36297
Area 7 Center and Girls Side	89672	44836	19237

Subsurface Chamber Bed for Areas 3, 5, 6, 8

Road, RV Site & Parking Areas

Total area =	408,339	sf
100 Year Storm = 7.78"		
100 Year Storm total Runoff Volume =	**264,740**	**cf**
100 Year Storm Runoff Volume =	**9,805**	**CY**
Lengths of 12" Culvert in these Sections		
330		
100		
60		
40		
330		
150		
80		
125		
160		
265		
90		
70		
125		
220		
100		
100		
250		
100		
200		
280		
180		
270		
300		
50		
210		
100		
210		
Total Length=	4495	ft

15" Culvert	
1.227148438	cf/lf

Total Culvert Volume =	**5516**	**cf**

Subsurface Chamber Bed Areas

Parking Lot by Store at entrance
60' x 150'

ADS Stormtech MC - 4500
Use 6 rows x 36 chambers (55.75' W x 152.37' L)

Chamber + Stone Storage =	**37,020**	**cf**
Infiltration @ 20 mpi (3 in/hr) per hour	**2090**	**cf/hr**
24 Hours Infiltration =	**50160**	**cf**

Mini Golf Area
150' x 150'

ADS Stormtech MC - 4500
Use 17 rows x 37 chambers (155.67' W x 156.39' L)

Chamber + Stone Storage =	**106,726**	**cf**
Infiltration @ 20 mpi (3 in/hr) per hour	**6086**	**cf/hr**
24 Hours Infiltration	**146,071.39**	**CF**

Pond 3P: (new Pond) - Chamber Wizard Field A

Chamber Model = ADS_StormTech MC-4500 b +Cap (ADS StormTech® MC-4500 with cap volume)
Effective Size= 90.4"W x 60.0"H => 26.46 sf x 4.02'L = 106.5 cf
Overall Size= 100.0"W x 60.0"H x 4.33'L with 0.31' Overlap
Cap Storage= 39.5 cf x 2 x 6 rows = 474.0 cf

100.0" Wide + 9.0" Spacing = 109.0" C-C Row Spacing

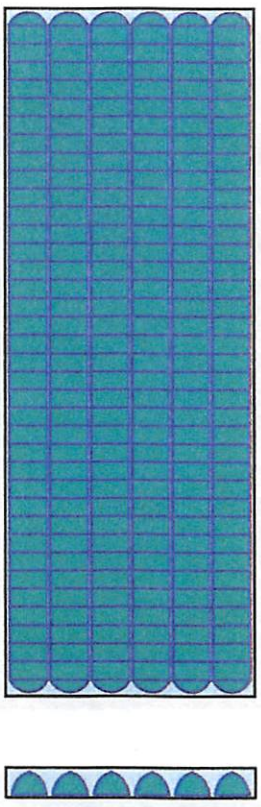
36 Chambers/Row x 4.02' Long +2.73' Cap Length x 2 = 150.37' Row Length +12.0" End Stone x 2 = 152.37' Base Length
6 Rows x 100.0" Wide + 9.0" Spacing x 5 + 12.0" Side Stone x 2 = 55.75' Base Width
9.0" Stone Base + 60.0" Chamber Height + 12.0" Stone Cover = 6.75' Field Height

216 Chambers x 106.5 cf + 39.5 cf Cap Volume x 2 x 6 Rows = 23,475.9 cf Chamber Storage

57,337.5 cf Field - 23,475.9 cf Chambers = 33,861.5 cf Stone x 40.0% Voids = 13,544.6 cf Stone Storage

Chamber Storage + Stone Storage = 37,020.6 cf = 0.850 af
Overall Storage Efficiency = 64.6%
Overall System Size = 152.37' x 55.75' x 6.75'

216 Chambers
2,123.6 cy Field
1,254.1 cy Stone



Pond 4P: (new Pond) - Chamber Wizard Field A

Chamber Model = ADS_StormTech MC-4500 b +Cap (ADS StormTech® MC-4500 with cap volume)
Effective Size= 90.4"W x 60.0"H => 26.46 sf x 4.02'L = 106.5 cf
Overall Size= 100.0"W x 60.0"H x 4.33'L with 0.31' Overlap
Cap Storage= 39.5 cf x 2 x 17 rows = 1,343.0 cf

100.0" Wide + 9.0" Spacing = 109.0" C-C Row Spacing

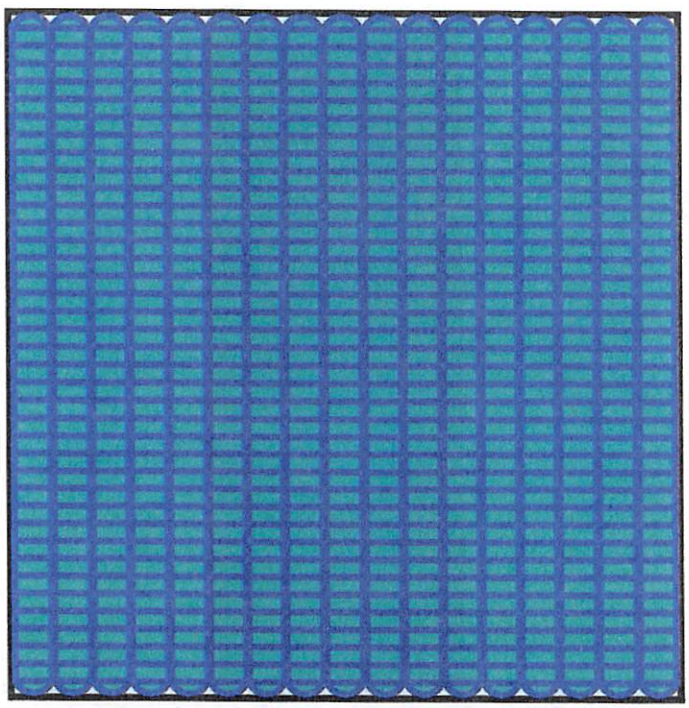
37 Chambers/Row x 4.02' Long +2.73' Cap Length x 2 = 154.39' Row Length +12.0" End Stone x 2 = 156.39' Base Length
17 Rows x 100.0" Wide + 9.0" Spacing x 16 + 12.0" Side Stone x 2 = 155.67' Base Width
9.0" Stone Base + 60.0" Chamber Height + 12.0" Stone Cover = 6.75' Field Height

629 Chambers x 106.5 cf + 39.5 cf Cap Volume x 2 x 17 Rows = 68,325.5 cf Chamber Storage

164,328.5 cf Field - 68,325.5 cf Chambers = 96,003.1 cf Stone x 40.0% Voids = 38,401.2 cf Stone Storage

Chamber Storage + Stone Storage = 106,726.7 cf = 2.450 af
Overall Storage Efficiency = 64.9%
Overall System Size = 156.39' x 155.67' x 6.75'

629 Chambers
6,086.2 cy Field
3,555.7 cy Stone



Technology Assessment Report

Stormceptor®

CSR™ New England Pipe

Prepared for
The Massachusetts Strategic
Envirotechnology Partnership
STEP

December, 1997

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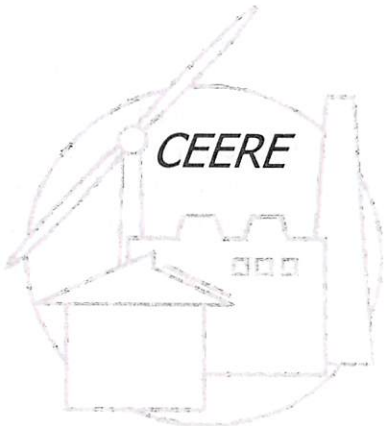

Center for Energy Efficiency and Renewable Energy

University of Massachusetts
UMASS Amherst

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PREFACE

The STEP technology assessment process is designed to identify those technologies that will support the economic and environmental/energy goals of the Commonwealth of Massachusetts and may benefit from STEP assistance. The process is meant to be one of screening, in which technologies are evaluated by independent technical specialists. Recommendation from this process does not constitute an endorsement of the technology or of the absolute validity of the technology. Rather, STEP technical assessments attest only that, through the screening process, the reviewers feel there may be benefit to the Commonwealth of Massachusetts.

EXECUTIVE SUMMARY

The technology described in this review is Stormceptor® and is currently owned by Stormceptor® Corporation and licensed to CSR/New England Pipe (CSR/NEP) of Wauregan, CT, for distribution in Massachusetts, among other states. The system is being commercialized by CSR/NEP. The Stormceptor technology addresses treatment of stormwater runoff. It is proposed as an effective spill control and stormwater quality enhancement system, capable of retaining grit, suspended solids, oils and grease during periods of both low and high flows. It is proposed as a replacement for conventional manholes within a storm drain system. It is not designed as a catch basin or detention system. It can be used within any new or existing lateral piped conveyance system and comes in several sizes with outlets up to 60". The system is claimed as capable of removing 50 - 80% of TSS when properly sized. The Stormceptor system is recommended as a stand alone or as a component to a system or in combination with different BMPs. An example configuration may include the following components: catch basin or water quality inlet, Stormceptor, detention basin or infiltration system.

The system is a prefabricated well type structure which provides sedimentation, oil, and grease separation. It is manufactured in both concrete or fiberglass. Current sizes range from 900 to 7200 gallons, with diameters between 6 and 12 feet. The design of the system provides two sections, a treatment chamber and bypass chamber. The structural components of the system are separated by an insert which has a weir, inflow drop pipe, and outflow riser. Operation of the system is passive with respect to flow control and treatment. During low flows or frequent storm events, stormwater from the inlet is directed down the inflow drop pipe located adjacent to the inlet of the treatment chamber. Flow in excess of the inflow drop pipe capacity is directed into the bypass chamber to the outlet of the system. The effective treatment capacity is set by a weir which surrounds the inflow drop pipe at the inlet and the volume of the treatment chamber. Effluent from the treatment chamber exits via the outflow riser which extends below the water surface in the treatment chamber up to the overflow chamber and to the system outlet. Sediment is retained in the bottom of the treatment chamber and oils and grease are retained at the top of the treatment chamber in a quiescent area.

The Stormceptor system is stormwater treatment structure providing event based solids separation. The value added in the Stormceptor system is the ability to reduce turbulence in the treatment chamber, which makes it better at removing TSS and TPH than conventional BMPs of the same category. The Stormceptor system has been demonstrated to provide at least 52% removal of TSS when sized according to Stormceptor's "Treatment Train" criteria and 77% when sized according to Stormceptor's "Sensitive Area" criteria. It is likely that a higher removal efficiency, greater than 80%, could be expected if the contributing drainage area is smaller than the sizing recommended. The system is likely to remove grease and oils with its inflow and outflow pipe configurations. The Stormceptor system appears to be a good control technology in areas of higher pollution potential, Standard 5 described in the Stormwater Management Handbooks (DEP and CZM, 1997). Stormceptor system may be used as a component in combination with different BMPs or may be used as a stand alone installation provided it is sized for 80% TSS removal. STEP recommends collection of additional data representing a varied set of operating conditions over a realistic maintenance cycle to verify TSS removal rates greater than 80%.

HIGHLIGHTS

- Performance data available demonstrates that the Stormceptor system can provide TSS removal rates of 77% when sized according to the "Sensitive Area" criteria. Evidence suggests that the Stormceptor system may be capable of achieving TSS removal rates between 89% and 99% when sized accordingly, under conditions similar to those reported in the Westwood Massachusetts site, including: climate and land use intensity.
- Performance data available to this reviewer suggest that the Stormceptor system can provide TSS removal rates of 52% when sized according to the "Treatment Train" criteria.
- Use of the Stormceptor system as a pretreatment component in combination with different BMPs, when sized according to the "Treatment Train" criteria, will likely meet standards 4 and 6 of the Stormwater Management Handbooks (DEP and CZM,1997). Use as a stand alone device may be justified when sized according to the "Sensitive Area" criteria.
- The Stormceptor system is likely to perform in areas with higher potential pollutant levels in Standard 5 of the Stormwater Management Handbooks (DEP and CZM,1997).
- The Stormceptor system is useful for new and retrofit installations in Standard 7 of the Stormwater Management Handbooks (DEP and CZM,1997), especially where space is limited.
- The Stormceptor system is also suited for secondary sediment control from construction related sediment loads specified in Standard 8 (DEP and CZM,1997).

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TECHNOLOGY PROPONENT

The technology described in this review is Stormceptor® and is currently owned by Stormceptor® Corporation and licensed to CSR/New England Pipe (CSR/NEP) of Wauregan, CT, for distribution in Massachusetts, among other states. The system is being commercialized by CSR/NEP. CSR/NEP is a subsidiary of CSR Hydro Conduit Corporation which manufactures Stormceptor in the most of the United States.

TECHNOLOGY DESCRIPTION

The Stormceptor technology addresses treatment of stormwater runoff. It is proposed as an effective spill control and stormwater quality enhancement system, capable of retaining grit, suspended solids, oils and grease during periods of both low and high flows. It is proposed as a replacement for conventional manholes within a storm drain system. It is not designed as an inlet or detention system. It can be used within any lateral piped conveyance system and comes in several sizes with outlets up to 60". The system is claimed as capable of removing 50 to 80% of TSS when properly sized. The Stormceptor system may be used as a stand alone BMP or as a component within a combination of different BMPs. An example of a combination of different BMPs is a catch basin, Stormceptor, and detention pond. It is compatible with any existing conveyance system. It is proposed that the system has an added value in its small size and its added removal capability over similar conventional BMPs such as catch basins and deep sumps. The system is currently protected by a United States Patent No. 4,985,148.

The system is a prefabricated well type structure which provides sedimentation, oil, and grease separation (Figure 1). It is manufactured in both concrete or fiberglass. Current sizes range from 900 to 7200 gallons, with diameters between 6 and 12 feet. The design of the system provides two sections, a treatment chamber and bypass chamber. The structural components of the system are separated by an insert which has a weir, inflow drop pipe, and outflow riser (Figure 2). The size of the insert and its associated components depends on the overall size of the treatment chamber and bypass chamber.

Operation of the system is passive with respect to flow control and treatment. During low flows or frequent storm events, stormwater from the inlet is directed down the inflow drop pipe located adjacent to the inlet of the treatment chamber. Flow in excess of the inflow drop pipe capacity is directed into the bypass chamber to the outlet of the system. The effective treatment capacity is set by a weir which surrounds the inflow drop pipe at the inlet and the volume of the treatment chamber. Effluent from the treatment chamber exits via the outflow riser which extends below the water surface in the treatment chamber, up to the overflow chamber, and to the system outlet. Sediment is retained in the bottom of the treatment chamber and oils and grease are retained at the top of the treatment chamber in a quiescent area. Oil and grease are prevented from leaving the chamber by the outflow riser.

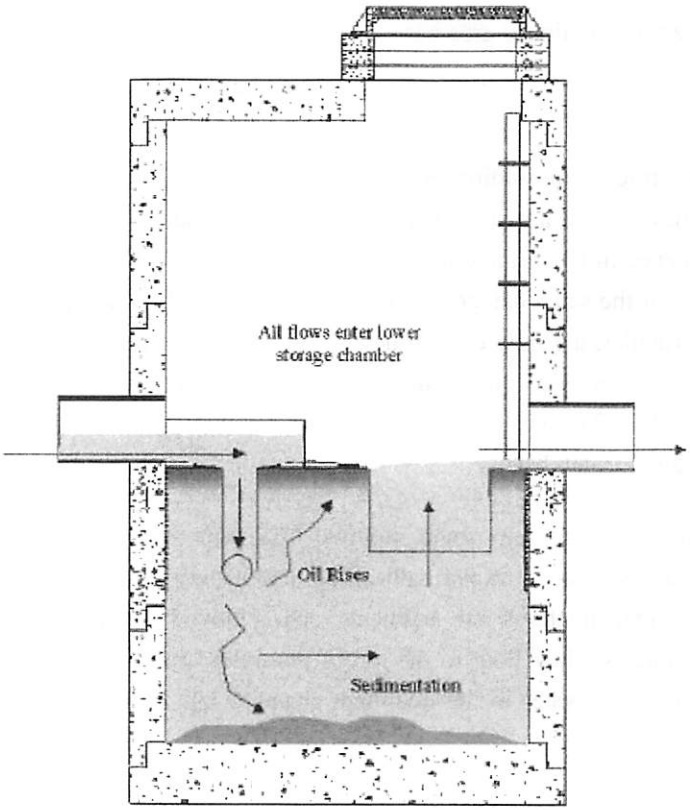

Figure 2. Stormceptor operation during average flow conditions.

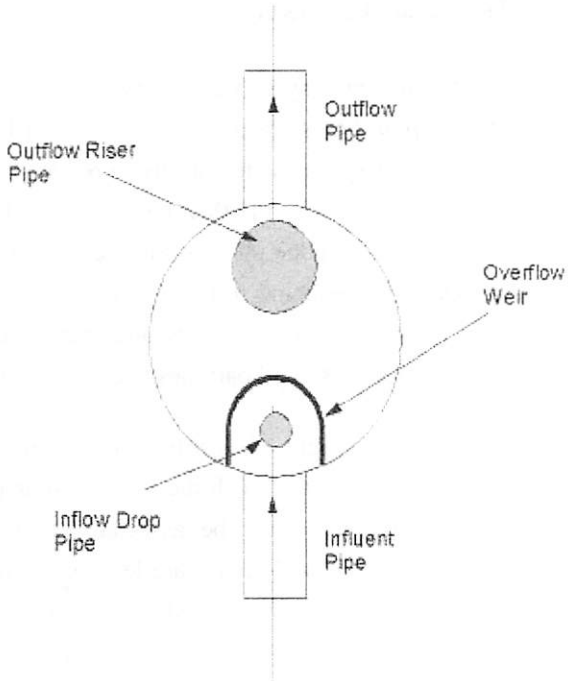

Figure 1. Top view of Stormceptor insert.

The inlet and outlet elevations of the system are kept at a minimum with 1" difference in the concrete and fiberglass units. The multiple inlet units have a 3" difference between the inlet and outlet. Approximately 9 inches of hydrostatic head is developed from the influent elevation in the weir. A low head system is designed to reduce the potential for scouring from higher velocities in the treatment chamber. During storm events exceeding the treatment capacity of the chamber the head on the system is kept constant because stormwater elevation over the drop pipe is nearly equivalent to the head over the outflow riser. Studies prepared by Stormceptor Corporation (Marsalek et al., 1994) demonstrated when total flow to the system was increased, in excess of the treatment chamber capacity, flow through the treatment chamber increased initially and then decreased slightly. This implies that treatment performance would not be lowered during high flow events and scouring and resuspension of previously settled solids is prevented.

The system is suited for local or lateral lines within any conveyance system. The system is not recommended for large storm drain trunk lines. The system is not designed to be used as an inlet catch

basin. Stormceptor Corporation produces 8 models with different sediment and oil capacities illustrated in Table A1 in the Appendix. Preliminary sizing recommendations are presented in Technical Design Manual (Stormceptor Corporation, 1997) and in Table A2 in the Appendix. The preliminary recommended sizing table specifies units per impervious drainage area based on percentages of treatment.

TECHNICAL FEASIBILITY

The Stormceptor system is stormwater treatment structure providing event based solids separation. The Stormceptor has a greater TSS removal efficiency than water quality inlets. The value added in the Stormceptor system is the ability to reduce turbulence in the treatment chamber, which makes it better at removing TSS and TPH than conventional BMPs of the same category. A significant amount of design engineering has gone into the Stormceptor. In particular, the flow control device developed for the insert is capable of reducing turbulence in the treatment chamber to quiescent levels. This directly increases removal efficiencies for TSS and grease and oils. The system appears to be capable of limiting resuspension of settled particles, a common problem in catch basins.

The basic principle of operation is sedimentation. In addition, some minimal treatment to pollutant parameters associated with the settled solids is likely to occur. In particular, BOD_5, COD, particulate N, P, and pathogens may be associated with the finer fractions of sediments and removed from the stormwater. Oil and grease are less dense than water so they float to the top of the treatment chamber. Since the outflow riser extends below the surface of the water in the treatment chamber, oil and grease will be trapped in the treatment chamber.

COMPETING TECHNOLOGIES

Several direct competing technologies exist for Stormceptor, including other sedimentation chamber technologies like oil and grit separators. Information submitted by a competing technology suggests that Stormceptor is a cost competitive product. However, no comparative data on oil and grit separators was submitted by CSR/NEP on these technologies. Typical oil and grit separators are not likely to achieve the same level of treatment as the Stormceptor system. The Stormceptor system should be competitive with other technologies that produce comparable removal efficiencies. The Stormceptor system has spatial requirement advantages over detention ponds and artificial wetlands which have large area requirements. The Stormceptor system is not a recharging system and therefore not comparable to recharging systems such as infiltration basins and trenches. It may produce equivalent treatment levels as recharging systems, when sized properly. The Stormceptor system is not suitable for meeting recharge Standard 3 as a singular treatment system (DEP and CZM, 1997), but may be well suited for pretreatment in a mixed component system with recharge. The system should be competitive with the other BMPs in the deep sump catch basin category.

DATA SUPPORTING CLAIMS

Prior to considering performance data from any treatment technology, the following notation is advised. Data collected from isolated stormwater treatment systems may be variable. Some of this variability may be due to differences in land use, climate, and soil type. Additionally, it is possible that storm events may have variable pollutant loads, resulting in varied treatment system performance at an individual site. The combination of these two sources of variability, inherent in all BMP performance verification, presents an unknown level of uncertainty. In order to overcome this uncertainty a larger set of data would be required to predict the performance of the technology under a variety of conditions. The Stormceptor system has a limited set of performance data.

The data submitted by CSR/NEP are intended to demonstrate performance capable of achieving Standards 4, 5, 6 and 7 of the Department of Environmental Protection (DEP) Stormwater Management Handbooks (DEP and CZM,1997). In this Technical Assessment, performance is based on available data in the proponent's submission from installations in Toronto and Edmonton Canada. Bench scale testing and modeling data were used as predictors of performance but not for sizing. A third installation, in Westwood, Massachusetts, supports performance claims at Stormceptor's "Sensitive Area" criteria of 80%. Stormceptor has more than 1600 units installed in the U.S. and Canada. Additional data from other installations may become available for future performance verifications.

Analytical Modeling and Bench Scale Studies

Stormceptor Corporation has committed resources to study the Stormceptor system using analytical models with bench and pilot scale validation. Several modeling scenarios were developed for Stormceptor by Marshall Macklin Monaghan, LTD. (1994) to evaluate the removal of TSS under a variety of storm event conditions using the Stormwater Management Model (SWMM). Some of the parameters for the model include: rainfall data, temperature, and runoff. The analytical model results are based on non-ideal settling and do not account for flocculation effects due to its considerable complexity. Predicted long term TSS removal rates were calculated as a function of drainage area per unit for 4 different Stormceptor models. Results from this modeling study suggest that in small drainage areas the Stormceptor units had higher removal rates. The long term TSS removal rates for a 1.2 acre/unit drainage area were calculated at 53%, 46%, 39%, and 30% for systems sized at 6800 gal., 4850 gal., 2800 gal., and 1820 gal., respectively. Removal rates decreased proportionately by 25% of the highest rate when the drainage area was doubled. Removal rates were less than 20% at 4.25 acres/unit.

Another laboratory study performed by Marcalek et al. (1994) suggests a much larger variation for TSS removal rates, ranging from 6% to 95%. In these studies flow rate was manipulated along with configurations of the inflow drop pipe and outflow riser. Systems used in these tests were 1/4 size and the sediment used was an ABS polymer used to control particle size more effectively. A scaling factor of 32 was used to estimate the actual prototype design flows based on equivalent Froude

number under the special case where no free fluid surface exists with incompressible fluid. The removal rates for fine to medium sands were 95% at 95 gal/min, 77% at 206 gal/min, 68% at 285 gal/min, and 6% at 634 gal/min.

A study from the University of Conventry (Pratt, 1996) tested the equivalent to the STC 900 system at 144 gal/min in a 20 minute event . Sand and crankcase oil were loaded at 4100 mg/l and 90 mg/l, respectively to the influent water. Removal efficiencies were reported at 83% for sand and 98% for oil. While this was a full scale study, the conditions of the test may not accurately reflect field conditions under all circumstances. In particular, the flow rates do not fall within the recommended ranges specified in the Stormceptor Design Manual (Stormceptor Corporation, 1997). Additionally, the use of model sands do not always reflect the behavior of sediments under field conditions. Lastly, the number of replicates do not warrant statistical significance due to limited replications.

Stormceptor Corporation and CSR/NEP have indicated that the preliminary sizing recommendations are based on their field installations and not the laboratory data or modeling data. Review of these data indicate that the laboratory data and modeling data do not give a definitive picture of system performance under field conditions. It is suggested that additional performance data be gathered from field installations and return to the modeling data for model calibration. Analysis of model sensitivity would be appropriate once additional field data has been collected.

Field Installations

A field test of the Stormceptor system was carried out in The City of Edmonton Canada at a parking lot located in the Westmount Shopping center on Fountain Lake. A single Stormceptor unit (Model STC2000, which is equivalent to an STC2400) was installed to treat an approximate impervious drainage area of 9.8 acres. This installation had a unit undersized by a factor of 3. The unit was fitted with automated samplers on inflow and outflow pipes. Water quality was measured on 4 storm events, and included TSS, metals, oil and grease. Average removal efficiencies were 51.5%, 39 to 53%, and 43%, respectively (Table 1). No additional data on the variability of these data were available. Precipitation data for the storm events were not made available to this reviewer at the time of this assessment. Therefore, it is unclear whether these events were 0.5 inch or more. The Stormceptor Corporation's recommended impervious drainage area for the STC 2000 (equivalent to the STC 2400) is 3.35 acres, therefore the system was largely under-sized. The performance of this system exceeded the predicted performance based on the sizing guidelines set by Stormceptor. Under similar environmental conditions, including climate, land use intensity, and soil conditions as that at the Edmonton installation, it is possible that the undersized Stormceptor system will provide at least 52% removal of TSS, sized under Stormceptor's "Treatment Train" criteria (50% TSS removal).

Table 1. Water Quality Tests at Westmount Shopping Center, Edmonton Canada, 1996

Water Quality Parameter	Average Percent Removal Efficiency
TSS	52%
Metals (Fe, Pb, Zn, Cr, and Cu)	39 - 53%
Oil and Grease	43%

Stormceptor conducted a survey of sediment loads to 23 Stormceptor units installed in the City of Toronto, Canada (Bryant et al., 1995). Analysis of the sediment accumulations and estimates of TSS removal efficiency were calculated based on predicted flow and loadings. In this study, a mass balance was not utilized to measure removal efficiency. Rather, estimates based on regional precipitation data and estimated mean concentration (EMC) (Novotny, 1992) were used to determine loadings. The removal efficiency was calculated from the ratio of sediment collected in the unit and corrected for water content, and estimated loading. Solids removal efficiency increased with greater storage capacity (r^2=0.60) (Figure 3). The range of removal efficiencies was 18 to 95%. The authors did not verify whether there were significant losses of sediment out of the units (Bryant et al., 1995). These data indicate a relatively high potential for removal, especially where sediment storage capacity is high. Data from this study were used to calculate preliminary sizing recommendations, detailed later in this review (Appendix, Table A1). The approach used to estimate performance and the subsequent sizing recommendations is based on rational assumptions. Actual performance under conditions other than those tested may require verification to compare with these results.

In Westwood Massachusetts, an ongoing study of a Stormceptor STC 2600, sized according to the "Sensitive Area" criteria, demonstrated 77% TSS removal efficiencies from six storm events. Two events produced no appreciable sediment load over the composite sampling period. The first three events had a mean of 90% TSS removal based on first flush grab samples. Three of the six events had removal rates in excess of 89% and as high as 99%. One event produced a low removal rate of 28% and may have been an artifact of the sampling procedure. Overall the removal efficiency for TSS is near 80%. Removal of TPH averaged 93%, based on first flush grab samples of the first three storm events. Overall TPH removal, based on composite sampling over 5 events, was 80% with 3 events contributing no data to the mean. The mean precipitation and duration of these events were 0.4 inches and 13 hours, respectively.

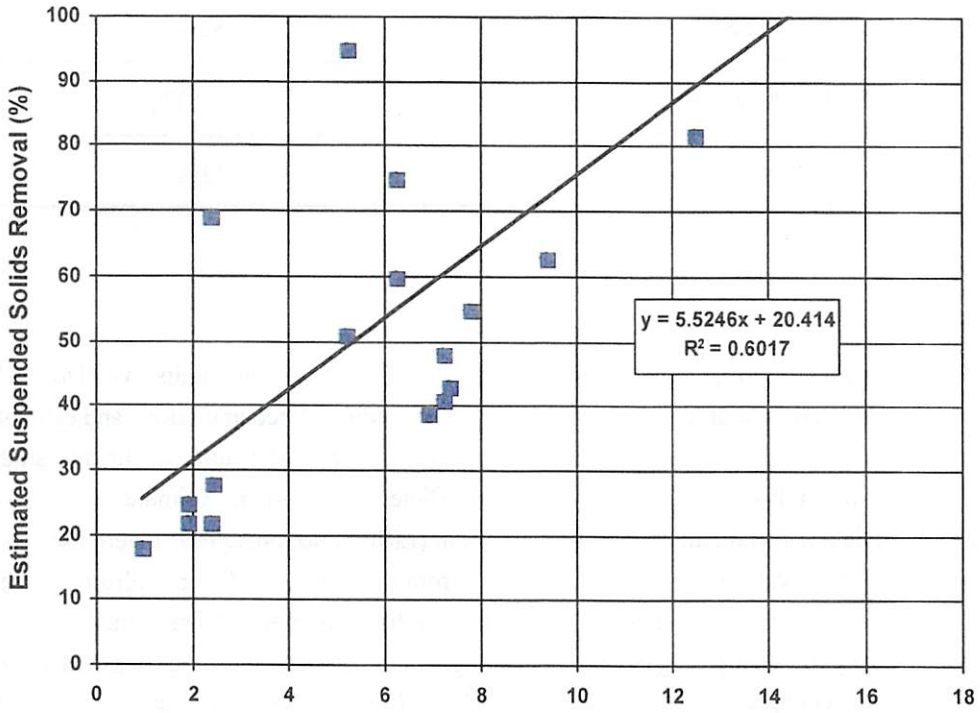

Figure 3: Stormceptor® Sizing Guideline - Removal efficiency as a function of storage capacity from 23 Stormceptor units in Toronto Canada.

Performance Summary

The Stormceptor system has been demonstrated to provide at least 77% removal of TSS when sized under Stormceptor's "Sensitive Area" criteria and 52% TSS removal when sized under Stormceptor's "Treatment Train" criteria. Based on these data, the Stormceptor systems receiving stormwater from a drainage area sized according to the "Sensitive Area" criteria are likely to provide a removal efficiency of 80%, on the annual stormwater runoff. While the set of data useful for predicting the relationship between treatment efficiency and loading rates is limited, it is likely that the STC 2400 is capable of meeting standards 4 and 6, for 80% removal of TSS in the first 0.5 or 1.0 inch of a storm event, if sized appropriately. STC 2400 Furthermore, performance of larger and smaller sized units may be capable of achieving removal rates that meet Standards 4 and 6. However, data to support this claim are not currently available.

SITE SUITABILITY RECOMMENDATIONS

The applicability of this technology with respect to TSS removal is similar to that of several other BMPs, including: sand and organic filters, catch basins, and water quality inlets, all described in the Stormwater Management Handbooks (DEP and CZM, 1997). The use of this technology can be made to Standards 4, 5, 6, and 7 in the Stormwater Management Handbooks (DEP and CZM, 1997).

The system is suitable for new and retrofit situations. The Stormceptor system is particularly well suited for constricted areas, areas that require pretreatment for a multi-component treatment system, and redevelopment and retrofits described under Standard 7 in the Stormwater Management Handbook (DEP and CZM, 1997). The Stormceptor system appears to have the ability to trap spills of hydrocarbons, oils, and grease. This makes the system suitable for use on areas with higher potential pollutant loads, specified under Standard 5 in the Stormwater Management Handbooks (DEP and CZM, 1997).

The system can be used on sites with a wide range of drainage areas provided it is sized correctly. On larger drainage area installations, units can be located throughout the drainage area rather than in a central location and provide treatment of runoff closer to its source. The system is suitable on small drainage areas or on individual inlets. The system is generally associated with a conveyance system and is recommended as part of a combination of different BMPs. The system is not designed as a recharge system and is not applicable to Standard 3 (DEP and CZM, 1997) unless combined with an approved recharge system. The system may be used as a pretreatment device for recharging systems. In this application, the life of the recharging system should be extended due to reduced clogging of the infiltrative surface. In high groundwater conditions the system is likely to withstand the hydrostatic pressures created by the saturated soil conditions around the unit. Care must be taken to assure the seam in the concrete unit does not leak. Buoyancy of the unit should be considered in the engineering plan. Stormceptor Corporation recommends use of fiberglass tanks where there is potential for spills of hazardous materials. The precast concrete units are applicable to other installations including roads, highways, and parking lots.

Sizing

The recommended sizing, presented in the Appendix Table A1, was developed by Stormceptor Corporation based on calculated loadings from the Toronto survey of system performance (Bryant et al., 1995). Based on the Edmonton Study, removal efficiencies determined for the STC 2000 (equivalent to the STC 2400) fall within the range of removal rates specified in the sizing guidlines. The performance ratings for the STC 2400, listed in Table A1 under "Treatment Train" criteria, may be conservative estimates, since that system was grossly undersized. When sized appropriately, the system is likely to perform as claimed under similar environmental and operating conditions including: climate, land use intensity, and soil conditions. The larger sized units listed in Table A1 have not been verified. The performance characteristics of these systems may vary as a function of scale. Performance of other sized units may have comparable removal efficiencies and are likely to

meet Standards 4 and 6, requiring 80% TSS removal of the first 0.5 and 1 inch of rainfall respectively. The Stormceptor system may be used as a stand alone BMP or as a component within a combination of different BMPs.. It is possible that sizing which corresponds to the "Sensitive Area" category in Table A1 may meet Standard 4 and 6, requiring 80% TSS removal of the first 0.5 and 1.0 inch of rainfall, respectively.

Maintenance

All BMPs require periodic maintenance. Inspection of the sediment load and oil and grease volumes is easily made from the surface with a tube dipstick inserted through a 6" vent tube. Depths of sediment indicating maintenance are presented the Appendix, under maintenance. Inspection of the internal structure should be part of the routine inspection plan. The unit is designed to accept 15% of its capacity in solids annually based on maximum drainage area loading listed in Table 4 of the Technical Design Manual (Stormceptor Corporation, 1997). Removal of sediment, oils, and grease from the system will depend on rates of accumulation. Sediment removal is recommended annually but is likely to vary widely based on site conditions and loadings. The Stormwater Management Handbook (DEP and CZM, 1997) recommends quarterly maintenance. Reduced or more frequent maintenance frequency can be determined after experience with the system increases. Typical maintenance cleaning can be done with a vacuum truck. Maintenance costs are not expected to be in excess of normal costs for maintaining deep sump catch basins. Costs for cleaning, not adjusted for economies of scale, range from $250 to $500 depending on the size of the system and disposal fees.

REGULATORY ISSUES

The performance requirements for stormwater treatment systems are established by the DEP Stormwater Management Standards listed in the Stormwater Management Handbook (DEP and CZM, 1997). Projects subject to the standards may be required to file a Notice of Intent when they are sited in wetlands jurisdictional areas. Under the Wetlands Protection Act, conservation commissions, must apply the standards to new or modified discharges. Permits for surface water discharges under the National Pollutant Discharge Elimination System (NPDES), issued by the Massachusetts DEP Bureau of Resource Protection Division of Watershed Management, are not required if the discharge is tied to a conveyance or system of conveyances operated primarily for the purpose of collecting and conveying uncontaminated stormwater runoff.

CROSS MEDIA IMPACTS

Disposal of sediment from stormwater treatment systems is permitted in lined or unlined permitted solid waste landfills. In the absence of written approval from DEP, sediments are considered non-hazardous

solid waste and may be treated in accordance with all DEP regulations policies and guidelines. Typical removal of sediment and biofilter material can be performed with a vacuum truck and disposed of. Grease and oils may accumulate in the sedimentation chambers and can be removed and disposed as non-hazardous solid waste. If the system has received influent from a hazardous materials spill, the system should be managed in accordance with an approved emergency response plan and appropriate state requirements. The Stormceptor system does not present more restrictions for removal of wastes than would be associated with any other BMP.

ENERGY ISSUES{TC "ENERGY ISSUES"}

There are no specific energy issues related to this technology as it is not an energy consumer. There may be energy benefits when this "passive" system is compared to other technologies that may consume energy resources.

NEED FOR ADDITIONAL RESEARCH, DEMONSTRATION, AND STEP SUPPORT

The Stormceptor technology is a unique approach for stormwater pretreatment and appears to be technically feasible based on a preliminary analysis of the available data. Further research on the Stormceptor system should include studies to assess actual sediment loading under a variety of environmental conditions. To establish removal rates in excess of those reported herein, further research on the Stormceptor system should include: i) evaluation of seasonal variation in performance, ii) performance as a function of flow rate, iii) efficiency with dual or multiple inlets, and iv) bacteria and pathogen removal efficiency in dry weather periods. The STEP program will be able to assist in performance verification on an as needed basis. Installations already being monitored by CSR and Stormceptor will continue to provide performance data in a variety of environmental conditions. Existing monitoring programs may be augmented with STEP support through STEP oversight and reporting. STEP support may include development of experimental plans and review of data. Additional data would be useful for confirming field performance claims greater than 80% TSS removal efficiency.

SUMMARY RECOMMENDATION

The Stormceptor system is based on reasonable and accepted principles applied to water treatment and conveyance systems. Review of available data suggests that the Stormceptor system should be capable of providing an effective solution for treatment of stormwater runoff. At present, it is not possible to verify the performance of all the Stormceptor models under the recommended sizing guidelines. The system is likely to be capable of TSS removal for Standards 4 and 6 when sized according to the "Sensitive Area" criteria. Other sized Stormceptor models may provide similar TSS removal rates when sized accordingly under similar climatic conditions, land use intensities, and soil conditions. The Stormceptor system is

uniquely designed to trap hydrocarbons and is well suited for areas of higher pollutant potential, Standard 5 in the Stormwater Management Handbook (DEP and CZM, 1997). The system is also likely to remove grease and oils.

Based on available data, the Stormceptor technology may be capable of meeting Standards 4, 5, 6, and 7 in the Stormwater Management Handbook (DEP and CZM, 1997) if installed, designed, and operated according to manufacturer's instructions. Additional data representing a varied set of operating conditions over a realistic maintenance cycle on other Stormceptor models will assist in further clarification of TSS removal rates. Performance claims can be further verified as data is generated on systems currently being monitored. The Stormceptor system compares favorably to other conventional BMP technologies with similar TSS removal rates, offering enhanced treatment and application.

Highlights

- Performance data available demonstrates that the Stormceptor system can provide TSS removal rates of 77% when sized according to the "Sensitive Area" criteria. Evidence suggests that the Stormceptor system may be capable of achieving TSS removal rates between 89% and 99% when sized accordingly, under conditions similar to those reported in the Westwood Massachusetts site, including: climate and land use intensity.
- Performance data available to this reviewer suggest that the Stormceptor system can provide TSS removal rates of 52% when sized according to the "Treatment Train" criteria.
- Use of the Stormceptor system as a pretreatment component in combination with different BMPs, when sized according to the "Treatment Train" criteria, will likely meet standards 4 and 6 of the Stormwater Management Handbooks (DEP and CZM,1997). Use as a stand alone device may be justified when sized according to the "Sensitive Area" criteria.
- The Stormceptor system is likely to perform in areas with higher potential pollutant levels in Standard 5 of the Stormwater Management Handbooks (DEP and CZM,1997).
- The Stormceptor system is useful for new and retrofit installations in Standard 7 of the Stormwater Management Handbooks (DEP and CZM,1997), especially where space is limited.
- The Stormceptor system is also suited for secondary sediment control from construction related sediment loads specified in Standard 8 (DEP and CZM,1997).

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APPENDIX

Table A1. Stormceptor® Capacities*					
Model	Maximum Treatment Flowrate (gal/min.)**	Down Riser Pipe / Orifice Diameter (in.)	Sediment Capacity (ft^3)	Oil Capacity (gal)	Total Holding Capacity (gal)
STA/STC 900	285	6	75	280	950
STA/STC 1200	285	6	110	280	1230
STA/STC 1800	285	6	195	280	1830
STA/STC 2400	475	8	180	880	2495
STA/STC 3600	475	8	345	880	3750
STA/STC 4800	800	10	465	1025	5020
STA/STC 6000	800	10	610	1025	6095
STA/STC 7200	1110	12	725	1100	7415

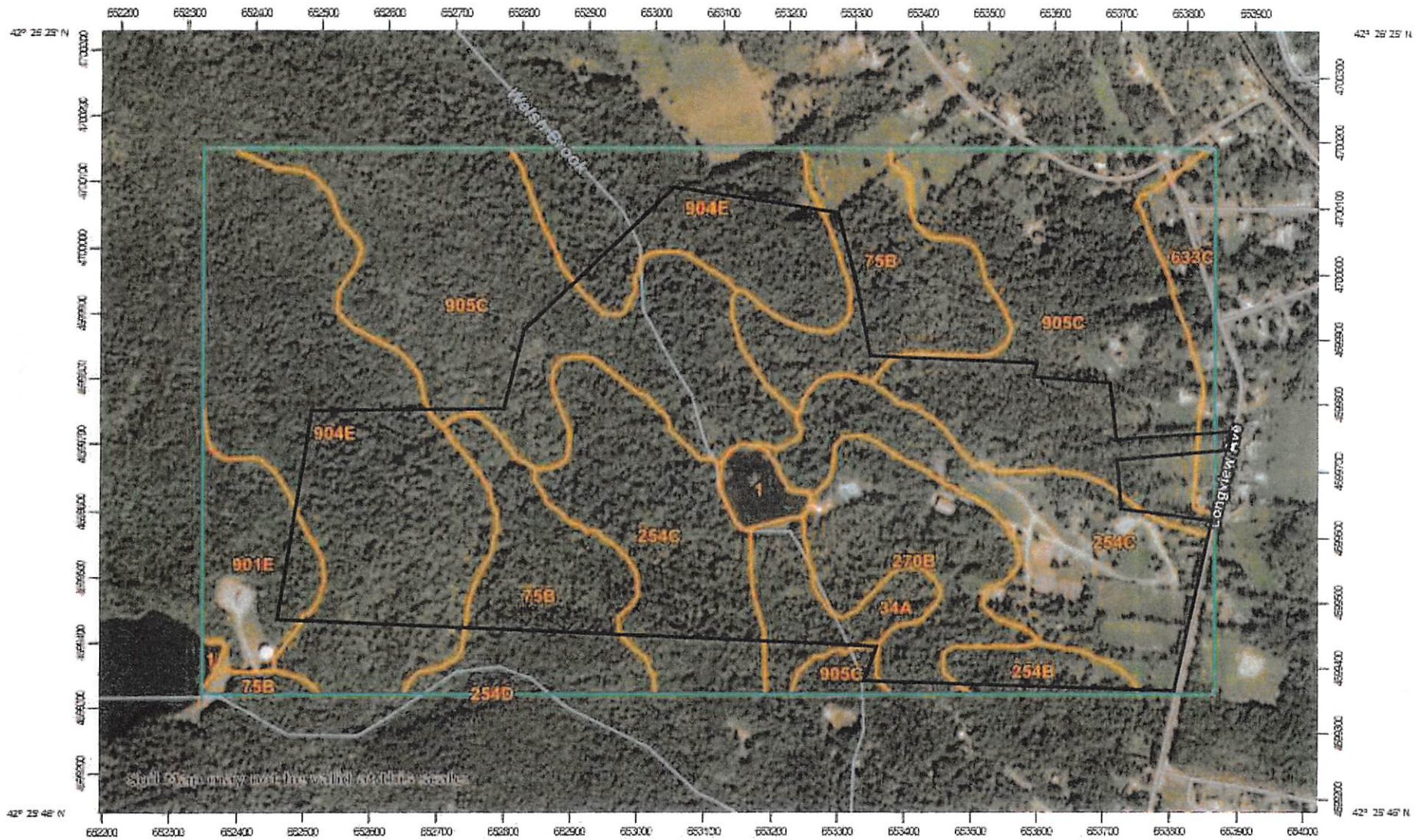
* approximate, ** without by-passing

Table A2. Maximum Impervious Drainage Area Guidelines (acres)				
Stormceptor® Model (STA / STC)	Sensitive Area (80% TSS removal)	Standard Area (70% TSS removal)	Degraded Area (60% TSS removal)	Treatment Train (50% TSS removal)
900	0.45	0.55	0.70	0.90
1200	0.70	0.85	1.05	1.45
1800	1.25	1.50	1.90	2.55
2400	1.65	2.00	2.50	3.35
3600	2.60	3.15	3.95	5.30
4800	3.60	4.30	5.40	7.25
6000	4.60	5.55	6.95	9.25
7200	5.55	6.70	8.40	11.25

Table 6. Sediment Depths Indicating Required Maintenance*{tc "Table 6. Sediment Depths Indicating Required Maintenance*"}**Table A3. Sediment Depths Indicating Required Maintenance***	
Model	**Sediment Depth (feet)**
900	0.50
1200	0.75
1800	1.00
2400	1.00
3600	1.25
4800	1.00
6000	1.50
7200	1.25

* based on 15% of the interceptor's sediment storage

Soil Map—Berkshire County, Massachusetts



Map Scale: 1:8,360 if printed on A landscape (11" x 8.5") sheet.

Meters: 0 100 200 400 600

Feet: 0 400 800 1600 2400

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

Berkshire County, Massachusetts

1—Cwater

Map Unit Setting

National map unit symbol: 98sq
Mean annual precipitation: 32 to 52 inches
Mean annual air temperature: 37 to 50 degrees F
Farmland classification: Not prime farmland

Map Unit Composition

Cwater: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Data Source Information

Soil Survey Area: Berkshire County, Massachusetts
Survey Area Data: Version 15, Jun 9, 2020

Berkshire County, Massachusetts

75B—Pillsbury fine sandy loam, 0 to 8 percent slopes, very stony

Map Unit Setting

National map unit symbol: 2ty6x
Elevation: 360 to 2,070 feet
Mean annual precipitation: 31 to 95 inches
Mean annual air temperature: 27 to 52 degrees F
Frost-free period: 90 to 140 days
Farmland classification: Not prime farmland

Map Unit Composition

Pillsbury, very stony, and similar soils: 79 percent
Minor components: 21 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pillsbury, Very Stony

Setting

Landform: Mountains, hills
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Mountainbase, interfluve, base slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Loamy lodgment till derived from gneiss and/or loamy lodgment till derived from mica schist and/or loamy lodgment till derived from granite

Typical profile

Oe - 0 to 1 inches: mucky peat
A - 1 to 6 inches: fine sandy loam
Bg1 - 6 to 13 inches: cobbly fine sandy loam
Bg2 - 13 to 23 inches: cobbly fine sandy loam
Cd - 23 to 65 inches: cobbly fine sandy loam

Properties and qualities

Slope: 0 to 8 percent
Surface area covered with cobbles, stones or boulders: 1.1 percent
Depth to restrictive feature: 21 to 43 inches to densic material
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.01 to 1.42 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water capacity: Low (about 3.3 inches)

Interpretive groups

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

Minor Components

Peru, very stony

Percent of map unit: 9 percent
Landform: Mountains, hills
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Mountainbase, base slope, interfluve
Microfeatures of landform position: Rises, rises
Down-slope shape: Convex
Across-slope shape: Linear, convex
Hydric soil rating: No

Peacham, very stony

Percent of map unit: 5 percent
Landform: Mountains, hills
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Mountainbase, interfluve, base slope
Microfeatures of landform position: Closed depressions, closed depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Wonsqueak

Percent of map unit: 4 percent
Landform: Mountains, hills
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Mountainbase, interfluve, base slope
Microfeatures of landform position: Closed depressions, closed depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Lyman, very stony

Percent of map unit: 3 percent
Landform: Mountains, hills
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Mountainbase, interfluve, base slope
Microfeatures of landform position: Rises, rises
Down-slope shape: Convex
Across-slope shape: Convex

Hydric soil rating: No

Data Source Information

Soil Survey Area: Berkshire County, Massachusetts
Survey Area Data: Version 15, Jun 9, 2020

Berkshire County, Massachusetts

34A—Fredon fine sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 98t1
Elevation: 250 to 1,200 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

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

Description of Fredon

Setting

Landform: Depressions
Landform position (two-dimensional): Footslope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Friable coarse-loamy eolian deposits over loose sandy and gravelly glaciofluvial deposits derived from slate and/or loose sandy glaciofluvial deposits derived from slate

Typical profile

H1 - 0 to 8 inches: fine sandy loam
H2 - 8 to 26 inches: fine sandy loam
H3 - 26 to 64 inches: stratified sand to loamy fine sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: About 6 to 12 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 4.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: B/D
Hydric soil rating: Yes

Minor Components

Halsey

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

Hero

Percent of map unit: 5 percent
Hydric soil rating: No

Data Source Information

Soil Survey Area: Berkshire County, Massachusetts
Survey Area Data: Version 15, Jun 9, 2020

Berkshire County, Massachusetts

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: Outwash terraces, moraines, eskers, outwash plains, kames
Landform position (two-dimensional): Backslope, footslope, summit, shoulder
Landform position (three-dimensional): Crest, side slope, tread, riser
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
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 content: 2 percent
Maximum salinity: Nonsaline (0.0 to 1.4 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0

Available water capacity: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: A
Ecological site: F145XY008MA - Dry Outwash
Hydric soil rating: No

Minor Components

Sudbury

Percent of map unit: 5 percent
Landform: Deltas, outwash plains, terraces
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): Head slope, crest, side slope, nose 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, dunes, outwash plains
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: Outwash plains, kames, outwash terraces, moraines, eskers, stream terraces
Landform position (three-dimensional): Rise
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Data Source Information

Soil Survey Area: Berkshire County, Massachusetts
Survey Area Data: Version 15, Jun 9, 2020

Berkshire County, Massachusetts

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: Outwash terraces, moraines, eskers, outwash plains, kames
Landform position (two-dimensional): Backslope, footslope, summit, shoulder
Landform position (three-dimensional): Crest, side slope, tread, riser
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
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 content: 2 percent
Maximum salinity: Nonsaline (0.0 to 1.4 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0

Available water capacity: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: A
Ecological site: F145XY008MA - Dry Outwash
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): Head slope, crest, side slope, nose slope, rise
Down-slope shape: Convex
Across-slope shape: Convex, linear
Hydric soil rating: No

Sudbury

Percent of map unit: 5 percent
Landform: Outwash plains, terraces, deltas
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, dunes, outwash plains
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

Data Source Information

Soil Survey Area: Berkshire County, Massachusetts
Survey Area Data: Version 15, Jun 9, 2020

Berkshire County, Massachusetts

633C—Pittsfield-Urban land complex, 0 to 15 percent slopes

Map Unit Setting

National map unit symbol: 98w1
Elevation: 0 to 1,000 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

Pittsfield and similar soils: 60 percent
Urban land: 25 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pittsfield

Setting

Landform: Drumlinoid ridges
Landform position (two-dimensional): Backslope, shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Friable coarse-loamy eolian deposits over friable, calcareous coarse-loamy basal till derived from limestone

Typical profile

H1 - 0 to 9 inches: loam
H2 - 9 to 32 inches: fine sandy loam
H3 - 32 to 64 inches: gravelly sandy loam

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 8.6 inches)

Interpretive groups

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

Description of Urban Land

Setting

Parent material: Excavated & filled land

Minor Components

Berkshire

Percent of map unit: 7 percent
Hydric soil rating: No

Marlow

Percent of map unit: 6 percent
Hydric soil rating: No

Kendaia

Percent of map unit: 2 percent
Landform: Depressions
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Berkshire County, Massachusetts
Survey Area Data: Version 15, Jun 9, 2020

Berkshire County, Massachusetts

270B—Hero loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 98tc
Elevation: 620 to 1,620 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: All areas are prime farmland

Map Unit Composition

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

Description of Hero

Setting

Landform: Terraces
Landform position (two-dimensional): Toeslope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Friable coarse-loamy eolian deposits over friable sandy glaciofluvial deposits derived from limestone and/or friable sandy and gravelly glaciofluvial deposits derived from limestone

Typical profile

H1 - 0 to 8 inches: loam
H2 - 8 to 32 inches: gravelly fine sandy loam
H3 - 32 to 64 inches: stratified gravelly loamy fine sand to very gravelly coarse sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 5.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B

Hydric soil rating: No

Minor Components

Copake

Percent of map unit: 12 percent
Hydric soil rating: No

Fredon

Percent of map unit: 3 percent
Landform: Terraces
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Berkshire County, Massachusetts
Survey Area Data: Version 15, Jun 9, 2020

Berkshire County, Massachusetts

904E—Lyman-Tunbridge association, 15 to 60 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2ty75
Elevation: 850 to 2,360 feet
Mean annual precipitation: 31 to 95 inches
Mean annual air temperature: 27 to 52 degrees F
Frost-free period: 60 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

Lyman, extremely stony, and similar soils: 45 percent
Tunbridge, extremely stony, and similar soils: 40 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Lyman, Extremely Stony

Setting

Landform: Mountains, hills
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Mountaintop, mountainflank, crest, side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy supraglacial till derived from granite and gneiss and/or loamy supraglacial till derived from phyllite and/or loamy supraglacial till derived from mica schist

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 3 inches: loam
E - 3 to 5 inches: fine sandy loam
Bhs - 5 to 7 inches: loam
Bs1 - 7 to 11 inches: loam
Bs2 - 11 to 18 inches: channery loam
R - 18 to 28 inches: bedrock

Properties and qualities

Slope: 15 to 60 percent
Surface area covered with cobbles, stones or boulders: 6.0 percent
Depth to restrictive feature: 11 to 24 inches to lithic bedrock
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to high (0.00 to 14.03 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Available water capacity: Low (about 3.4 inches)

Interpretive groups

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

Description of Tunbridge, Extremely Stony

Setting

Landform: Mountains, hills
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Mountaintop, mountainflank, crest, side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy supraglacial till derived from granite and gneiss and/or loamy supraglacial till derived from phyllite and/or loamy supraglacial till derived from mica schist

Typical profile

Oe - 0 to 3 inches: moderately decomposed plant material
Oa - 3 to 5 inches: highly decomposed plant material
E - 5 to 8 inches: fine sandy loam
Bhs - 8 to 11 inches: fine sandy loam
Bs - 11 to 26 inches: fine sandy loam
BC - 26 to 28 inches: fine sandy loam
R - 28 to 38 inches: bedrock

Properties and qualities

Slope: 15 to 60 percent
Surface area covered with cobbles, stones or boulders: 6.0 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to high (0.00 to 14.03 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 6.1 inches)

Interpretive groups

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

Minor Components

Berkshire, extremely stony

Percent of map unit: 9 percent
Landform: Mountains, hills
Landform position (two-dimensional): Backslope, summit, shoulder

Landform position (three-dimensional): Mountaintop, mountainflank, crest, side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Wonsqueak
Percent of map unit: 2 percent
Landform: Mountains, hills
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Mountainbase, mountaintop, crest, side slope
Microfeatures of landform position: Open depressions, open depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Peacham, extremely stony
Percent of map unit: 2 percent
Landform: Mountains, hills
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Mountaintop, mountainflank, crest, side slope
Microfeatures of landform position: Open depressions, open depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Pillsbury, extremely stony
Percent of map unit: 2 percent
Landform: Mountains, hills
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Mountaintop, mountainflank, crest, side slope
Microfeatures of landform position: Open depressions, open depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Berkshire County, Massachusetts
Survey Area Data: Version 15, Jun 9, 2020

Berkshire County, Massachusetts

901E—Berkshire-Marlow association, 15 to 45 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2wlnm
Elevation: 750 to 2,070 feet
Mean annual precipitation: 31 to 95 inches
Mean annual air temperature: 27 to 52 degrees F
Frost-free period: 90 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

Berkshire, extremely stony, and similar soils: 55 percent
Marlow, extremely stony, and similar soils: 30 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Berkshire, Extremely Stony

Setting

Landform: Mountains, hills
Landform position (two-dimensional): Backslope, summit, shoulder
Landform position (three-dimensional): Mountainflank, side slope, nose slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy supraglacial meltout till derived from phyllite and/or granite and gneiss and/or mica schist

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A - 2 to 4 inches: fine sandy loam
E - 4 to 5 inches: fine sandy loam
Bs1 - 5 to 7 inches: fine sandy loam
Bs2 - 7 to 13 inches: fine sandy loam
Bs3 - 13 to 21 inches: fine sandy loam
BC1 - 21 to 28 inches: fine sandy loam
BC2 - 28 to 33 inches: fine sandy loam
C - 33 to 65 inches: fine sandy loam

Properties and qualities

Slope: 15 to 45 percent
Surface area covered with cobbles, stones or boulders: 6.0 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None

Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water capacity: High (about 10.0 inches)

Interpretive groups

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

Description of Marlow, Extremely Stony

Setting

Landform: Mountains, hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountainflank, nose slope, side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy lodgment till derived from mica schist and/or granite and/or phyllite

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A - 2 to 5 inches: fine sandy loam
E - 5 to 8 inches: fine sandy loam
Bs1 - 8 to 15 inches: fine sandy loam
Bs2 - 15 to 19 inches: fine sandy loam
BC - 19 to 33 inches: gravelly fine sandy loam
Cd - 33 to 65 inches: fine sandy loam

Properties and qualities

Slope: 15 to 45 percent
Surface area covered with cobbles, stones or boulders: 6.0 percent
Depth to restrictive feature: 20 to 41 inches to densic material
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.01 to 1.42 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water capacity: Low (about 5.1 inches)

Interpretive groups

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

Minor Components

Lyman, extremely stony

Percent of map unit: 9 percent

Landform: Mountains, hills
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Mountainflank, side slope, crest
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Peru, extremely stony

Percent of map unit: 4 percent
Landform: Mountains, hills
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Mountainflank, nose slope, side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Pillsbury, extremely stony

Percent of map unit: 1 percent
Landform: Mountains, hills
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Mountainflank, side slope, nose slope, interfluve
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Peacham, extremely stony

Percent of map unit: 1 percent
Landform: Mountains, hills
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Mountainflank, interfluve, base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Berkshire County, Massachusetts
Survey Area Data: Version 15, Jun 9, 2020

Berkshire County, Massachusetts

905C—Peru-Marlow association, 3 to 15 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2ty7p
Elevation: 790 to 2,100 feet
Mean annual precipitation: 31 to 95 inches
Mean annual air temperature: 27 to 52 degrees F
Frost-free period: 90 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

Peru, extremely stony, and similar soils: 61 percent
Marlow, extremely stony, and similar soils: 20 percent
Minor components: 19 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Peru, Extremely Stony

Setting

Landform: Mountains, hills
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Mountainflank, mountainbase, interfluve, nose slope, side slope
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Loamy lodgment till derived from granite and/or loamy lodgment till derived from mica schist and/or loamy lodgment till derived from phyllite

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 5 inches: fine sandy loam
E - 5 to 6 inches: fine sandy loam
Bs1 - 6 to 7 inches: fine sandy loam
Bs2 - 7 to 13 inches: fine sandy loam
Bs3 - 13 to 18 inches: fine sandy loam
BC - 18 to 21 inches: fine sandy loam
Cd1 - 21 to 37 inches: fine sandy loam
Cd2 - 37 to 65 inches: fine sandy loam

Properties and qualities

Slope: 3 to 15 percent
Surface area covered with cobbles, stones or boulders: 6.0 percent
Depth to restrictive feature: 21 to 43 inches to densic material
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.01 to 1.42 in/hr)
Depth to water table: About 17 to 34 inches

Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water capacity: Low (about 3.6 inches)

Interpretive groups

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

Description of Marlow, Extremely Stony

Setting

Landform: Mountains, hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Mountainbase, mountainflank, interfluve, nose slope, side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy lodgment till derived from granite and/or loamy lodgment till derived from mica schist and/or loamy lodgment till derived from phyllite

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A - 2 to 5 inches: fine sandy loam
E - 5 to 8 inches: fine sandy loam
Bs1 - 8 to 15 inches: fine sandy loam
Bs2 - 15 to 19 inches: fine sandy loam
BC - 19 to 33 inches: gravelly fine sandy loam
Cd - 33 to 65 inches: fine sandy loam

Properties and qualities

Slope: 3 to 15 percent
Surface area covered with cobbles, stones or boulders: 6.0 percent
Depth to restrictive feature: 20 to 41 inches to densic material
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.01 to 1.42 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water capacity: Low (about 5.1 inches)

Interpretive groups

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

Minor Components

Lyman, extremely stony

Percent of map unit: 6 percent
Landform: Mountains, hills
Landform position (two-dimensional): Shoulder, summit, backslope
Landform position (three-dimensional): Mountainflank, mountainbase, side slope, interfluve, nose slope
Microfeatures of landform position: Rises, rises
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Pillsbury, extremely stony

Percent of map unit: 5 percent
Landform: Mountains, hills
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Mountainflank, mountainbase, nose slope, side slope, interfluve
Microfeatures of landform position: Closed depressions, closed depressions, open depressions, open depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Berkshire, extremely stony

Percent of map unit: 5 percent
Landform: Mountains, hills
Landform position (two-dimensional): Backslope, summit, shoulder
Landform position (three-dimensional): Mountainflank, mountainbase, nose slope, side slope, interfluve
Microfeatures of landform position: Rises, rises
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Monadnock, extremely stony

Percent of map unit: 3 percent
Landform: Mountains, hills
Landform position (two-dimensional): Backslope, summit, shoulder
Landform position (three-dimensional): Mountainbase, mountainflank, interfluve, nose slope, side slope
Microfeatures of landform position: Rises, rises
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Data Source Information

Soil Survey Area: Berkshire County, Massachusetts
Survey Area Data: Version 15, Jun 9, 2020