

## ALTON ENGINEERING

Hydrology - Water Resources – Environmental - Site Design & Permitting - Wetland Sciences

### Alton Day Stone, PE, LSP, ASE

Registered Professional Engineer, Licensed Site Professional, Approved Soil Evaluator, Wetland Scientist  
10 Rugg Road, Sterling, MA 01564  
Office: 978.660.7728 Email: altonengineering@gmail.com

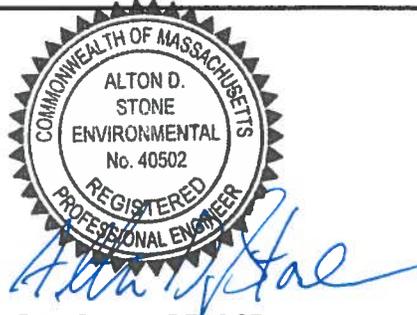
## REDEVELOPED PARKING LOT – NEW BUILDING 141 SOUTHWEST CUTOFF, WORCESTER, MASSACHUSETTS

May 16, 2020

### REDEVELOPMENT CHECKLIST [Volume 2, Chapter 3 Massachusetts Stormwater Handbook]

Prepared By  
Alton Engineering

Prepared For  
D.J. & Associates



Alton Day Stone, PE, ASE

05-16-2020

**Standard 7:** The proposed project is fully compliant with Standard 7 rather than “as much as practical”. With one minor exception Redevelopment Qpeak rates are less than or equal to the Existing Qpeak rates. Near 100% of the runoff generated under Redevelopment conditions is recharged.

Under Redevelopment conditions 82% TSS removal is achieved for Watershed A that generates 64% ± of the total runoff.

#### **Existing Conditions**

**On-Site:** The Site has a total area of 105,380 sf and was subdivided into three watersheds – Catchments A, B, & C. Stormwater runoff peak flow rates (Qpeak) were calculated for each watershed under Existing (Pre-Redevelopment) and Proposed (Post-Redevelopment) Conditions. Watersheds and surface cover details are depicted on the attached Watershed Plans.

**Watershed A.** Watershed A includes 52,039 sf of impervious paved parking and the existing building (CN 98), and 11,029 sf of grassed areas (CN 39). Runoff is not managed and flows off-site to the north. All most all of the Proposed redevelopment will occur in Watershed A.

**Watershed B.** Watershed B includes 26,090 sf of impervious paved parking and the existing building (CN 98), and 780 sf of grassed areas (CN 39). Runoff flows to a catch basin and a series of recharge pits for infiltration. Alteration of Watershed B is not proposed. Existing and Proposed Conditions will remain the same.

**Watershed C.** Watershed C includes 15,172 sf of brush-covered ground (CN 49) in poor condition situated along the edge of, and down a portion of, a steep bank on the east side of the Site. Runoff flows to the down the bank to the east to a depression and pool formed between a second step bank on the adjacent property where much of the runoff collects. Approximately 10,000 sf of Watershed C will be altered and transferred into Watershed A.

**Higher Potential Pollutant Loads:** The Site is commercial and all work is conducted within buildings. Raw materials or finished products are not stored or staged outside of the buildings. The are not any sources of high pollution loads.

**Watershed:** Not Applicable. The Site is not located in a watershed that has a hydraulic connection to watershed stream system. The wetlands along the east side of the Site are a self-contained system as shown on the attached Figure 2A from the MassGIS Oliver Website.

**The Project:** The project is a Redevelopment Project – i.e. “Expansion facilities on developed property”. A new building and BMP system are to be installed on an existing developed commercial property. The new building will be situated within an existing paved parking area. Under Proposed Conditions the impervious area will be increased by 6,114 sf = 5.8% of total Site area.

### ***The Stormwater Management Standards***

**Standard 1 (Untreated Discharges):** Not Applicable. Under Existing and Proposed Conditions there are not any outfalls. Under Proposed Conditions almost all stormwater is captured by the BMP Systems and recharged to groundwater.

**Standard 2 (Peak Rate Control and Flood Prevention):** Under proposed Conditions Standard 2 is met. Post Development Q<sub>peak</sub> rates are less than under Existing Conditions (see Project Drainage Report).

### **Improvement of Existing Conditions:**

- **Stormwater Reduction:** The Project will reduce both runoff rates and volumes to less than current estimated conditions (see Project Drainage Report).

- **Watershed & Project Location:** Not Applicable. The Site is not located in a watershed that has a hydraulic connection to watershed stream system. The wetlands along the east side of the Site are a self-contained system as shown on the attached Figure 2A from the MassGIS Oliver Website.
- **Adverse Flooding Impacts:** Not Applicable for 2-, 10-, 25- and 100-Year Design Storms (see above¶). A Flood Map is attached.
- **Qpeak Discharge Rates – 100-Year Design Storm:** The Proposed BMP system will attenuate Qpeak rates for the 100-Year Storm to less current estimated conditions (see Project Drainage Report).

**Standard 3 (Recharge to Ground Water):**

- Redevelopment design meets Standard 3. Stormwater derived from Sub-watersheds A and B = 95± % of total site runoff is recharged to groundwater (see Project Drainage Report).
- Under Proposed Conditions recharge to groundwater is significantly increased over that of Existing Conditions. Under Existing Conditions only runoff from Watershed B is recharged. Under Proposed Conditions runoff from both Watershed A (the major watershed) and Watershed B will be recharged to groundwater.
- Methods for reducing runoff were evaluated and recharge to groundwater via infiltration was selected as the most viable method due to the high vertical hydraulic conductivity (infiltration rate) for the sand & gravel soil in which the Recharged Trench is located.

**Standard 4 (80% TSS Removal):** The BMP system removes 82% of TSS (see attached Calculation Spreadsheet).

- a. Suitable practices for source control and pollution prevention are described in the long term pollution prevention plan.
- b. Stormwater BMPs are sized to capture the required water quality volume in that 95±% of total site runoff is treated and recharged to groundwater.
- c. Pretreatment is provided in accordance with the Stormwater Handbook. Treatment BMP include sweeping, deep sump catch basins, and Cultec 330 Stormfilter water quality units.

**Standard 5 (Higher Potential Pollutant Loads HPPL):** Not Applicable. The Site is commercial, not manufacturing, and all work is conducted within buildings. Raw materials or finished products are not stored or staged outside of the buildings. There are not any sources of high pollution loads.

**Standard 6 (Critical Areas):** Not Applicable. See attached Figure 3 from MassGIS Oliver Website.

**Standard 8 (Erosion, Sediment Control):** A construction period erosion, sedimentation and pollution prevention plan has been submitted.

**Standard 9 (Operation & Maintenance):** A long term Operation & Maintenance Plan has been submitted.

**Standard 10 (Illicit Discharges):** Illicit discharges – e.g. floor drains, industrial, sanitary or industrial waste water – will not be incorporated into the Redevelopment Project, are not present under current conditions. The property is serviced by the Municipal Water & Sewer Systems. Therefore an illicit discharge is very unlikely. Scheduled inspections will note any concerns and a plan prepared for necessary remediation.

***Attachments:***

NRCS Soils Map.

Figure 1 USGS Site Location Map.

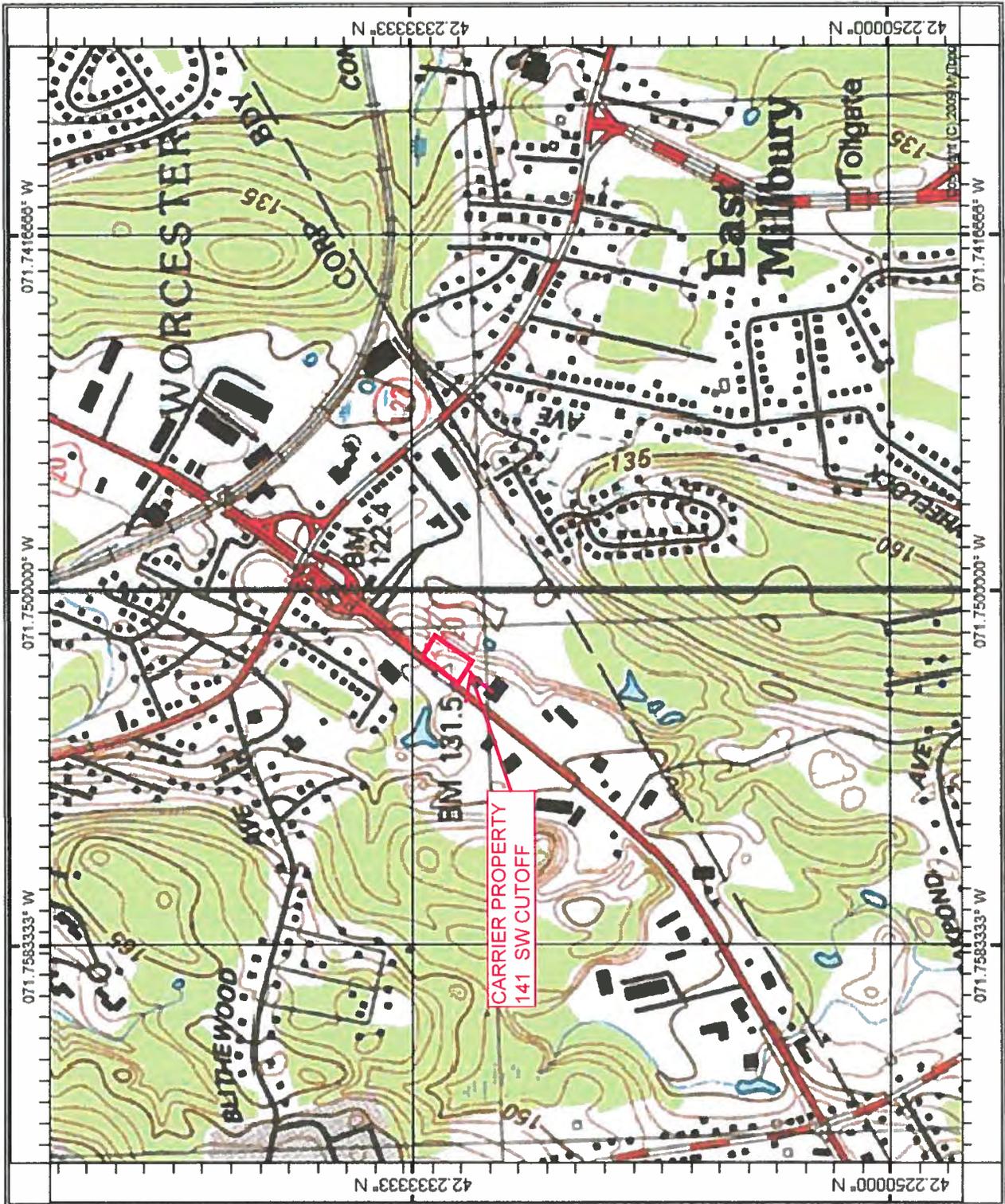
Figure 2A MassGIS Oliver Website – Wetland Overview.

Figure 3 MassGIS Oliver Website – DEP Water Supply and Critical Area Data.

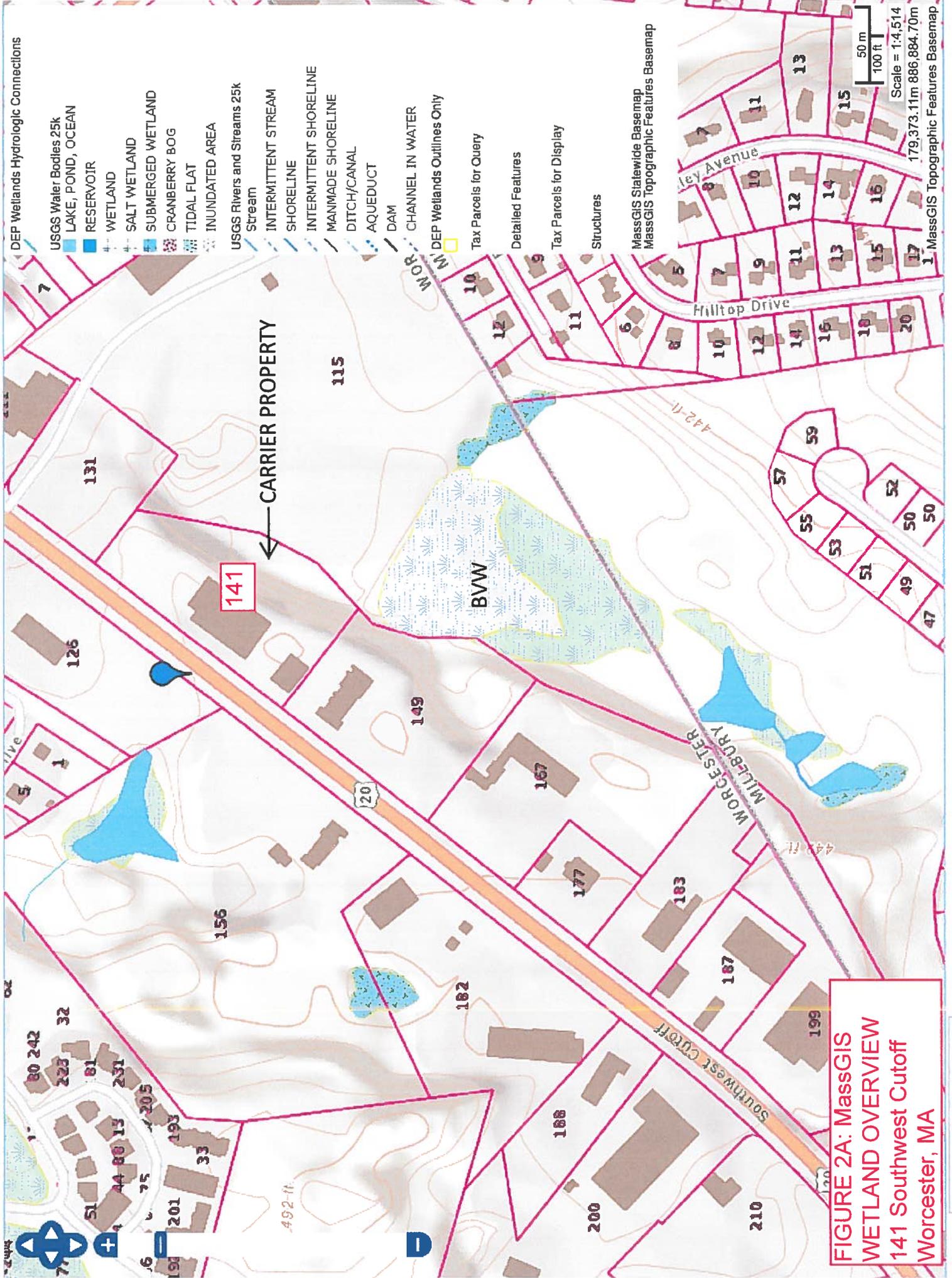
TSS Removal Calculations.

Flood Map

Watershed Plans



**FIGURE 1: PROPERTY LOCATION MAP**  
**CARRIER PROPERTY**  
**141 SOUTHWEST CUTOFF, WORCESTER, MA**



**FIGURE 2A: MassGIS WETLAND OVERVIEW**  
**141 Southwest Cutoff**  
**Worcester, MA**





## MAP LEGEND

 Area of Interest (AOI)	 Spoil Area
 Soils	 Stony Spot
 Soil Map Unit Polygons	 Very Stony Spot
 Soil Map Unit Lines	 Wet Spot
 Soil Map Unit Points	 Other
 Special Point Features	 Special Line Features
 Blowout	 Water Features
 Borrow Pit	 Streams and Canals
 Clay Spot	 Transportation
 Closed Depression	 Rails
 Gravel Pit	 Interstate Highways
 Gravelly Spot	 US Routes
 Landfill	 Major Roads
 Lava Flow	 Local Roads
 Marsh or swamp	 Background
 Mine or Quarry	 Aerial Photography
 Miscellaneous Water	
 Perennial Water	
 Rock Outcrop	
 Saline Spot	
 Sandy Spot	
 Severely Eroded Spot	
 Sinkhole	
 Slide or Slip	
 Sodic Spot	

## MAP INFORMATION

The soil surveys that comprise your AOI were mapped at scales ranging from 1:20,000 to 1:25,000.

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

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

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

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

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

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

Soil Survey Area: Worcester County, Massachusetts, Northeastern Part

Survey Area Data: Version 14, Sep 13, 2019

Soil Survey Area: Worcester County, Massachusetts, Southern Part

Survey Area Data: Version 12, Sep 12, 2019

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

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

Date(s) aerial images were photographed: Sep 12, 2014—Sep 28, 2014

### Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
52A	Freetown muck, 0 to 1 percent slopes	1.9	0.5%
71A	Ridgebury fine sandy loam, 0 to 3 percent slopes, extremely stony	0.0	0.0%
71B	Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony	18.0	4.8%
102C	Chatfield-Hollis-Rock outcrop complex, 0 to 15 percent slopes	65.8	17.3%
245B	Hinckley loamy sand, 3 to 8 percent slopes	26.8	7.1%
245C	Hinckley loamy sand, 8 to 15 percent slopes	3.0	0.8%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	15.0	4.0%
260A	Sudbury fine sandy loam, 0 to 3 percent slopes	3.4	0.9%
260B	Sudbury fine sandy loam, 3 to 8 percent slopes	2.9	0.8%
305B	Paxton fine sandy loam, 3 to 8 percent slopes	4.5	1.2%
307B	Paxton fine sandy loam, 0 to 8 percent slopes, extremely stony	13.1	3.5%
307C	Paxton fine sandy loam, 8 to 15 percent slopes, extremely stony	3.9	1.0%
312B	Woodbridge fine sandy loam, 0 to 8 percent slopes, extremely stony	11.3	3.0%
421B	Canton fine sandy loam, 0 to 8 percent slopes, very stony	17.5	4.6%
422B	Canton fine sandy loam, 0 to 8 percent slopes, extremely stony	3.7	1.0%
422C	Canton fine sandy loam, 8 to 15 percent slopes, extremely stony	19.9	5.2%
651	Udorthentis, smoothed	89.1	23.5%
<b>Subtotals for Soil Survey Area</b>		<b>299.8</b>	<b>79.0%</b>
<b>Totals for Area of Interest</b>		<b>379.6</b>	<b>100.0%</b>

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
245B	Hinckley loamy sand, 3 to 8 percent slopes	2.0	0.5%
254A	Merrimac fine sandy loam, 0 to 3 percent slopes	14.5	3.8%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	26.4	7.0%
260A	Sudbury fine sandy loam, 0 to 3 percent slopes	1.8	0.5%
420B	Canton fine sandy loam, 3 to 8 percent slopes	13.5	3.5%
422B	Canton fine sandy loam, 0 to 8 percent slopes, extremely stony	7.8	2.1%
422C	Canton fine sandy loam, 8 to 15 percent slopes, extremely stony	8.7	2.3%
651	Udorthents, smoothed	5.0	1.3%
<b>Subtotals for Soil Survey Area</b>		<b>79.8</b>	<b>21.0%</b>
<b>Totals for Area of Interest</b>		<b>379.6</b>	<b>100.0%</b>

# National Flood Hazard Layer FIRMette



42°14'11.21"N

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

## Legend

**SPECIAL FLOOD HAZARD AREAS**

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

**OTHER AREAS OF FLOOD HAZARD**

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

**OTHER AREAS**

- Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone I*

**GENERAL STRUCTURES**

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

**OTHER FEATURES**

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

**MAP PANELS**

- Digital Data Available
- No Digital Data Available
- Unmapped

**OTHER MAP PANELS**

- Digital Data Available
- No Digital Data Available
- Unmapped

**GENERAL NOTES**

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

**DISCLAIMER**

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

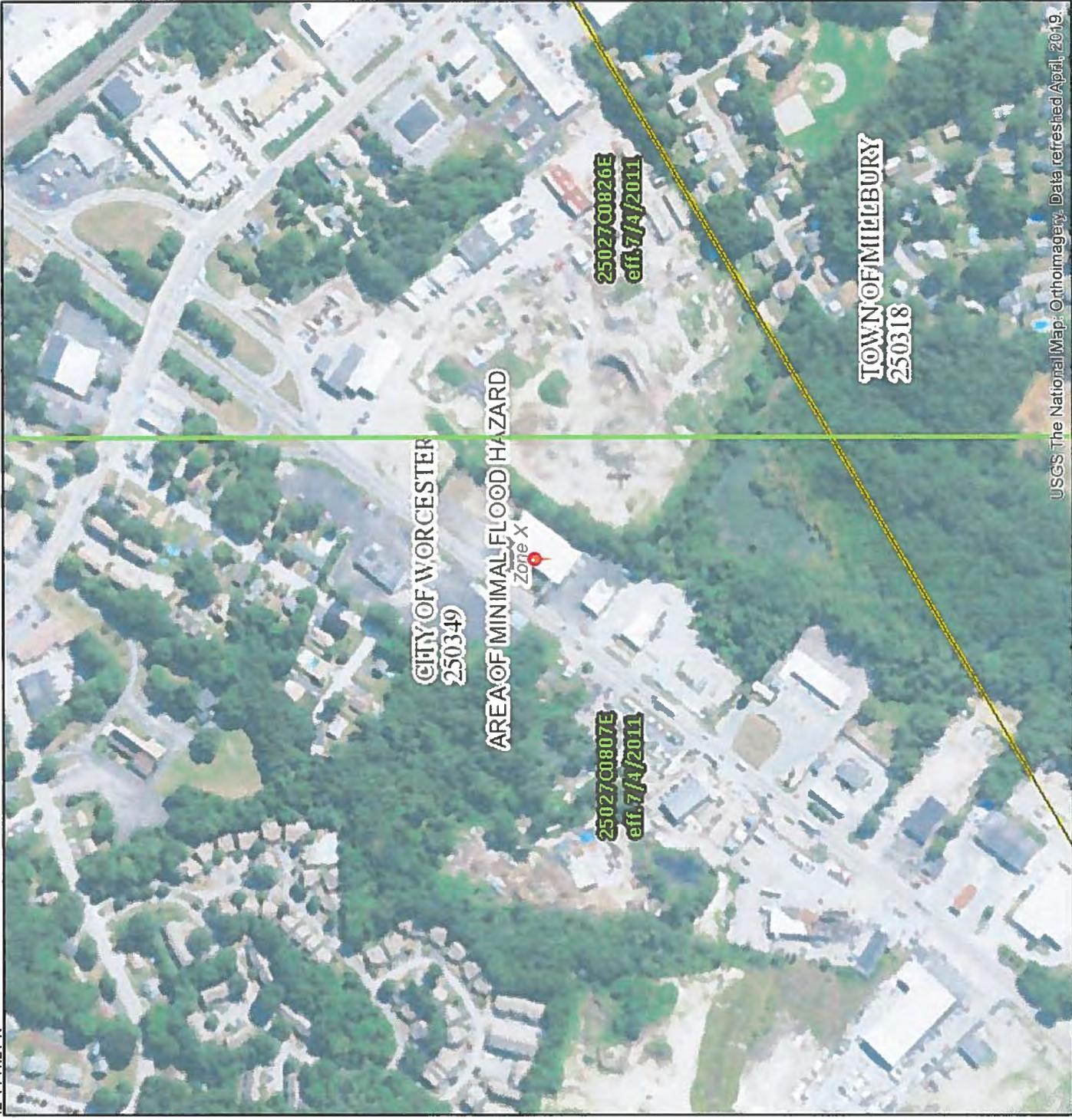
The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on **12/31/2019 at 10:48:22 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

**COORDINATES**

71°44'45.34"W

42°13'44.57"N



USGS The National Map: Orthoimagery. Data refreshed April, 2019.



**ALTON ENGINEERING**

Hydrology - Water Resources - Environmental - Site Design & Permitting - Wetland Sciences  
 10 Rugg Road, Sterling, MA 01564  
 Office: 978.660.7728 Email: altonengineering@gmail.com

**F. Carrier Realty LLC Commercial Property  
 141 Southwest Cutoff, Worcester, MA**

**Rev. 05-12-20**

**TOTAL SUSPENDED SOLIDS REMOVAL RATE**

B BMP	C TSS REMOVAL RATE %/100	D STARTING TSS LOAD %/100	E AMOUNT REMOVED %/100	F REMAINING LOAD %/100
Parking Lot Sweeping	0.1	1.00	0.10	0.90
Deep Sump Catchbasin	0.25	0.90	0.25	0.65
Cultec 330 WQU*	0.73	0.65	0.47	0.18

**Removal Rate = 0.10 + 0.25 + 0.47 = 82%**

Cultec specifications indicate the 330 can remove > 70% of TSS.

From the Cultec 330 WQU water will be conveyed to a distribution box and thence to a crushed stone subsurface recharge field that will remove additional TSS prior to infiltration into the soil.

## ALTON ENGINEERING

Hydrologic - Water Resources – Environmental – Site Design & Permitting – Wetland Sciences

### Alton Day Stone, PE, LSP, ASE

Registered Professional Engineer, Licensed Site Professional, Approved Soil Evaluator  
10 Rugg Road, Sterling, MA 01564  
Phone: 978.660.7728 Email: altonengineering@gmail.com

May 16, 2020

AE Project No: SADOWSKI-CARRIER0001

Mr. David Sadowski  
D.J. and Associates  
7 Cedar Street 01510  
Clinton, MA, MA

**RE: Revised Drainage Report – Redeveloped Parking Lot & New Building Addition  
141 Southwest Cutoff, Worcester, MA**

Dear Mr. Sadowski:

This report presents a Revised Drainage Report for the proposed redevelopment of a 55,460 sf portion of the 141 Southwest Cutoff (Carrier) property (the Site). Improvements include: (1) removal of the existing bituminous paved parking lot, (2) construction of a new building addition, (3) installation of a new bituminous pavement parking lot and access road, (4) concrete pads for AC units, and (5) a stormwater management system.

Under existing conditions there is limited stormwater management on the Site. Some runoff from the south section flows to a catch basin in the parking lot and series of leaching pits. Otherwise, the majority of runoff flows off-site to the north, with lesser flow off-site to the east.

Under the Proposed Conditions stormwater management system runoff from the new existing and new building roofs and portions of the paved areas on the east and west sides of the buildings parking will flow to two 4'-deep sump Catch Basins and discharge from the basins into two Cultec Model 330 water quality units. From the WQU water will be conveyed to two H2O custom designed Distribution Boxes and thence via three outlet pipes to a pipe & stone Recharge Trench for infiltration of runoff. The proposed new system is designed to fully infiltrate runoff derived from the 2-, 10-, 25-, & 100-Year Design Storms.

- Total Site Area: 105,380 sf
- Area of Redevelopment: 55,460 sf
- Total Impervious Areas: Existing Conditions = 74,496 sf. Proposed Conditions = 80,640 sf.
- Net change = 6,114 sf increase in impervious surfaces under Proposed Conditions = 5.8%.

## MODEL HYDROLOGY & SOIL CONDITIONS

Stormwater runoff peak flow rates ( $Q_{peak}$ ) were calculated using HydroCAD computer modeling. Model input is summarized below.

- Rainfall: Precipitation data for the 2-, 10-, 25-, 50- and 100-Year Design Storms for Worcester County North were input from the HydroCAD Lookup Table: 2-Year = 3.13", 10-Year = 4.68", 25-Year = 5.88", 50-Year = 7.00", 100-Year = 8.34".
- Soil: Hydrologic Soil Group A (sand & gravel), based on soil observed in three test pits excavated in the area of the proposed recharge field and NRCS soil data (Map attached).
- Time of concentration: 5 minutes.
- Infiltration Rate: Three percolation tests were conducted on the Site in the area of a proposed Recharge Trench. Perc-rates of 3 minutes per inch were observed for each test. A recharge rate of 20 in/hour (velocity) was used in the model.

## WATERSHEDS - EXISTING CONDITIONS

The Site has a total area of 105,380 sf and was subdivided into three watersheds – Catchments A, B, & C. Stormwater runoff peak flow rates ( $Q_{peak}$ ) were calculated for each watershed under Existing (Pre-Redevelopment) and Proposed (Post-Redevelopment) Conditions. Watersheds and surface cover details are depicted on the attached Watershed Plans.

**Watershed A.** Watershed A includes 52,039 sf of impervious paved parking and the existing building (CN 98), and 11,029 sf of grassed areas (CN 39). Runoff is not managed and flows off-site to the north. All most all of the Proposed redevelopment will occur in Watershed A.

**Watershed B.** Watershed B includes 26,090 sf of impervious paved parking and the existing building (CN 98), and 780 sf of grassed areas (CN 39). Runoff flows to a catch basin and a series of recharge pits for infiltration. Alteration of Watershed B is not proposed. Existing and Proposed Conditions will remain the same.

**Watershed C.** Watershed C includes 15,172 sf of brush-covered ground (CN 49) in poor condition situated along the edge of, and down a portion of, a steep bank on the east side of the Site. Runoff flows to the down the bank to the east to a depression and pool formed between a second step bank on the adjacent property where much of the runoff collects. Approximately 10,000 sf of Watershed C will be altered and transferred into Watershed A.

## WATERSHEDS – PROPOSED CONDITIONS

### **Stormwater Management System Components.**

A Best Management Practices (BMP) Stormwater management system is proposed only for Watershed A. Watershed B will continue to flow to the existing catch basin and infiltration pits. Watershed C is reduced in size and runoff will continue to sheet flow to the eastward.

The BMP stormwater system for Washed A (three sub-watersheds) includes the following components:

- Two deep sump Catch Basins.
- Two Cultec Stormfilter 330 Water Quality Units.
- Two custom Distribution Boxes that convey water to the three laterals running the length of the Recharge Trench.
- Recharge Trench – essentially a large rectangular pipe and stone leachfield. Trench dimensions are: Length = 110 ft, Width = 30 ft., Depth = 7 ft. Three 12-in. diameter perforated ADS laterals extend the length of the Trench. The Trench is filled with stone providing 40% open (pore) space and with 8,400 cf of storage.
- An overflow discharge pipe from the Trench is not included and is not necessary. As describe below, the Trench is capable of retaining the entire runoff from the 100-Year Design Storm and has additional storage volume. In addition, in the event of an even greater storm runoff can back up through the Distribution Boxes and two Catch Basins and pool or flow laterally off the Site. The Stormwater Management System previously submitted included an overflow pipe. In this revised BMP System the size of the Trench was increased so as to able to manage the entire 100-Year Storm.

**Watershed A.** Watershed A is subdivided into three Sub-watersheds –A1.1, A1.2 and A2.

- Total Area = 69,724 sf. Impervious = 67,645 sf.
- Sub-watershed A1.1 – East Side. Includes 26,480 sf of impervious paved parking (CN 98) and 12,186 sf grassed area (CN 39). The BMP train includes a deep sump Catch Basin (CB-A1) > Cultec 330 StormFilter (water quality unit A1) > custom Distribution Box (DB A1) having three outlet lines > Recharge Trench laterals. Water from DB A1 is conveyed to the east end of the Recharge Trench.
- Sub-watershed A1.2 – Roofs. Includes roof drainage from the existing & proposed buildings; 17,750 sf of impervious roofs (CN 98). Water from Roof Drain Laterals is collected by a 12-inch Ø Mainline (Reach A1.2) and conveyed to Distribution Box 1.
- Sub-watershed A2 – West Side. Includes 11,297sf of impervious paved parking (CN 98). The BMP train includes a deep sump Catch Basin (CB-A2) > Cultec 330 StormFilter (water quality unit A2) > custom Distribution Box (DB A2) having three outlet lines > Recharge Trench laterals. Water from DB A2 is conveyed to the west end of the Recharge Trench.

**Watershed B.** Watershed B is the same as for Existing Conditions. No alterations are proposed.

**Watershed C.** Total Area = 10,239 sf. Includes 9,113 sf of brush-covered ground in poor condition (CN 49) and 1,216 sf of impervious surface (CN 98) – pavement and concrete pads for mechanical units. The watershed is situated along the edge of a steep bank on the east side of the Site. Runoff sheet flows down the bank to the east.

## TSS REMOVAL

Total Suspended Solids removal calculations are presented on the attached spreadsheet. The BMP Treatment Train for Proposed Conditions Watershed A will removal 82% of TSS before discharge to the Recharge Trench.

## RUNOFF CALCULATIONS (MODEL) RESULTS

Model results indicate the Recharge Trench is capable of containing and infiltrating runoff from the 2-, 10-, 25-, and 100-Year Storm Design Storms. Existing and Proposed Conditions Qpeak rates are tabulated below.

### Runoff Qpeak Rates (cfs)

Design Storm	<u>2-Year</u>	<u>10-Year</u>	<u>25-Year</u>	<u>100-Year</u>
<u>Watershed A</u>				
Existing	3.9	5.25	6.62	10.32
Proposed*	0 [3.11]	0 [5.28]	0 [7.01]	0 [10.59]
<u>Watershed B**</u>				
Existing	1.67	2.56	3.25	4.64
Proposed	1.67	2.56	3.25	4.64
<u>Watershed C</u>				
Existing	0	0.09	0.33	0.81
Proposed	0.01	0.16	0.33	0.75
<b>Total Qpeak Runoff to Off-Site</b>				
<u>Existing</u>	3.9	5.34	6.95	11.13
<u>Proposed</u>	0.01	0.16	0.33	0.75

### Key Comments & Conclusions

- \* The “0” value indicates that the Recharge Trench is capable of storing and infiltrating all runoff such that none flows off-site. The [parentheses] value – e.g. 10.59 – is the Qpeak generated by the storm that flows to the Trench.
- The top of the Trench stone bed = El 415. The peak storage elevation for the 100-Year Storm = El 414.36. The total Trench Storage Volume is 9,240 cf. The 100-Year Storm results in 8,400 cf of storage and an Infiltration Rate of 1.56 cfs.
- \*\* Under Existing and Proposed Conditions runoff from Watershed B is recharged on-site via the existing catch basin and leaching pits. No alteration is proposed.

- Watershed A – Qpeak Proposed rates are less than Qpeak Existing rates for all storms.
- Watershed B – Qpeak Proposed rates are equal to Qpeak Existing rates for all storms, with all runoff being infiltrated on-site.
- Watershed C – Qpeak Proposed rates slightly exceed the Qpeak Existing rates for the 2- and 10-Year Storms. Qpeak Existing & Proposed rates are equal for the 25-Year Storm, and the Qpeak Proposed rate is less than Qpeak Existing rate for the 100-Year Storm. The slight Qpeak increases for the 2-Year Storm (0.01 cfs) and 10-Year Storm (0.05 cfs) are considered insignificant and within the margin or error for the program.
- Total off-site stormwater runoff under Proposed Conditions is significantly less than under Existing Conditions.
- With the exception of Proposed Watershed C there is a complete recharge and infiltration of all runoff from each of the Design Storm events.
- No off-site runoff will occur from the Recharge Trench provided it is constructed as designed.

Yours truly,

**ALTON ENGINEERING**



Alton Day Stone, PE, ASE  
Principal Engineer

Attachments:

HydroCAD Report  
NRCS Soils Map  
TSS Removal Spreadsheet  
USGS Site Location Map

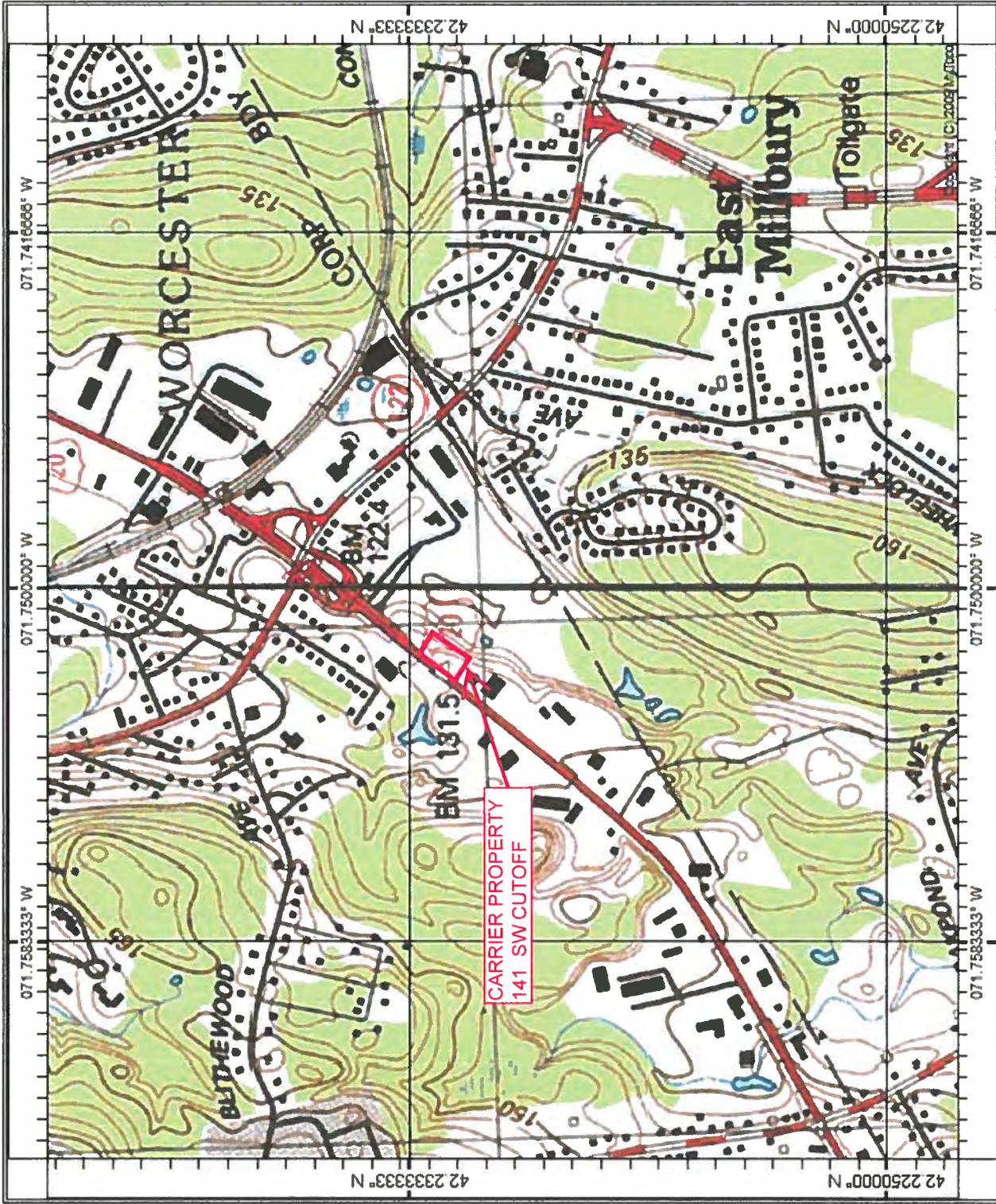


FIGURE 1: PROPERTY LOCATION MAP  
CARRIER PROPERTY  
141 SOUTHWEST CUTOFF, WORCESTER, MA



## MAP LEGEND

 Area of Interest (AOI)	 Spoil Area
 Soils	 Stony Spot
 Soil Map Unit Polygons	 Very Stony Spot
 Soil Map Unit Lines	 Wet Spot
 Soil Map Unit Points	 Other
 Special Point Features	 Special Line Features
 Blowout	 Streams and Canals
 Borrow Pit	 Transportation
 Clay Spot	 Rails
 Closed Depression	 Interstate Highways
 Gravel Pit	 US Routes
 Gravelly Spot	 Major Roads
 Landfill	 Local Roads
 Lava Flow	 Background
 Marsh or swamp	 Aerial Photography
 Mine or Quarry	
 Miscellaneous Water	
 Perennial Water	
 Rock Outcrop	
 Saline Spot	
 Sandy Spot	
 Severely Eroded Spot	
 Sinkhole	
 Slide or Slip	
 Sodic Spot	

## MAP INFORMATION

The soil surveys that comprise your AOI were mapped at scales ranging from 1:20,000 to 1:25,000.

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

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

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

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

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

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

Soil Survey Area: Worcester County, Massachusetts, Northeastern Part  
Survey Area Data: Version 14, Sep 13, 2019

Soil Survey Area: Worcester County, Massachusetts, Southern Part  
Survey Area Data: Version 12, Sep 12, 2019

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

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

Date(s) aerial images were photographed: Sep 12, 2014—Sep 28, 2014

## Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
52A	Freelown muck, 0 to 1 percent slopes	1.9	0.5%
71A	Ridgebury fine sandy loam, 0 to 3 percent slopes, extremely stony	0.0	0.0%
71B	Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony	18.0	4.8%
102C	Chatfield-Hollis-Rock outcrop complex, 0 to 15 percent slopes	65.8	17.3%
245B	Hinckley loamy sand, 3 to 8 percent slopes	26.8	7.1%
245C	Hinckley loamy sand, 8 to 15 percent slopes	3.0	0.8%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	15.0	4.0%
260A	Sudbury fine sandy loam, 0 to 3 percent slopes	3.4	0.9%
260B	Sudbury fine sandy loam, 3 to 8 percent slopes	2.9	0.8%
305B	Paxton fine sandy loam, 3 to 8 percent slopes	4.5	1.2%
307B	Paxton fine sandy loam, 0 to 8 percent slopes, extremely stony	13.1	3.5%
307C	Paxton fine sandy loam, 8 to 15 percent slopes, extremely stony	3.9	1.0%
312B	Woodbridge fine sandy loam, 0 to 8 percent slopes, extremely stony	11.3	3.0%
421B	Canton fine sandy loam, 0 to 8 percent slopes, very stony	17.5	4.6%
422B	Canton fine sandy loam, 0 to 8 percent slopes, extremely stony	3.7	1.0%
422C	Canton fine sandy loam, 8 to 15 percent slopes, extremely stony	19.9	5.2%
651	Udorthentic, smoothed	89.1	23.5%
<b>Subtotals for Soil Survey Area</b>		<b>299.8</b>	<b>79.0%</b>
<b>Totals for Area of Interest</b>		<b>379.6</b>	<b>100.0%</b>

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
245B	Hinckley loamy sand, 3 to 8 percent slopes	2.0	0.5%
254A	Merrimac fine sandy loam, 0 to 3 percent slopes	14.5	3.8%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	26.4	7.0%
260A	Sudbury fine sandy loam, 0 to 3 percent slopes	1.8	0.5%
420B	Canton fine sandy loam, 3 to 8 percent slopes	13.5	3.5%
422B	Canton fine sandy loam, 0 to 8 percent slopes, extremely stony	7.8	2.1%
422C	Canton fine sandy loam, 8 to 15 percent slopes, extremely stony	8.7	2.3%
651	Udorthents, smoothed	5.0	1.3%
<b>Subtotals for Soil Survey Area</b>		<b>79.8</b>	<b>21.0%</b>
<b>Totals for Area of Interest</b>		<b>379.6</b>	<b>100.0%</b>

**ALTON ENGINEERING**

Hydrology - Water Resources - Environmental - Site Design & Permitting - Wetland Sciences  
 10 Rugg Road, Sterling, MA 01564  
 Office: 978.660.7728 Email: altonengineering@gmail.com

**F. Carrier Realty LLC Commercial Property  
 141 Southwest Cutoff, Worcester, MA**

**Rev. 05-12-20**

**TOTAL SUSPENDED SOLIDS REMOVAL RATE**

B BMP	C TSS REMOVAL RATE %/100	D STARTING TSS LOAD %/100	E AMOUNT REMOVED %/100	F REMAINING LOAD %/100
Parking Lot Sweeping	0.1	1.00	0.10	0.90
Deep Sump Catchbasin	0.25	0.90	0.25	0.65
Cultec 330 WQU*	0.73	0.65	0.47	0.18

**Removal Rate = 0.10 + 0.25 + 0.47 = 82%**

Cultec specifications indicate the 330 can remove > 70% of TSS.

From the Cultec 330 WQU water will be conveyed to a distribution box and thence to a crushed stone subsurface recharge field that will remove additional TSS prior to infiltration into the soil.

**ALTON ENGINEERING**

Hydrology - Water Resources - Environmental - Site Design & Permitting - Wetland Sciences  
 10 Rugg Road, Sterling, MA 01564  
 Office: 978.660.7728 Email: altonengineering@gmail.com

**F. Carrier Realty LLC Commercial Property  
 141 Southwest Cutoff, Worcester, MA**

**Rev. 05-12-20**

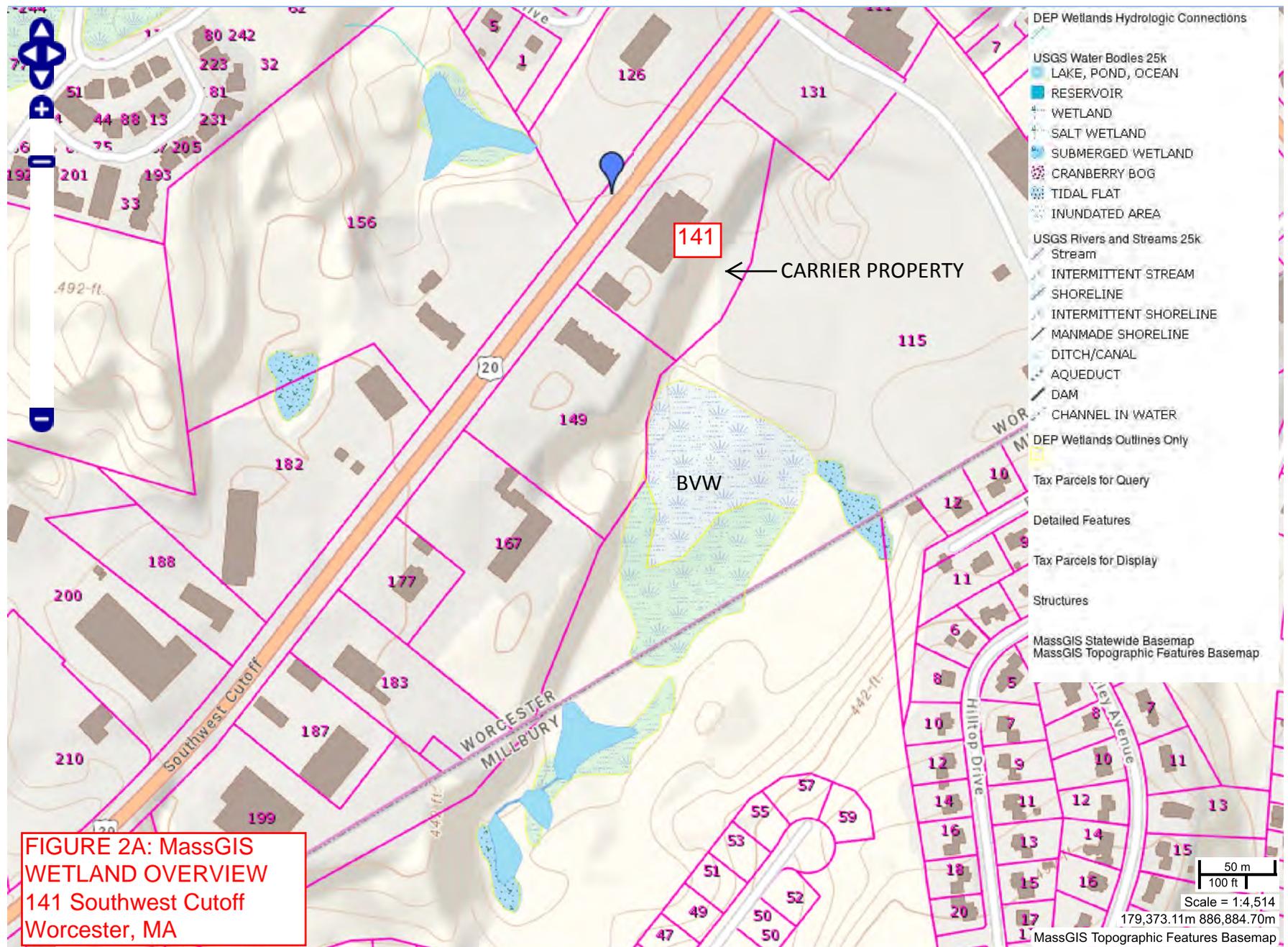
**TOTAL SUSPENDED SOLIDS REMOVAL RATE**

B BMP	C TSS REMOVAL RATE %/100	D STARTING TSS LOAD %/100	E AMOUNT REMOVED %/100	F REMAINING LOAD %/100
Parking Lot Sweeping	0.1	1.00	0.10	0.90
Deep Sump Catchbasin	0.25	0.90	0.25	0.65
Cultec 330 WQU*	0.73	0.65	0.47	0.18

**Removal Rate = 0.10 + 0.25 + 0.47 = 82%**

Cultec specifications indicate the 330 can remove > 70% of TSS.

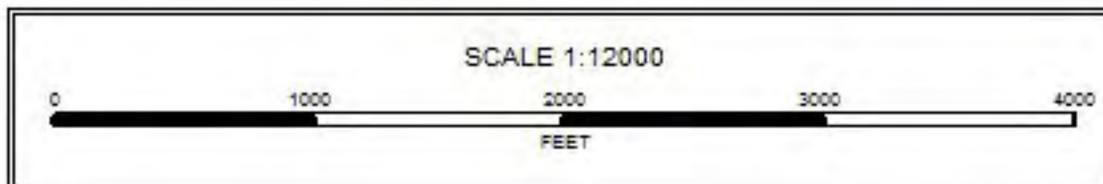
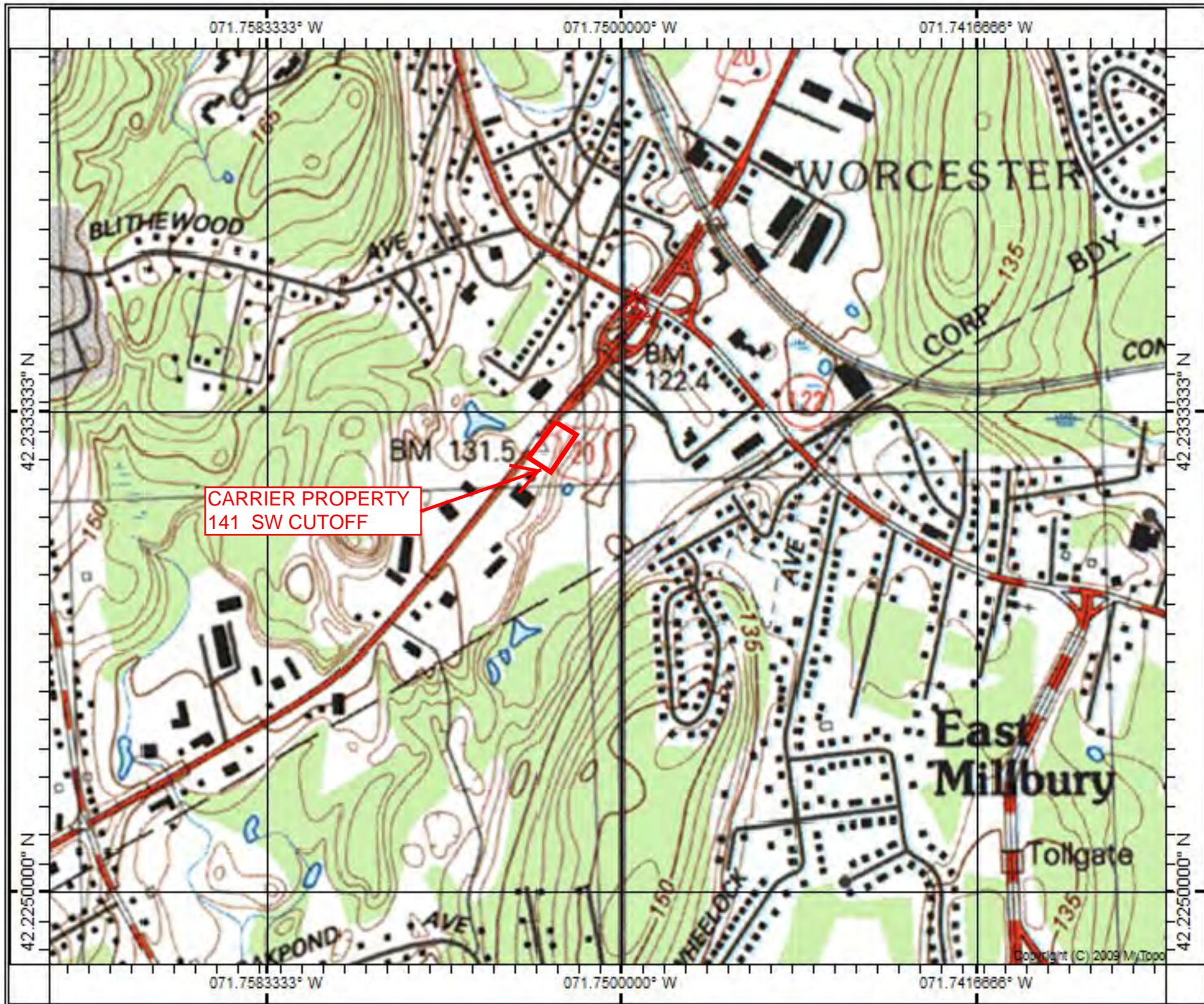
From the Cultec 330 WQU water will be conveyed to a distribution box and thence to a crushed stone subsurface recharge field that will remove additional TSS prior to infiltration into the soil.



**FIGURE 2A: MassGIS WETLAND OVERVIEW**  
**141 Southwest Cutoff**  
**Worcester, MA**

- DEP Wetlands Hydrologic Connections
- USGS Water Bodies 25k
  - LAKE, POND, OCEAN
  - RESERVOIR
- WETLAND
  - SALT WETLAND
  - SUBMERGED WETLAND
  - CRANBERRY BOG
  - TIDAL FLAT
  - INUNDATED AREA
- USGS Rivers and Streams 25k
  - Stream
  - INTERMITTENT STREAM
  - SHORELINE
  - INTERMITTENT SHORELINE
  - MANMADE SHORELINE
  - DITCH/CANAL
  - AQUEDUCT
  - DAM
  - CHANNEL IN WATER
- DEP Wetlands Outlines Only
- Tax Parcels for Query
- Detailed Features
- Tax Parcels for Display
- Structures
- MassGIS Statewide Basemap
- MassGIS Topographic Features Basemap

Scale = 1:4,514  
 179,373.11m 886,884.70m



**FIGURE 1: PROPERTY LOCATION MAP  
CARRIER PROPERTY  
141 SOUTHWEST CUTOFF, WORCESTER, MA**



## MAP LEGEND

### Area of Interest (AOI)

 Area of Interest (AOI)

### Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

### Special Point Features



Blowout



Borrow Pit



Clay Spot



Closed Depression



Gravel Pit



Gravelly Spot



Landfill



Lava Flow



Marsh or swamp



Mine or Quarry



Miscellaneous Water



Perennial Water



Rock Outcrop



Saline Spot



Sandy Spot



Severely Eroded Spot



Sinkhole



Slide or Slip



Sodic Spot



Spoil Area



Stony Spot



Very Stony Spot



Wet Spot



Other



Special Line Features

### Water Features



Streams and Canals

### Transportation



Rails



Interstate Highways



US Routes



Major Roads



Local Roads

### Background



Aerial Photography

## MAP INFORMATION

The soil surveys that comprise your AOI were mapped at scales ranging from 1:20,000 to 1:25,000.

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

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

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

Source of Map: Natural Resources Conservation Service

Web Soil Survey URL:

Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Worcester County, Massachusetts, Northeastern Part

Survey Area Data: Version 14, Sep 13, 2019

Soil Survey Area: Worcester County, Massachusetts, Southern Part

Survey Area Data: Version 12, Sep 12, 2019

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

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

Date(s) aerial images were photographed: Sep 12, 2014—Sep 28, 2014

## MAP LEGEND

## MAP INFORMATION

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

## Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
52A	Freetown muck, 0 to 1 percent slopes	1.9	0.5%
71A	Ridgebury fine sandy loam, 0 to 3 percent slopes, extremely stony	0.0	0.0%
71B	Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony	18.0	4.8%
102C	Chatfield-Hollis-Rock outcrop complex, 0 to 15 percent slopes	65.8	17.3%
245B	Hinckley loamy sand, 3 to 8 percent slopes	26.8	7.1%
245C	Hinckley loamy sand, 8 to 15 percent slopes	3.0	0.8%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	15.0	4.0%
260A	Sudbury fine sandy loam, 0 to 3 percent slopes	3.4	0.9%
260B	Sudbury fine sandy loam, 3 to 8 percent slopes	2.9	0.8%
305B	Paxton fine sandy loam, 3 to 8 percent slopes	4.5	1.2%
307B	Paxton fine sandy loam, 0 to 8 percent slopes, extremely stony	13.1	3.5%
307C	Paxton fine sandy loam, 8 to 15 percent slopes, extremely stony	3.9	1.0%
312B	Woodbridge fine sandy loam, 0 to 8 percent slopes, extremely stony	11.3	3.0%
421B	Canton fine sandy loam, 0 to 8 percent slopes, very stony	17.5	4.6%
422B	Canton fine sandy loam, 0 to 8 percent slopes, extremely stony	3.7	1.0%
422C	Canton fine sandy loam, 8 to 15 percent slopes, extremely stony	19.9	5.2%
651	Udorthents, smoothed	89.1	23.5%
<b>Subtotals for Soil Survey Area</b>		<b>299.8</b>	<b>79.0%</b>
<b>Totals for Area of Interest</b>		<b>379.6</b>	<b>100.0%</b>

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
245B	Hinckley loamy sand, 3 to 8 percent slopes	2.0	0.5%
254A	Merrimac fine sandy loam, 0 to 3 percent slopes	14.5	3.8%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	26.4	7.0%
260A	Sudbury fine sandy loam, 0 to 3 percent slopes	1.8	0.5%
420B	Canton fine sandy loam, 3 to 8 percent slopes	13.5	3.5%
422B	Canton fine sandy loam, 0 to 8 percent slopes, extremely stony	7.8	2.1%
422C	Canton fine sandy loam, 8 to 15 percent slopes, extremely stony	8.7	2.3%
651	Udorthents, smoothed	5.0	1.3%
<b>Subtotals for Soil Survey Area</b>		<b>79.8</b>	<b>21.0%</b>
<b>Totals for Area of Interest</b>		<b>379.6</b>	<b>100.0%</b>

**ALTON ENGINEERING**

Hydrology - Water Resources - Environmental - Site Design & Permitting - Wetland Sciences

10 Rugg Road, Sterling, MA 01564

Office: 978.660.7728 Email: altonengineering@gmail.com

**F. Carrier Realty LLC Commercial Property  
141 Southwest Cutoff, Worcester, MA**

**Rev. 05-12-20**

**TOTAL SUSPENDED SOLIDS REMOVAL RATE**

<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>	<b>F</b>
<b>BMP</b>	<b>TSS REMOVAL RATE</b>	<b>STARTING TSS LOAD</b>	<b>AMOUNT REMOVED</b>	<b>REMAINING LOAD</b>
	<b>% /100</b>	<b>% /100</b>	<b>% /100</b>	<b>% /100</b>
Parking Lot Sweeping	0.1	1.00	0.10	0.90
Deep Sump Catchbasin	0.25	0.90	0.25	0.65
Cultec 330 WQU*	0.73	0.65	0.47	0.18
	<b>Removal Rate = 0.10 + 0.25 + 0.47 = 82%</b>		0.82	

Cultec specifications indicate the 330 can remove > 70% of TSS.

From the Cultec 330 WQU water will be conveyed to a distribution box and thence to a crushed stone subsurface recharge field that will remove additional TSS prior to infiltration into the soil.

**Alton Day Stone, PE, LSP, ASE**

Professional Engineer, Licensed Site Professional, Approved Soil Evaluator, Wetland Scientist

**Hydrology - Water Resources – Environmental - Site Design & Permitting - Wetland Sciences**

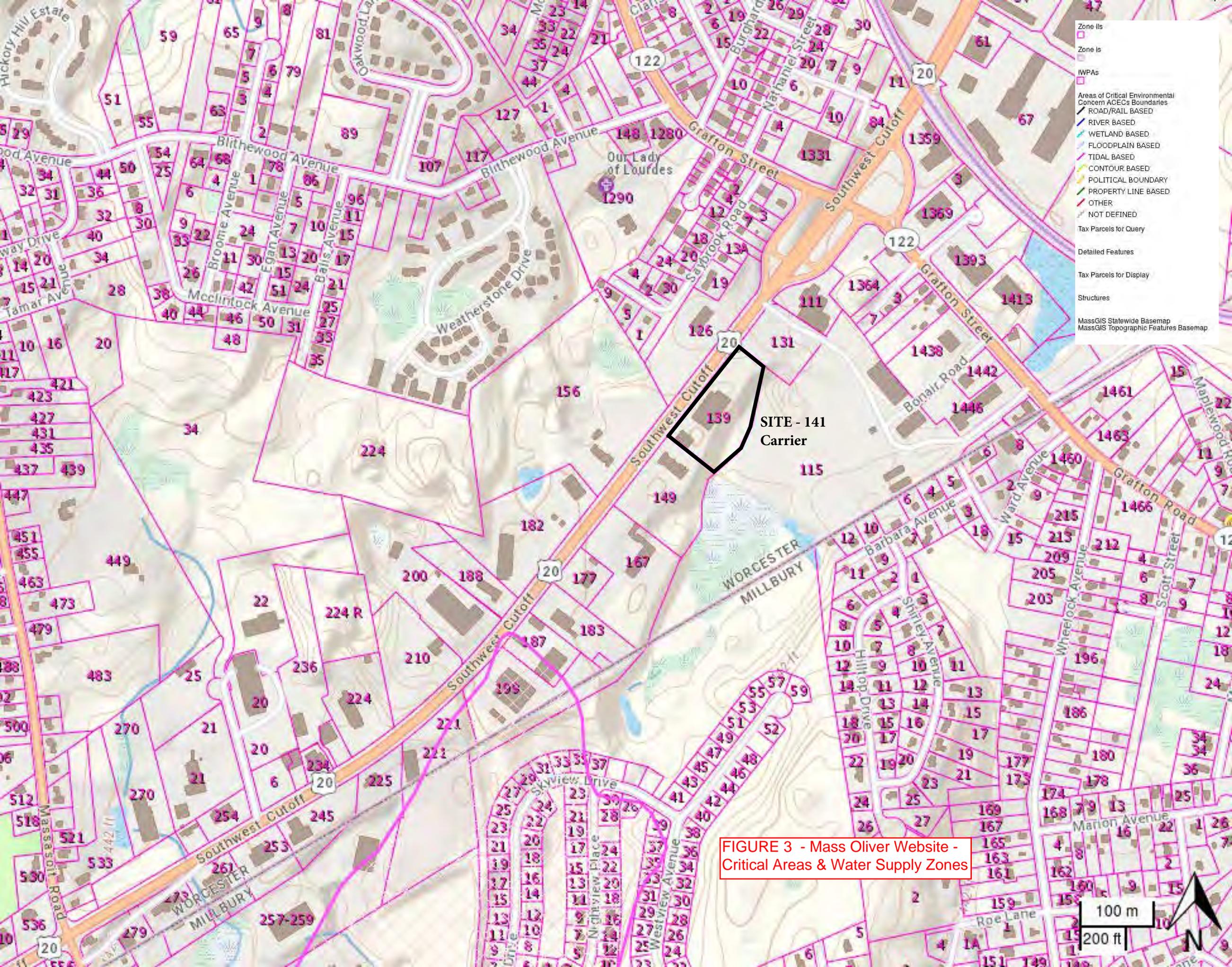
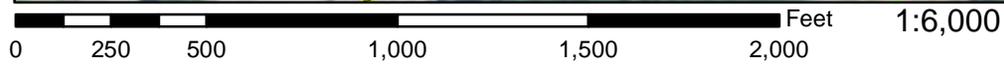
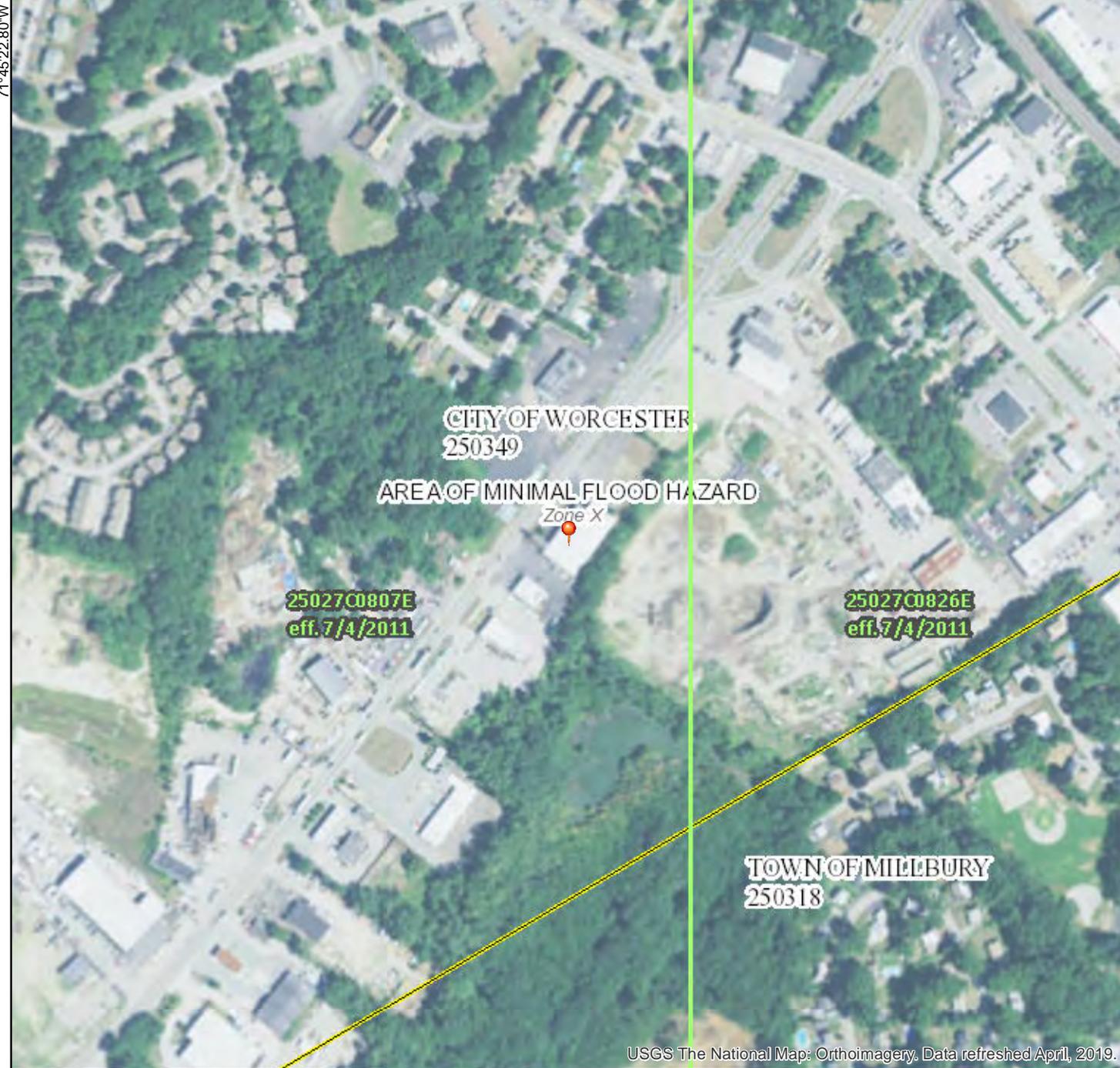


FIGURE 3 - Mass Oliver Website - Critical Areas & Water Supply Zones

# National Flood Hazard Layer FIRMette



42°14'11.21"N



42°13'44.57"N

## Legend

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

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

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

OTHER AREAS		Area of Minimal Flood Hazard Zone X
		Effective LOMRs
		Area of Undetermined Flood Hazard Zone D

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

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

MAP PANELS		Digital Data Available
		No Digital Data Available
		Unmapped

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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 12/31/2019 at 10:48:22 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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



71°44'34.34"W