Attachment 5:

Impaired Waters Assessments - Progress Reports

List of Impaired Waterbodies

Waterbody ID	Waterbody Name
MA32-05	Westfield River
MA34-19	Stony Brook
MA35026	Greenwood Pond
MA51073	Indian Lake
MA51-08	Unnamed Tributary
MA62-14	Robinson Brook
MA62-39	Rumford River
MA71-02	Mystic River
MA71-03	Mystic River
MA73-01	Neponset River
MA73-02	Neponset River

Impaired Waters Assessment for Westfield River (MA32-05) – Progress Report

Impaired Water Body

Name: Westfield River

Location: Russell and Westfield, MA

Water Body ID: MA32-05

Impairments

The Westfield River (MA32-05) is listed under Category 5, "Waters Requiring a TMDL", on MassDEP's final *Massachusetts Year 2008*, final *Massachusetts Year 2010* and proposed *Massachusetts Year 2012 Integrated List of Waters*. Table 1 below shows the impairments to the Westfield River included on each list.

Table 1. Impairments to Westfield River (MA32-05) Included on the Massachusetts Integrated List of Waters

Massachusetts Integrated List of Waters		
Final 2008 List	**Final 2010 List**	**Proposed 2012 List**
Cause unknown	Excess algal growth	Excess algal growth
Taste, odor and color	Taste and odor	Taste and odor
Noxious aquatic plants	Aquatic macroinvertebrate bioassessments	Aquatic macroinvertebrate bioassessments
Turbidity	Turbidity	Turbidity

According to MassDEP's *Westfield River Watershed 2001 Water Quality Assessment Report* (MassDEP, 2005) the *Aesthetics* and *Aquatic Life Uses* are assessed as support for the upper 16.8-mile reach of this segment of the Westfield River. The lower 1.0 mile reach of the river (downstream from the Westfield WWTP discharge) is assessed as impaired because of slight instream turbidity, presence of sewage fungus, excess algal growth, and sewage odor.

Relevant Water Quality Standards

Water Body Classification: Class B

Applicable State Regulations:

- *314 CMR 4.05 (5) (a) Aesthetics*. All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.

- *314 CMR 4.05 (3)(b) 8 Taste and Odor*. None in such concentrations or combinations that are aesthetically objectionable, that would impair any use assigned to this Class, or that would cause tainting or undesirable flavors in the edible portions of aquatic life.
- *314 CMR 4.05 (3)(b) 6 Color and Turbidity*. These waters shall be free from color and turbidity in concentrations or combinations that are aesthetically objectionable or would impair any use assigned to this class.

Site Description

The Westfield River (segment MA32-05) begins at the confluence with the Middle Branch Westfield River in Huntington, MA and flows southeasterly for 17.8 miles to the Route 20 Bridge in Westfield, MA where the segment ends. In its upper reach, the river flows past the Huntington town center and receives discharge from the Huntington Waste Water Treatment Plant (WWTP). The river flows southeast from the Huntington WWTP and is dammed at the Littleville Power Company's Crescent Mill Dam. Downstream of the dam, the river receives wastewater and noncontact cooling water from the Texon USA facility. The river flows through steep terrain in the town of Russell and is again dammed at the Westfield River Paper Company Dam. Just downstream of the dam, the river receives discharge of treated effluent from the Russell WWTP. The river is again dammed a few miles south of the Russell WWTP at the Woronoco Dam in the village of Woronoco. The river continues southeast into the town of Westfield where the river widens and a broad floodplain is present. The Westfield WWTP discharges to the River upstream of the Route 20 Bridge.

MassDOT identified the directly contributing area based on plan review and a site visit on March 30, 2012. MassDOT's property that directly contributes stormwater runoff to the Westfield River is comprised of both non-urban and urban portions of Route 20 which runs adjacent to the Westfield River for significant stretches, from approximately 0.6 miles northwest of Interstate-90 (I-90) east to the Route 20 Bridge. Approximately 0.1 miles of the urban portion of I-90 drains to the Westfield River. Runoff from other sections flows overland and infiltrates or discharges to isolated wetlands before reaching the river and therefore is not considered a direct discharge.

There are no MassDOT owned urban roadways which directly contribute stormwater to the Westfield River upstream of I-90. The total watershed and subwatershed of the Westfield River are shown in Figure 1 and Figure 2. The directly contributing areas are shown in Figures 3-6.

Assessment under BMP 7U

None of the impairments for the Westfield River have been addressed by a total maximum daily load (TMDL) report. Therefore, MassDOT assessed these impairments using the approach described in BMP 7U (*Water Quality Impaired Waters Assessment and Mitigation Plan*) of MassDOT's Storm Water Management Plan, which applies to impairments that have been assigned to a water body prior to completion of a TMDL. As described in MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT, 2011), impervious cover (IC) provides a measure of the potential impact of stormwater on many impairments. For this water body, MassDOT used the IC method to assess the following impairments:

- excess algal growth
- taste and odor
- aquatic macroinvertebrate bioassessments
- turbidity

MassDOT's Application of the Impervious Cover Method

MassDOT's Application of Impervious Cover Method in BMP 7U applies many aspects of USEPA Region I's Impervious Cover (IC) Method described in EPA's *Stormwater TMDL Implementation Support Manual* (ENSR, 2006) to MassDOT's Impaired Waters Program. This method assesses potential stormwater impacts on the impaired water and evaluates the impervious cover reduction required to meet IC targets. Consistent with findings of EPA and others, when a watershed has less than 9% impervious cover MassDOT concludes that stormwater is not the likely cause of the impairment. Additional information regarding this method is provided in MassDOT's Application of IC Method document.

As outlined in the IC methodology, MassDOT first calculated the percent IC of the water body's entire contributing watershed (total watershed upstream of the downstream end of an impaired segment) and that of the local watershed contributing to the impaired segment (referred to as the subwatershed in this analysis) to determine whether stormwater has a potential to cause the impairments of the receiving water body. The total watershed and subwatershed to the impaired water body were delineated using the USGS Data Series 451. When USGS Data Series watersheds did not delineate the subwatershed of the water body under review, the GIS shapefiles were modified by delineating to the water body based on USGS topography. Impervious cover data was available as part of the USGS data layers Data Series 451 and MassGIS's impervious surfaces data layer. In cases where it was determined that stormwater was a potential cause of the impairment, MassDOT calculated the degree to which impervious cover would need to be reduced in the subwatershed to meet the 9% IC target. This reduction was then applied proportionally to the area of MassDOT roadways/properties directly discharging to the water body segment to identify MassDOT's target IC reduction. The 9% IC reduction serves only as a recommended target and is not meant to imply that failing to meet the target would cause an exceedance in water quality standards. As explained in BMP 7U, MassDOT will consider a variety of factors apart from numeric guidelines, including site constraints and the magnitude of any potential exceedances in water quality standards, to determine the precise nature and extent of additional BMPs recommended for particular locations. This approach is consistent with the iterative, adaptive management BMP approach set forth in EPA guidelines.

MassDOT calculated the effective impervious cover reduction afforded by the existing structural BMPs currently incorporated into the stormwater infrastructure of MassDOT's properties. This effective IC reduction was calculated by applying effective impervious cover reduction rates to existing BMPs based on their size, function and contributing watershed. BMP performances were derived from EPA Region 1's *Stormwater Best Management Practices (BMP) Performance Analysis* report (EPA, 2010) and engineering judgment. More information on the approach used to calculate the effective impervious cover reductions is described in BMP 7U. When the reduction in effective impervious cover achieved by the existing BMPs was equal to or greater than the target reduction, no further measures were proposed. When this was not the case, MassDOT considered additional BMPs in order to meet the targeted reduction.

Using this approach, MassDOT derived the following site parameters for the total contributing watershed of the impaired water (Westfield River (MA32-05)):

Table 2. Site Parameters for Westfield River (MA32-05)

Total Watershed		
Watershed Area	234,993	acres
Impervious Cover (IC) Area	4,570	acres
Percent Impervious	1.9	%
IC Area at 9% Goal	21,149	acres
Target Reduction % in IC	0	%
Subwatershed		
Subwatershed Area	11,622	acres
Impervious Cover (IC) Area	1,120	acres
Percent Impervious	9.6	%
IC Area at 9% Goal	1,046	acres
Target Reduction % in IC	6.6	%
Reductions Applied to DOT Direct Watershed		
MassDOT's Urban IC Area **Directly** Contributing to Impaired Segment	25	acres
MassDOT's Target Reduction in Effective IC (6.6% of DOT Urban **Directly** Contributing IC)	1.6	acres

While the total watershed is less than 9 % impervious, MassDOT also looked at the subwatershed to be conservative. The subwatershed is greater than 9% impervious which indicates that stormwater may be contributing to the impairment for this section of the river. The subwatershed should target a reduction of its effective IC by 6.6% to reach the 9% IC target. Therefore, MassDOT will aim to reduce its effective IC in the directly contributing watershed by the same percentage by removing 1.6 acres of effective IC.

Existing BMPs

Immediately upstream of the Route 20 Bridge, stormwater from Route 20 discharges to what was originally designed as a water quality swale. Approximately 4.3 acres of impervious cover drains to the swale via a 36” reinforced concrete pipe and headwall. The proposed check dam at the downstream end of the swale no longer exists and the swale is not currently providing water quality treatment as designed. The swale is located within a permanent drainage easement and could be retrofitted to allow for proper infiltration of stormwater runoff, allowing treatment of 4.3 acres of impervious cover, exceeding the 1.6 acre target.

Ex-BMP-1. Water Quality Swale.

There are no existing effective BMPs within MassDOT's directly contributing watershed to the Westfield River that are mitigating potential stormwater quality impacts. Therefore, no effective IC reduction is currently provided.

Next Steps

Because the total mitigation of impervious surface achieved by MassDOT's existing BMPs is less than the target reduction of 1.6 acres, MassDOT will consider the implementation of additional BMPs, specifically retrofitting the existing swale.

Conclusions

MassDOT evaluated its property within the directly contributing watershed to segment MA32-05 of the Westfield River to identify existing BMPs. This assessment of the Westfield River has shown that there are no existing effective BMPs that are mitigating stormwater impacts.

MassDOT should reduce its effective IC within the directly contributing watershed by 1.6 acres to achieve the targeted reduction in IC. MassDOT will now work with its design consultants to identify locations suitable for construction of additional BMPs to treat directly contributing IC as part of MassDOT's Impaired Waters Retrofit Initiative. The existing swale described above has retrofit potential to provide proper water quality treatment. The design consultants will develop construction plans for BMPs that will aim to provide the target IC reduction or treatment to the maximum extent practicable.

MassDOT has concluded, based on review of the draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal watershed permits, that the BMPs outlined in the stormwater management plan and those under consideration for reducing effective IC from MassDOT areas are consistent with its existing permit requirements.

MassDOT will continue to identify opportunities to implement additional structural BMPs to address pollutant loading when road work is conducted under MassDOT's Programmed Projects Initiative. Work on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative

adaptive management approach to addressing impairments. MassDOT will include an update in annual reports and biannual submittals to EPA regarding the design progress made towards meeting the IC reduction, plans for construction of the BMPs and finalized assessments. Furthermore, MassDOT will continue to implement non-structural BMPs that reduce the impacts of stormwater.

References

ENSR. (2006). Stormwater TMDL Implementation Support Manual for US Environmental Protection Agency Region 1. ENSR International & EPA Region 1, Boston, MA. Project No.: 10598-001-500. Retrieved from: http://www.epa.gov/region1/eco/tmdl/pdfs/Stormwater-TMDL-Implementation-Support-Manual.pdf

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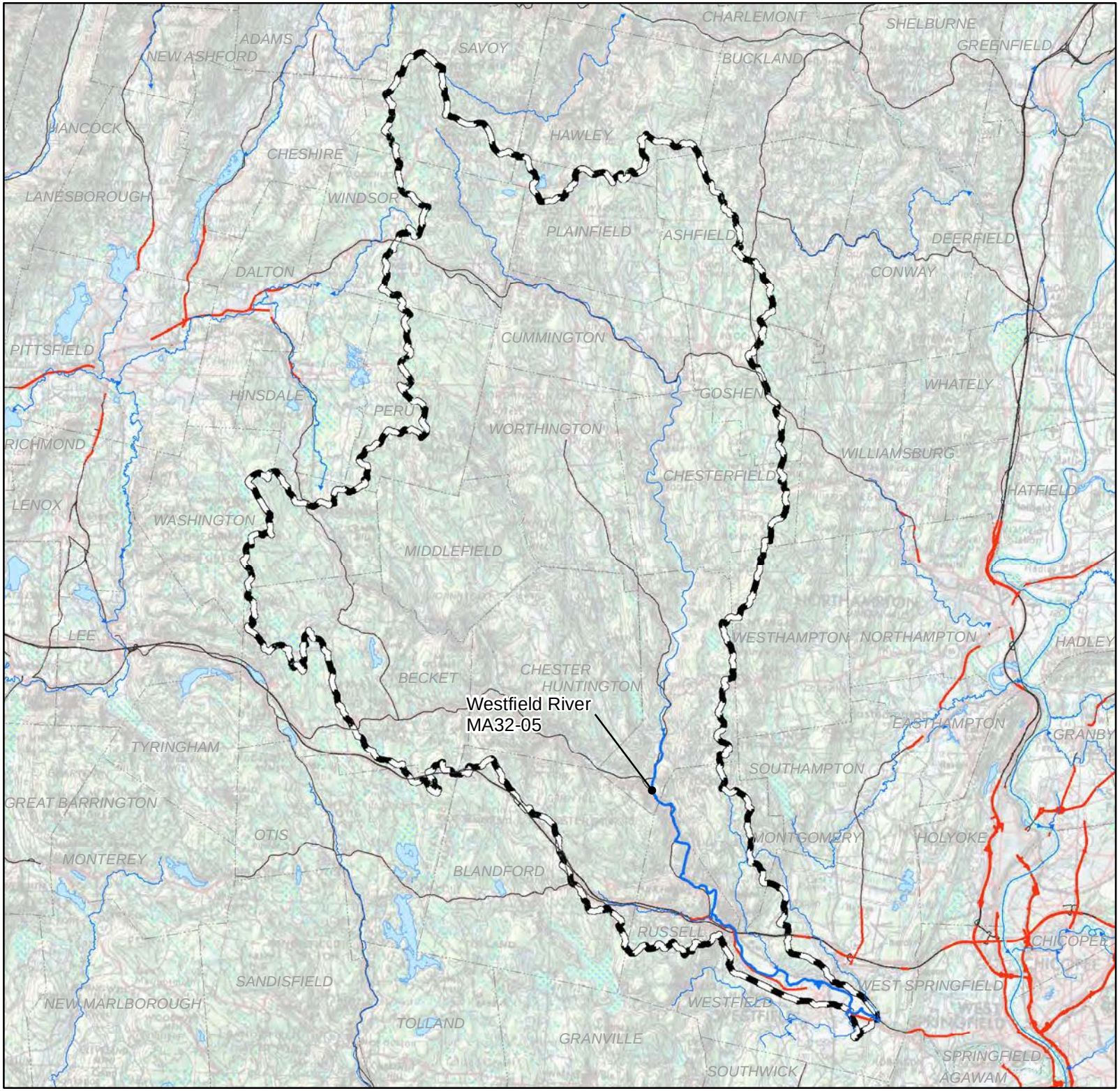

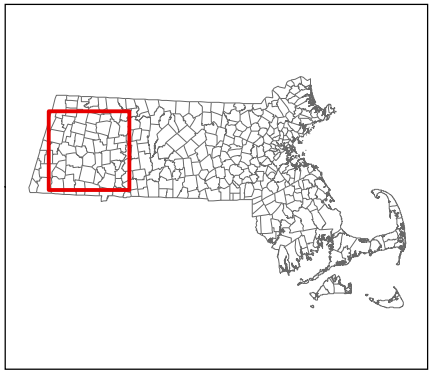

Westfield River MA32-05

Impaired Stream Segment

Impaired Water Bodies

NWI Wetland Areas

MassDOT Roads in Urban Areas

MassDOT Roads

Westfield River Watershed

Town Boundaries

N

0 1.5 3 4.5 9 Miles

1 in = 4.8 miles

Figure 1

Westfield River Total Watershed MA32-05

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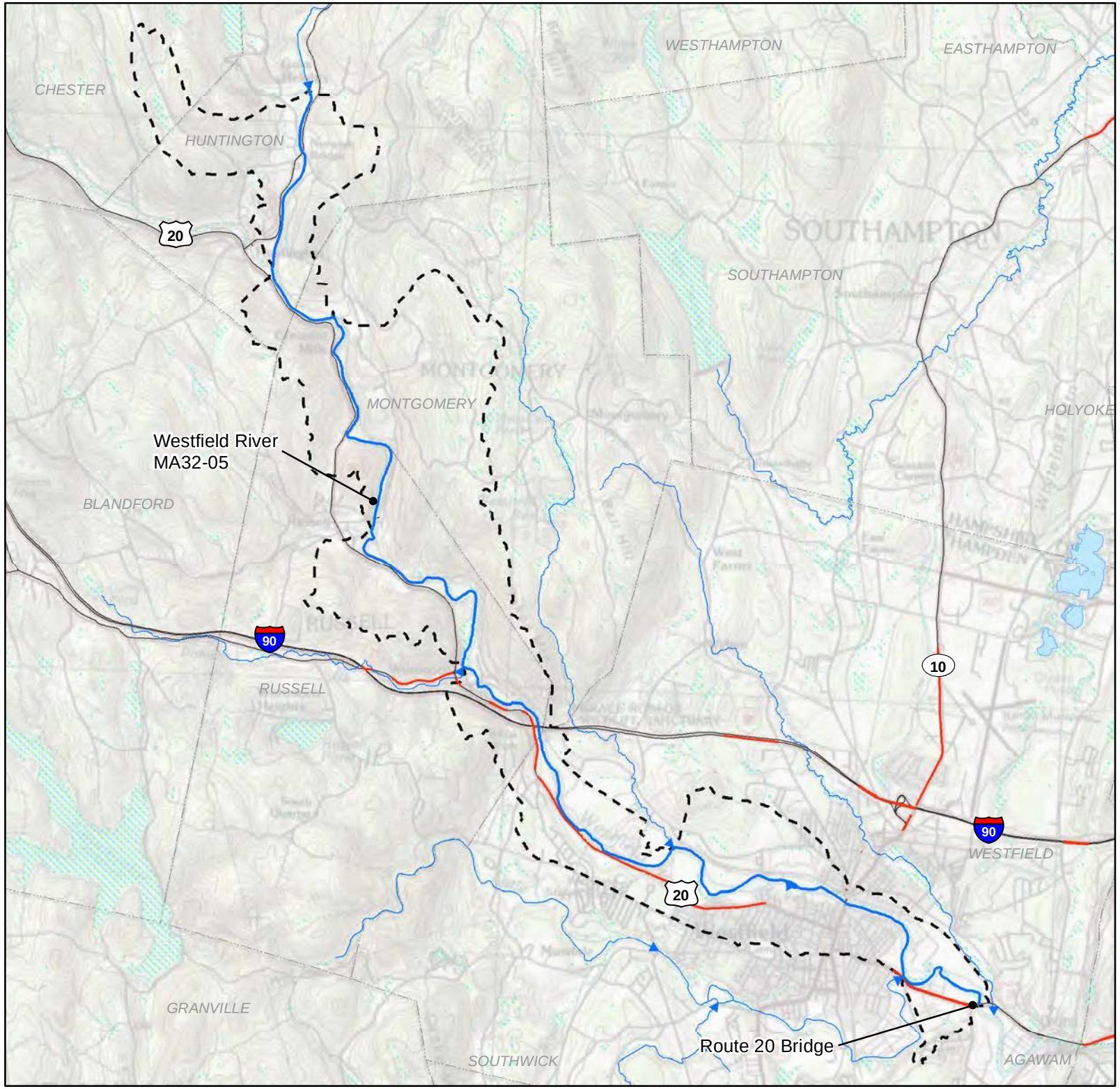

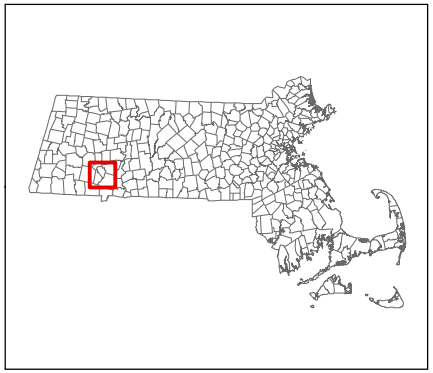

Westfield River MA32-05

Impaired Stream Segment

Impaired Water Bodies

NWI Wetland Areas

MassDOT Roads in Urban Areas

MassDOT Roads

Westfield River Subwatershed

Town Boundaries

N

0 0.5 1 1.5 3 Miles

1 in = 1.5 miles

Figure 2

Westfield River Subwatershed MA32-05

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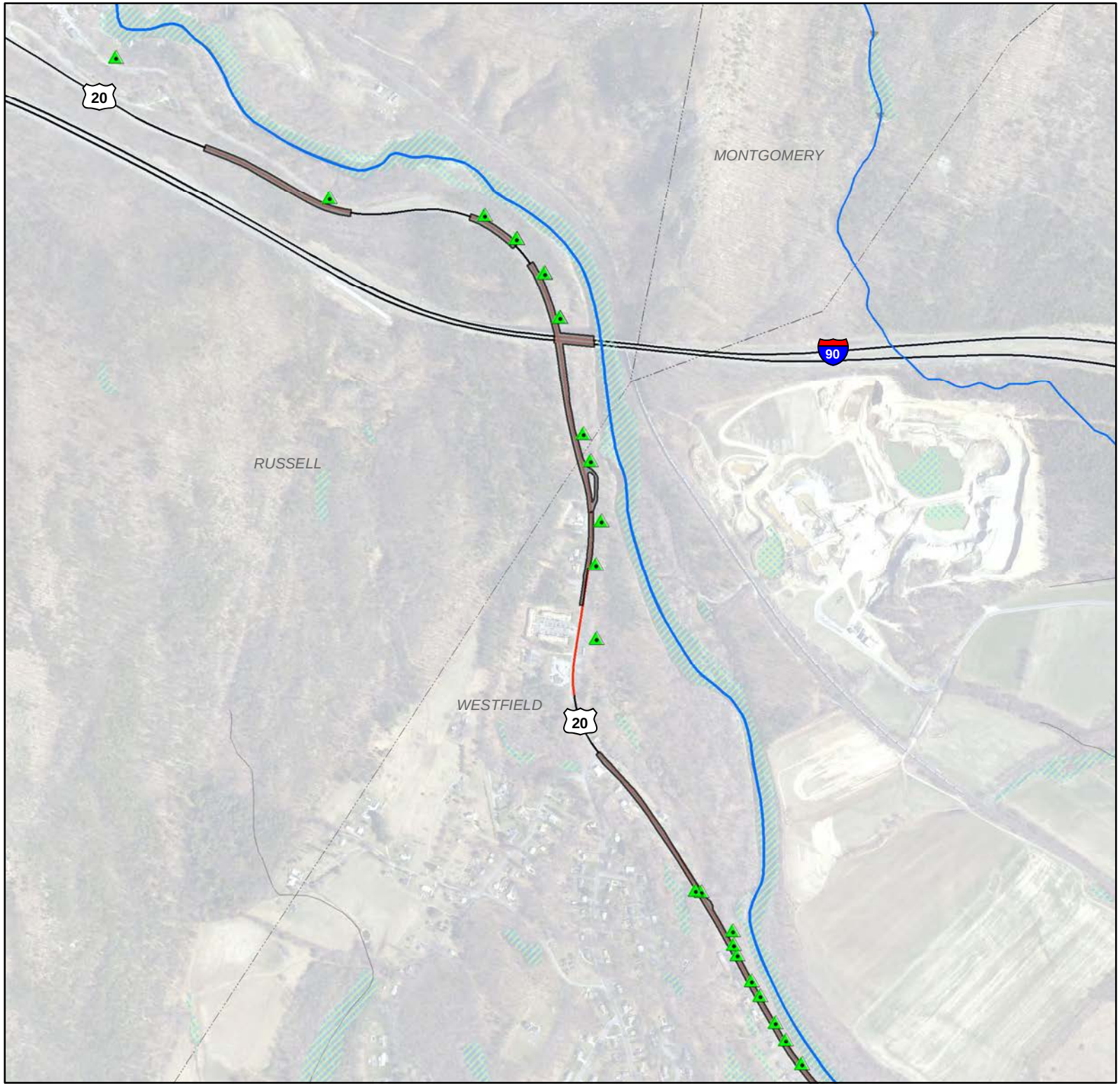

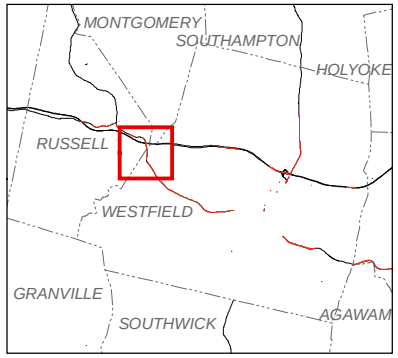

Stormwater Outfalls

MassDOT Directly Contributing Watersheds

Westfield River MA32-05

Impaired Stream Segment

Non-Impaired Stream Segment

NWI Wetland Areas

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

N

0 500 1,000 2,000 Feet

1 inch = 1,000 feet

Figure 3

Westfield River (MA32-05) Directly Contributing MassDOT Watershed

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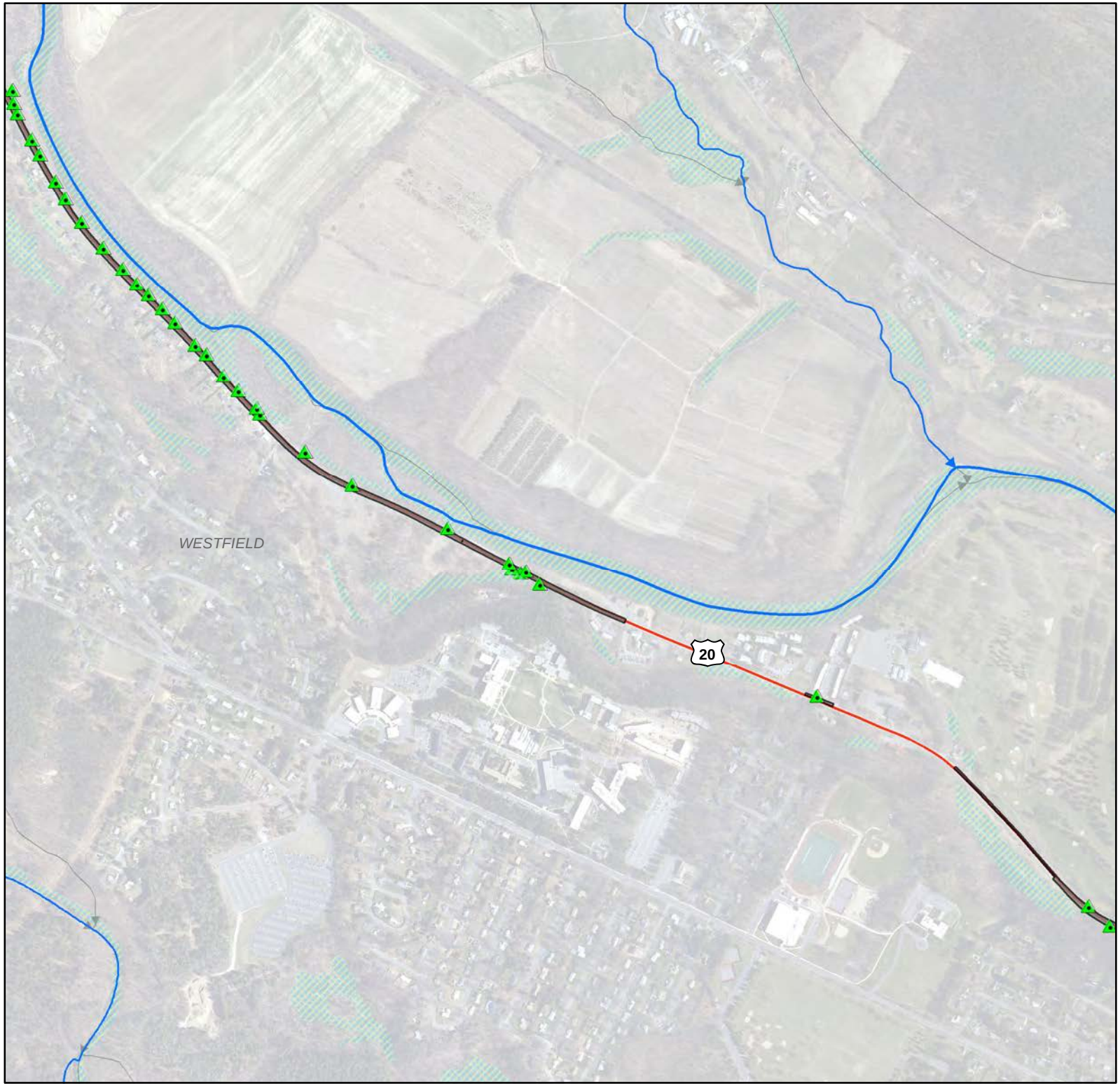

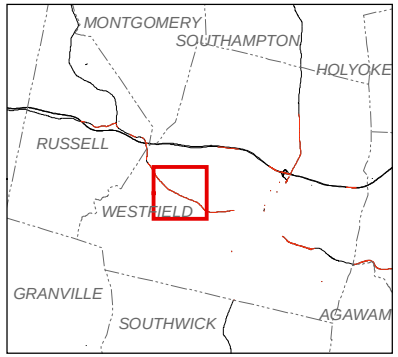

Stormwater Outfalls

MassDOT Directly Contributing Watersheds

Westfield River MA32-05

Impaired Stream Segment

Non-Impaired Stream Segment

NWI Wetland Areas

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

N

0 500 1,000 2,000 Feet

1 inch = 1,000 feet

Figure 4

Westfield River (MA32-05) Directly Contributing MassDOT Watershed

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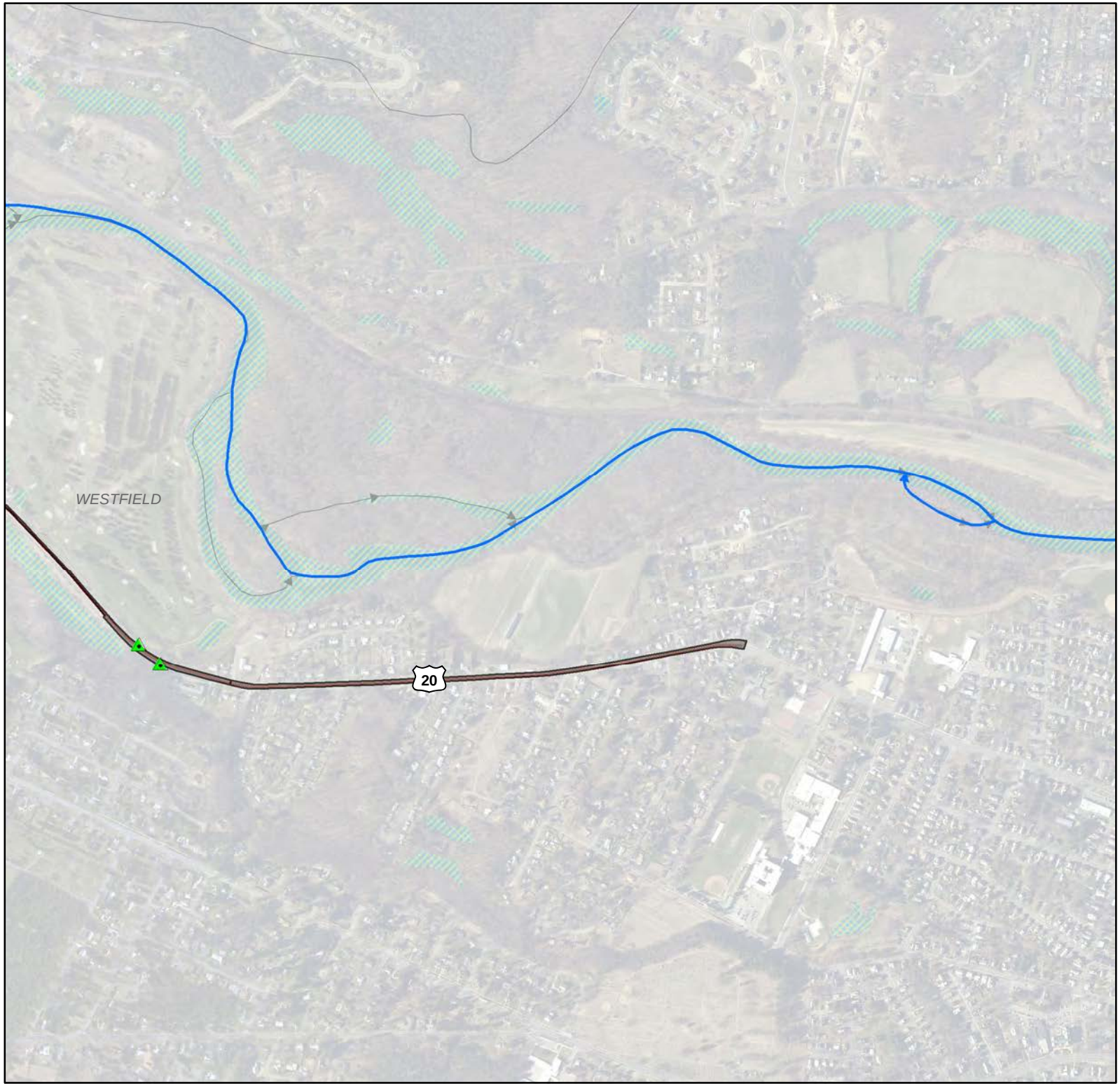

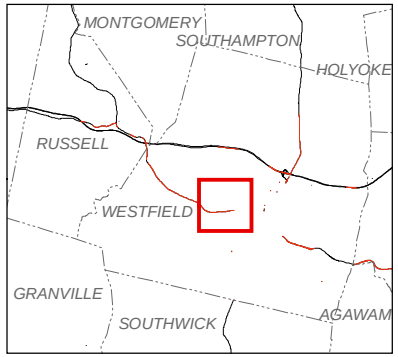

Stormwater Outfalls

MassDOT Directly Contributing Watersheds

Westfield River MA32-05

Impaired Stream Segment

Non-Impaired Stream Segment

NWI Wetland Areas

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

N

0 500 1,000 2,000 Feet

1 inch = 1,000 feet

Figure 5

Westfield River (MA32-05) Directly Contributing MassDOT Watershed

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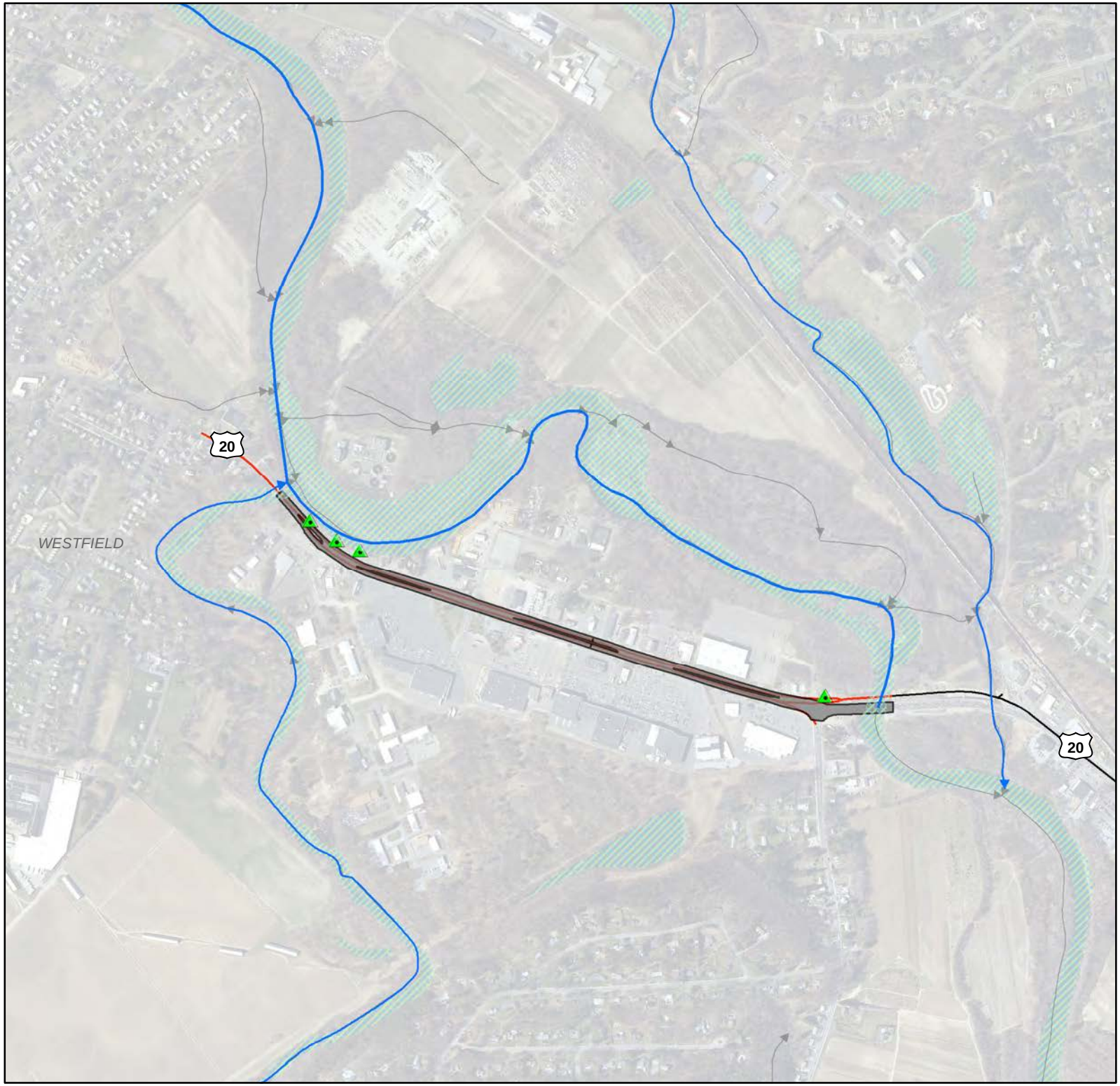

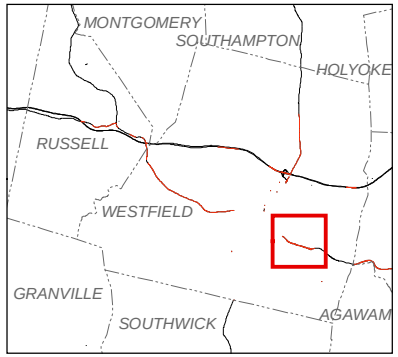

Stormwater Outfalls

MassDOT Directly Contributing Watersheds

Westfield River MA32-05

Impaired Stream Segment

Non-Impaired Stream Segment

NWI Wetland Areas

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

N

0 500 1,000 2,000 Feet

1 inch = 1,000 feet

Figure 6

Westfield River (MA32-05) Directly Contributing MassDOT Watershed

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Impaired Waters Assessment for Stony Brook (MA34-19) – Progress Report

Impaired Water Body

Name: Stony Brook

Location: Granby, Ludlow, Chicopee, and South Hadley, MA

Water Body ID: MA34-19

Impairments

Stony Brook (MA34-19) is listed under Category 5, "Waters Requiring a TMDL", on both MassDEP's final *Massachusetts Year 2008* and proposed *Massachusetts Year 2010 Integrated List of Waters*. According to MassDEP's *Connecticut River Watershed 2003 Water Quality Assessment Report* (MassDEP, 2008b), the lower 3.5 miles of Stony Brook have been classified as impaired for turbidity and elevated *E. coli* bacteria, and the upper 9.8 miles have not been assessed. Additionally, the brook has been placed on alert status for aquatic life based on the results of a biological study conducted in 2003. The 0.5-mile segment of Stony Brook that flows through Upper Pond and Lower Pond is further classified as impaired for non-native macrophytes (MassDEP, 2008b).

Final *Massachusetts Year 2008 Integrated List of Waters* (MassDEP, 2008a):

- Escherichia coli
- Turbidity
- Non-native aquatic plants

Final *Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2011):

- Escherichia coli
- Turbidity
- Non-native aquatic plants

Relevant Water Quality Standards

Water Body Classification: Class B, combined sewer overflow (Note: due to the elimination of the sole CSO discharge to this segment, the CSO designation should be removed from this segment during the next update of the water quality standards). (MassDEP, 2008b)

Applicable State Regulations:

- *314 CMR 4.05 (3)(b) 4 Bacteria*.
    - a. At bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: where E. coli is the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 126 colonies per 100 ml and no single sample taken during the bathing season shall exceed 235 colonies per 100 ml; alternatively, where enterococci are the chosen indicator, the geometric mean of the five most recent samples taken

during the same bathing season shall not exceed 33 colonies per 100 ml and no single sample taken during the bathing season shall exceed 61 colonies per 100 ml;

- b. For other waters and, during the non bathing season, for waters at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: the geometric mean of all E. coli samples taken within the most recent six months shall not exceed 126 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 235 colonies per 100 ml; alternatively, the geometric mean of all enterococci samples taken within the most recent six months shall not exceed 33 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 61 colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

- *314 CMR 4.05 (3)(b) 6 Color and Turbidity*. These waters shall be free from color and turbidity in concentrations or combinations that are aesthetically objectionable or would impair any use assigned to this class.
- *314 CMR 4.05 (5) (a) Aesthetics*. All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.

Site Description

Stony Brook is a 13.3-mile long waterway that passes through the towns of Granby, Ludlow, Chicopee, and South Hadley, MA. The brook crosses beneath Route 202 in Granby near the border with South Hadley after flowing for approximately 7.3 miles. Stony Brook flows through South Hadley for approximately 6 miles, crossing beneath Route 116 and finally emptying into the Connecticut River. The watershed and subwatershed contributing to Stony Brook are depicted in Figures 1 and 2, respectively.

MassDOT's property that directly contributes stormwater runoff to Stony Brook is comprised of portions of Route 202 and Route 116. The extent of MassDOT's directly contributing IC is depicted in Figure 3. Drainage along Route 202 in most of South Hadley and Granby is collected in small trunk lines that discharge to unimpaired stream segments or wetlands. Near Stony Brook, the drainage is collected in five catchbasins at or near the road's low point, which is located just southwest of the river crossing. The stormwater is piped directly into Stony Brook via one of two 12" circular outfalls on the northern side of the Route 202 road bridge.

Route 116 in South Hadley is classified as urban beginning at its intersection with Route 202 and ending at its intersection with Brainerd Street and Mosier Street, which occurs just south of the Route 116 road bridge over Stony Brook. Drainage from the road's high point at Belmont Avenue appears to be piped down-grade through catchbasins along the western curb before it is collected in a yard drain approximately 300 feet from the Brainerd and Mosier Street intersection. Flow to the yard drain appears to be piped northwest to Brainerd Street, where it outfalls directly into an unimpaired stream segment just 400 feet from the stream's confluence with Stony Brook. The stream segment, pictured below on the left, flows quickly and has a sandy bottom, which provides little or no treatment by the time the drainage reaches Stony Brook. Consequently, drainage from this segment of roadway has been classified as direct. The remaining urban drainage from Route 116 is collected in a catchbasin on the eastern shoulder of Route 116 immediately before the intersection with Brainerd Street and Mosier Street. Drainage from this catchbasin is piped directly into a different unimpaired stream segment, which flows quickly over a sandy bottom for

approximately 300 feet before joining Stony Brook. This stream segment is pictured below on the right. Drainage from this road segment has also been classified as direct.

Stream segment receiving stormwater from yard drain.

Stream segment receiving stormwater from catchbasin.

Assessment under BMP 7U

None of the impairments for Stony Brook have been addressed by a Total Maximum Daily Load (TMDL). Therefore, MassDOT assessed these impairments using the approach described in BMP 7U of MassDOT's Storm Water Management Plan (Water Quality Impaired Waters Assessment and Mitigation Plan), which applies to impairments that have been assigned to a water body prior to completion of a TMDL. As described in MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method; MassDOT, 2011), IC provides a measure of the potential impact of stormwater on many impairments. For this water body, MassDOT used the IC method to assess the impairment for turbidity.

The impairment for E. Coli is assessed separately in the section titled Assessment under BMP 7U for Bacteria. The impairment for non-native aquatic plants is not related to discharges from stormwater. Therefore, this impairment was not considered further by MassDOT under the Impaired Waters Program.

MassDOT's Application of the Impervious Cover Method

MassDOT's Application of the Impervious Cover Method in BMP 7U applies many aspects of the USEPA Region I's Impervious Cover (IC) Method described in EPA's *Stormwater TMDL Implementation Support Manual* (ENSR, 2006) to MassDOT's program. This method assesses potential stormwater impacts on the impaired water and evaluates the impervious cover reduction required to ensure that stormwater is not the cause of the impairments. Consistent with the findings of the EPA and others, when a watershed has less than 9% impervious cover, MassDOT concludes that stormwater is not the likely cause of the impairment. Additional information regarding this method is provided in MassDOT's Application of IC Method document.

First, MassDOT calculated the percent IC of the water body's entire contributing watershed (total watershed upstream of the downstream end of an impaired segment) and that of the local watershed contributing to the impaired segment (referred to as the subwatershed in this analysis) to determine whether stormwater has a potential to cause the impairments of the receiving water body. The total watershed and subwatershed to the impaired water body were delineated using the USGS Data Series 451. When USGS Data Series watersheds did not delineate the subwatershed

of the water body under review, the GIS shapefiles were modified by delineating to the water body based on USGS topography to add specificity. Impervious cover data was available as part of the USGS data layers Data Series 451 and MassGIS's impervious surfaces data layer. In cases where it was determined that stormwater was a potential cause of the impairment, MassDOT calculated the degree to which impervious cover would need to be reduced in the subwatershed to meet the 9% IC target. This reduction was then applied proportionally to the area of MassDOT roadways/properties directly discharging to the water body segment to identify MassDOT's target IC reduction. The 9% IC reduction serves only as a recommended target and is not meant to imply that failing to meet the target would cause an exceedance in water quality standards. As explained in BMP 7U, MassDOT will consider a variety of factors apart from numeric guidelines, including site constraints and the magnitude of any potential exceedances in water quality standards, to determine the precise nature and extent of additional BMPs recommended for particular locations. This approach is consistent with the iterative, adaptive management BMP approach set forth in EPA guidelines.

MassDOT also assessed if the effective impervious cover was reduced by existing structural BMPs currently incorporated into the stormwater infrastructure of MassDOT's properties. In this case, it was determined that there were no existing structural BMPs treating stormwater draining to Stony Brook, so MassDOT will consider installing BMPs in order to meet the targeted reduction.

Using this approach, MassDOT derived the following site parameters for the total watershed contributing to the impaired water (Stony Brook (MA34-19)):

Total Watershed		
Watershed Area	14,577	acres
Impervious Cover (IC) Area	1,374	acres
Percent Impervious	9.4	%
IC Area at 9% Goal	1,312	acres
Target Reduction % in IC	4.5	%

Subwatershed		
Subwatershed Area	12,819	acres
Impervious Cover (IC) Area	1,244	acres
Percent Impervious	9.7	%
IC Area at 9% Goal	1,154	acres
Target Reduction % in IC	7.3	%

Reductions Applied to DOT Direct Watershed		
MassDOT's IC Area **Directly** Contributing to Impaired Segment	2.9	acres
MassDOT's Target Reduction in Effective IC (7.3% of DOT Directly Contributing IC)	0.2	acres

The subwatershed is greater than 9% impervious, which indicates that stormwater may be contributing to the impairment. The subwatershed should target a reduction of its effective IC by 7.3% to reach the 9% goal. Therefore, MassDOT will aim to reduce its effective IC in the directly contributing watershed by the same percentage by removing 0.2 acres of effective IC.

Next Steps

Because MassDOT does not have existing BMPs that mitigate the effective impervious cover draining to Stony Brook, MassDOT will consider integrating new BMPs to achieve the target reduction of 0.2 acres.

Drainage from Route 202 could potentially be rerouted through a BMP placed in the space adjacent to Stony Brook. However, this strategy would involve excavating and re-grading pipe for an entire small drainage system. Depending on the BMPs selected, a project at this location could reduce the effective IC up to a maximum of 1.1 acres, which exceeds the target reduction; however, construction costs could prove prohibitive after further review.

Stormwater from Route 116 that is currently directed through the yard drain could be piped to a BMP adjacent to its receiving unimpaired stream segment. This strategy may only involve excavating and relocating the pipe from the yard drain to the outfall. Depending on the BMPs selected, a project at this location could reduce the effective IC up to a maximum of 0.8 acres, which exceeds the target reduction. Further investigation into the feasibility of this approach could indicate that the required construction is more complex than initially speculated.

Assessment under BMP 7U for Pathogens

Pathogen concentrations in stormwater vary widely temporally and spatially; concentrations can vary by an order of magnitude within a given storm event at a single location (MassDEP, 2009b). Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites will be assessed collectively based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an iterative adaptive management approach for stormwater to be consistent with relevant TMDL and permit condition requirements..

In addition, while there is a positive relationship between impervious cover and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely solely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in stormwater runoff (Smith, 2002). This study found a geometric mean of 186 colonies/100 ml. Concentrations of pathogens in stormwater runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform bacteria in urban stormwater from other sources ranging between 14,000 and 17,000 fecal coliform organisms/100 mL have been reported (MassDEP, 2009b). These data suggests that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other stormwater systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles, and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the stormwater system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally cross them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from stormwater runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other stormwater systems and a large number of other factors.

Assessment and Mitigation Plan

Pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (MassDEP, 2009a)
- "The NPDES permit does not, however, establish numeric effluent limitations for stormwater discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals."(MassDEP, 2009b)

- "Although the TMDL presents quantified WLAs for stormwater that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs." (MassDEP, no date).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of stormwater management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contains specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing stormwater discharges to pathogen-impaired waters. Section 2.2.1(c) of the permit states "For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA." Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Storm Water Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure
- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System
- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

In addition, the structural BMPs that will be considered to reduce the IC will also have the effect of reducing pathogen loads.

MassDOT believes the existing and proposed efforts are consistent with the current and draft MS4 permit's requirements and TMDL recommendations. MassDOT's existing stormwater management plan outlines BMPs that include education and illicit discharge detection and elimination. Although not included in this permit term, MassDOT will be implementing a pet waste management program at its rest stops that have discharges to pathogen impaired waters. In addition, MassDOT has requested coverage under an individual stormwater permit for the next permit term. This permit may contain additional programmatic BMPs to address pathogens.

Conclusions

MassDOT evaluated its property within the directly contributing watershed to Stony Brook to identify existing BMPs. The evaluation determined that there are no existing BMPs present. The following table summarizes the IC reduction target:

Impervious Cover Reduction		
IC in Directly Contributing Watershed	2.9	acres
Target Reduction in Effective IC	0.2	acres
IC Effectively Reduced by Existing BMPs	0	acres
IC Remaining to Mitigate with Proposed BMPs	0.2	acres

MassDOT will aim to reduce its effective IC within the directly contributing watershed by 0.2 acres to achieve the targeted reduction in IC. MassDOT will now work with its design consultants to identify locations suitable for construction of additional BMPs to treat directly contributing IC as part of MassDOT's Impaired Waters Retrofit Initiative. The design consultants will develop construction plans for BMPs that will aim to provide the target IC reduction or treatment to the maximum extent practicable.

MassDOT will continue to identify opportunities to implement additional structural BMPs to address pollutant loading when road work is conducted under MassDOT's programmed projects initiative. Work on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to addressing impairments. MassDOT will include an update in annual reports and biannual submittals to EPA regarding the design progress made towards meeting the IC reduction, plans for construction of the BMPs and finalized assessments. Furthermore, MassDOT will continue to implement non-structural BMPs that reduce the impacts of stormwater.

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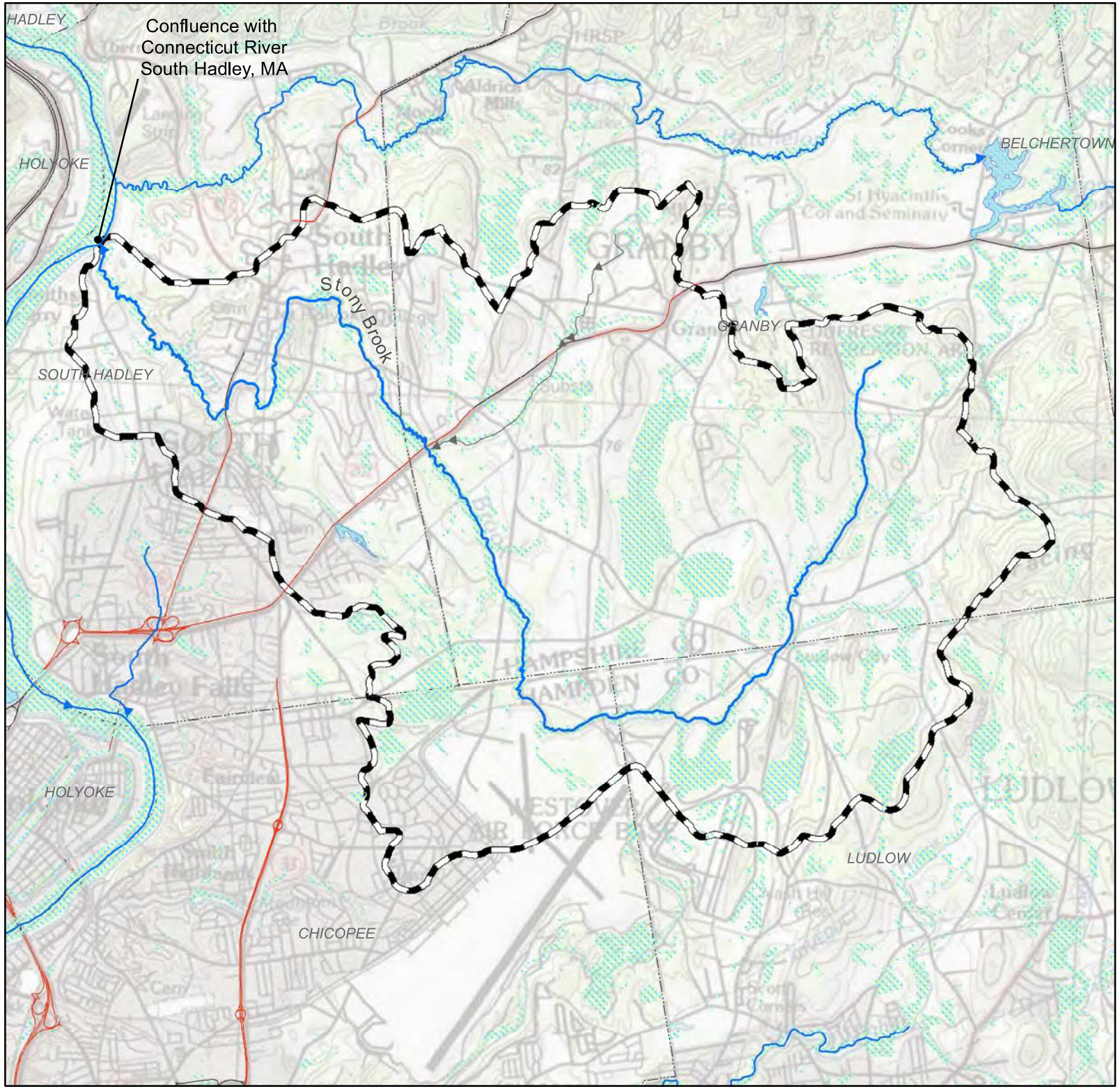

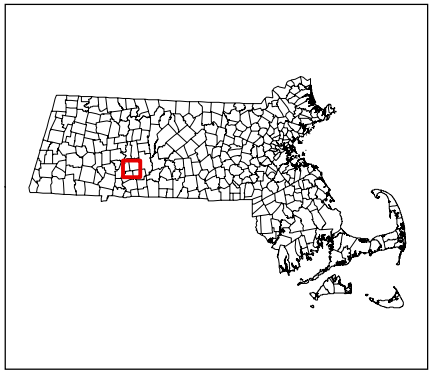

Stony Brook Watershed

Stony Brook

Impaired Stream Segment

Tributary to Stony Brook

Impaired Water Body

NWI Wetland Areas

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

N

0 0.5 1 1.5 Miles

1 in = 1 miles

Figure 1

Stony Brook Watershed MA34-19

March 2012

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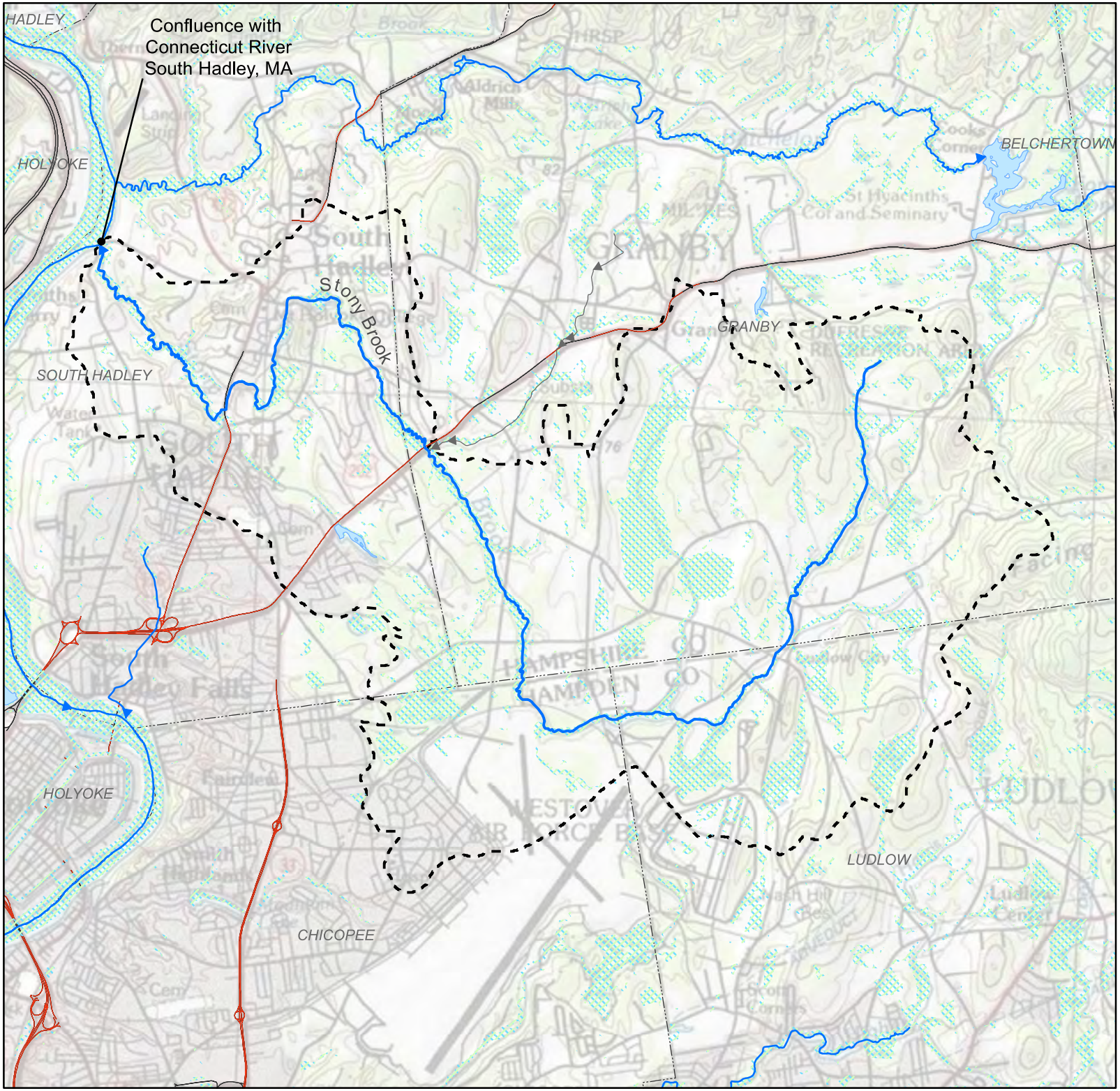

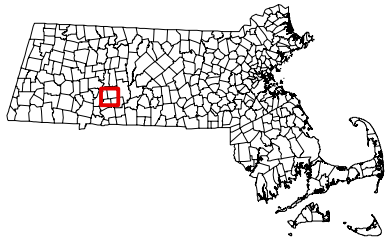

Stony Brook Subwatershed

Stony Brook

Impaired Stream Segment

Tributary to Stony Brook

Impaired Water Bodies

NWI Wetland Areas

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

N

0 0.5 1 1.5 Miles

1 in = 1 miles

Figure 2

Stony Brook Subwatershed MA34-19

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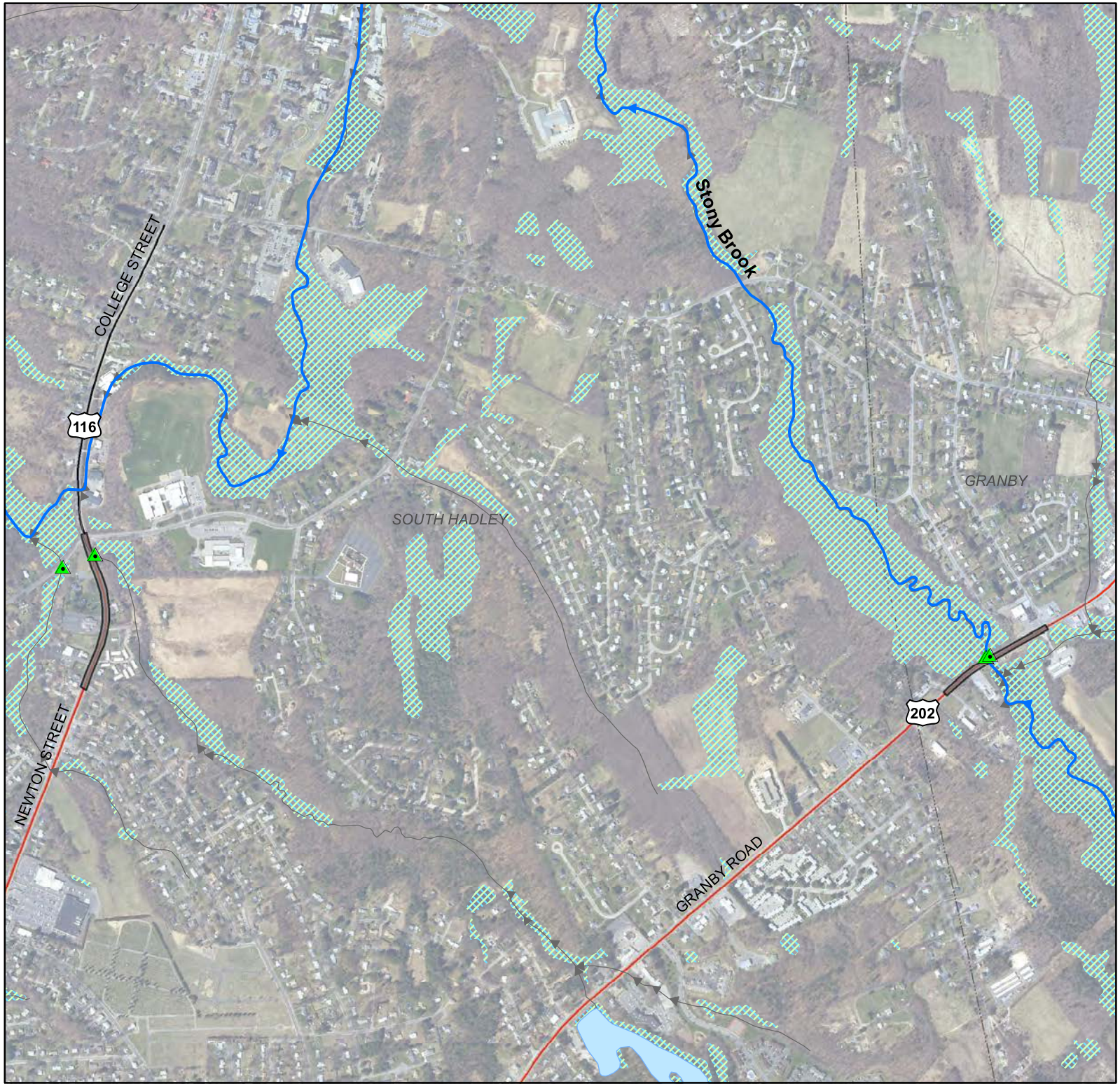

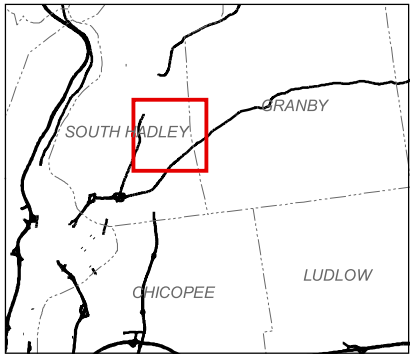

Stormwater Outfalls

MassDOT Directly Contributing Watershed

Stony Brook

Non-Impaired Stream Segment

Impaired Water Bodies

NWI Wetland Areas

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

N

0 0.1 0.2 0.3 0.4 Miles

1 inch = 0.2 miles

Figure 3

Stony Brook (MA34-19) Directly Contributing MassDOT Watershed

March 2012

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Impaired Waters Assessment for Greenwood Pond (MA35026) – Progress Report

Impaired Water Body

Name: Greenwood Pond

Location: Templeton, MA

Water Body ID: MA35026

Impairments

Final *Massachusetts Year 2008 Integrated List of Waters* (MassDEP, 2008):

- Noxious Aquatic Plants

Final *Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2011):

- Aquatic Plants (Macrophytes)

Greenwood Pond (MA35026) is listed as a Category 4a water body, "*TMDL is Completed,*" on both MassDEP's final *Massachusetts Year 2008* and the final *Massachusetts Year 2010 Integrated List of Waters*. Greenwood Pond is covered by a Total Maximum Daily Load (TMDL) for phosphorus according to MassDEP's *Total Maximum Daily Loads of Phosphorus for Selected Millers Basin Lakes* [CN 123.2] (MassDEP, 2003).

Relevant Water Quality Standards

Water Body Classification: B

Applicable State Regulations:

- *314 CMR 4.05 (5) (a) Aesthetics*. All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.

- *314 CMR 4.05 (5) (c) Nutrients*. Unless naturally occurring, all surface waters shall be free from nutrients in concentrations that would cause or contribute to impairment of existing or designated uses and shall not exceed the site specific criteria developed in a TMDL or as otherwise established by the Department pursuant to 314 CMR 4.00. Any existing point source discharge containing nutrients in concentrations that would cause or contribute to cultural eutrophication, including the excessive growth of aquatic plants or algae, in any surface water shall be provided with the most appropriate treatment as determined by the Department, including, where necessary, highest and best practical treatment (HBPT) for POTWs and BAT for non POTWs, to remove such nutrients to ensure protection of existing

and designated uses. Human activities that result in the nonpoint source discharge of nutrients to any surface water may be required to be provided with cost effective and reasonable best management practices for nonpoint source control.

Site Description

Greenwood Pond is a water body in Templeton, MA that is trisected by Route 2 and bounded by Patriots Road (Route 2A) to the north. The pond is composed of four basins with a total surface area of approximately 12.5 acres and a contributing watershed of approximately 1,242 acres (DEP, 2003). Water exits the pond through an approximately 60-inch RCP culvert where it flows through a large wetland system prior to discharging to the Otter River. According to the final *Massachusetts Year 2010 Integrated List of Waters* Greenwood Pond is impaired for aquatic plants (Macrophytes) (MassDEP, 2011). Figure 1 shows the subwatershed for Greenwood Pond.

Route 2 runs east-west through the middle of Greenwood Pond. Route 2 is a divided, two-lane roadway with small, piped stormwater collection systems discharging to outfalls along either side, some of which discharge directly to Greenwood Pond. To the east of Greenwood Pond, stormwater is collected in catch basins and piped through two trunks lines which discharge upstream of the pond approximately 500-feet away. To the west of the pond catch basins discharge directly to the side of the roadway. Approximately 0.4 acres of MassDOT urban area drains to Greenwood Pond. Figure 2 shows MassDOT urban area property directly draining to Greenwood Pond.

Assessment under BMP 7R for Aquatic Plants (Macrophytes)

The TMDL for phosphorus for Greenwood Pond addresses the impairment of aquatic plants (macrophytes). Therefore, MassDOT assessed the contribution of phosphorus from MassDOT urban area property directly draining to this water body to address these impairments. The assessment was completed using the approach described in BMP 7R (TMDL Watershed Review).

TMDL

The Massachusetts Department of Environmental Protection's (MassDEP) TMDL report titled *Total Maximum Daily Loads of Phosphorus for Selected Millers Basin Lakes* [CN 123.2] (MassDEP, 2003) can be summarized as follows:

- Pollutant of Concern: Phosphorus
- Impairment for Greenwood Pond Addressed in TMDL: aquatic plants (macrophytes)
- Applicable Waste Load Allocation (WLA): See p. 79 and 114 of TMDL Report.
  - Description of Associated Land Use: Commercial/Industrial
  - Commercial/Industrial Land Use Current Load (TP): 15 kg/yr (33 lbs/yr)
  - Commercial/ Industrial Land Use Target WLA (TP): 2 kg/yr (4 lbs/yr)
  - Commercial/Industrial Area in Watershed: 4.9 ha (12.1 acres)
  - Commercial/Industrial Land Use Target Areal WLA (TP): 0.4 kg/ha/yr (0.4 lb/acre/yr)

Estimated Loading from MassDOT

The loading of total phosphorus (TP) from MassDOT property directly contributing stormwater runoff to Greenwood Pond was estimated using the following assumptions and calculations:

- MassDOT estimates the TP loading from its impervious areas as 1.60 lb/acre/yr. This loading rate is based on data collected in a study of stormwater runoff conducted by the United States Geological Survey (USGS) (Smith and Granato, 2010). The study analyzed stormwater samples from 12 sites located on highways operated by MassDOT across Massachusetts between September 2005 and September 2007. Samples were taken under a variety of weather conditions during this period.
- MassDOT estimates the TP loading from its pervious areas as 0.6 lb/acre/yr. This loading rate is based on the loading rate for hayland provided in the United States Environmental Protection Agency's (EPA) document EPA 440/5-80-011, "Modeling phosphorus loading and Pond response under uncertainty: a manual and compilation of export coefficients" (Reckhow, 1980). Hayland was chosen to represent the pervious right-of-way areas which are typically cleared areas that are mowed only once per year.
- MassDOT calculated its total estimated TP loading rate using the estimated loading rates listed above. MassDOT urban area property contributing stormwater directly to Greenwood Pond is 0.3 acres of impervious area and 0.1 acres of pervious area. The TP loading is 0.55 lb/yr without accounting for existing BMPs or treatment throughout the watershed.
- MassDOT calculated its target TP WLA using the TMDL target areal WLA of 0.4 lb/ac/yr and the total area of MassDOT urban area property within the TMDL watershed directly draining to Greenwood Pond (0.4 acres). The target TP WLA for MassDOT runoff is 0.15 lb/yr.

Assessment and Mitigation Plan

MassDOT calculated its current TP loading rate (0.55 lb/yr) and its target TP WLA (0.15 lb/yr) using values provided in MassDEP's TMDL report. The difference between these two values represents the target reduction in TP that MassDOT will aim to achieve to comply with the WLA. For the watershed directly contributing to Greenwood Pond, this target reduction is 0.4 lb/yr, or 71%. As explained in BMP 7R, MassDOT's pollutant loading analysis provides only a preliminary estimate of the level of pollutant reductions that may be recommended. In light of the variability of data on stormwater discharges, MassDOT will rely on a variety of other factors apart from numeric guidelines, including site constraints, to determine the precise nature and extent of additional BMPs recommended for particular locations. This approach is consistent with the iterative, adaptive management BMP approach set forth in EPA guidelines.

During a site visit on May 14, 2012, no existing BMPs were identified in the DOT direct watershed to Greenwood Pond. Thus, there is currently no TP reduction being provided.

Next Steps

Because the total mitigation achieved by MassDOT's existing BMPs is less than the target reduction of 0.4 lb/yr, the implementation of additional BMPs will be considered by MassDOT.

Conclusions

MassDOT evaluated its property within the directly contributing watershed to Greenwood Pond to identify existing BMPs. This assessment of Greenwood Pond has shown that MassDOT has no existing BMPs in place, and therefore, discharges stormwater directly to Greenwood Pond without providing treatment.

To meet the TMDL for the phosphorus MassDOT should reduce its TP loading within the urban area directly contributing watershed by 0.4 lb/yr to achieve the targeted reduction. MassDOT will now work with its design consultants to identify locations suitable for construction of additional

BMPs as part of MassDOT's Impaired Waters Retrofit Initiative. The design consultants will develop construction plans for BMPs that will aim to provide the target load reduction or treatment to the maximum extent practicable. Once the design of proposed BMPs is finalized, MassDOT will develop a final assessment of this water body under the Impaired Waters program.

MassDOT will continue to identify opportunities to implement additional structural BMPs to address pollutant loading when road work is conducted under MassDOT's programmed projects initiative. Work on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to addressing impairments. MassDOT will include an update in annual reports and biannual submittals to EPA regarding the design progress made towards meeting the load reduction, plans for construction of the BMPs and finalized assessments. Furthermore, MassDOT will continue to implement non-structural BMPs that reduce the impacts of stormwater.

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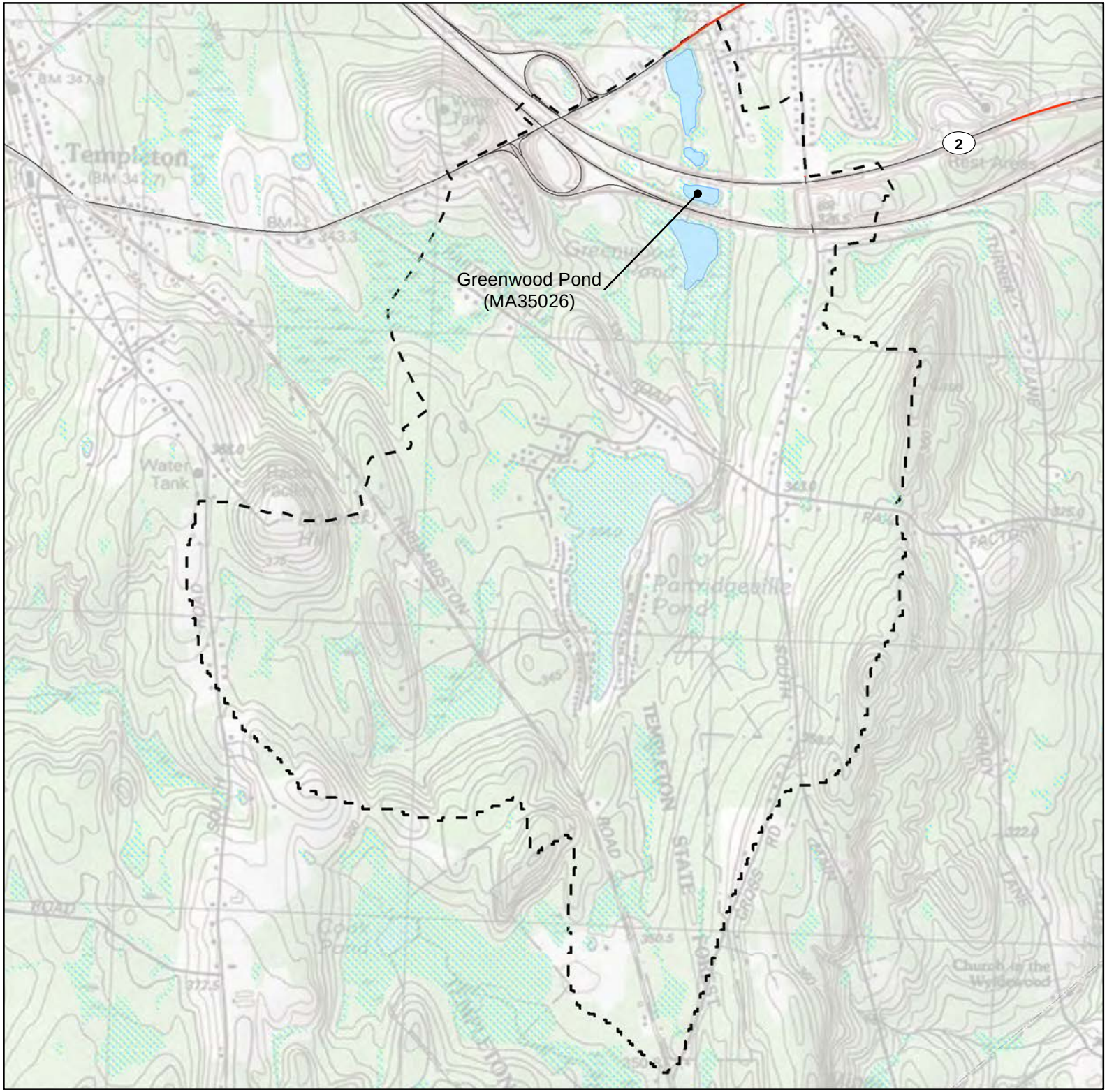

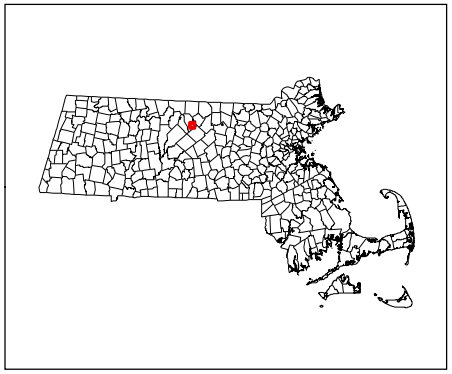

Impaired Stream Segment

Impaired Water Bodies

NWI Wetland Areas

MassDOT Roads in Urban Areas

MassDOT Roads

Greenwood Pond Subwatershed

Town Boundaries

N

0 1,500 3,000 Feet

1 in = 1,500 feet

Figure 1

Greenwood Pond Subwatershed MA35026

March 2012

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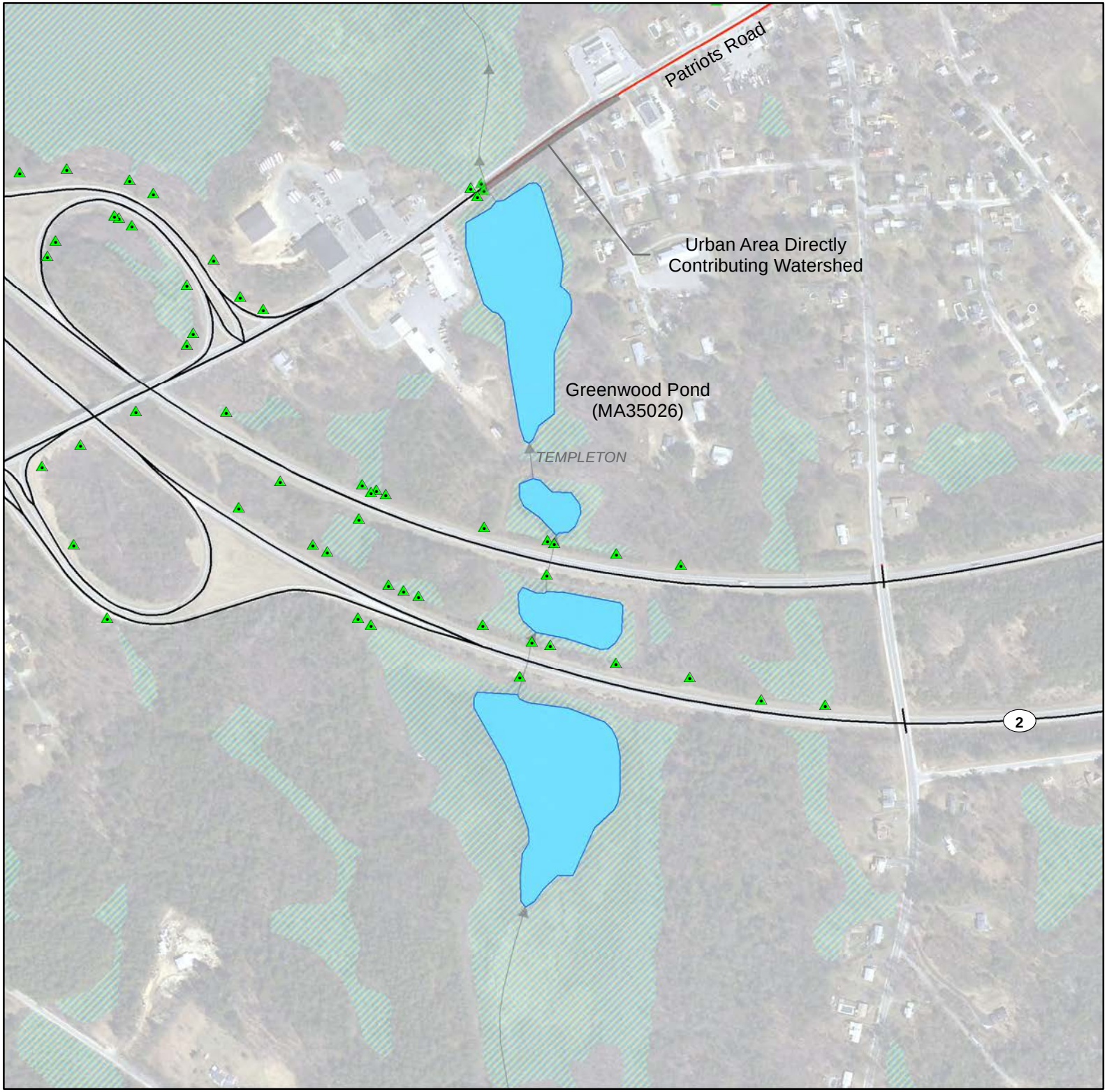

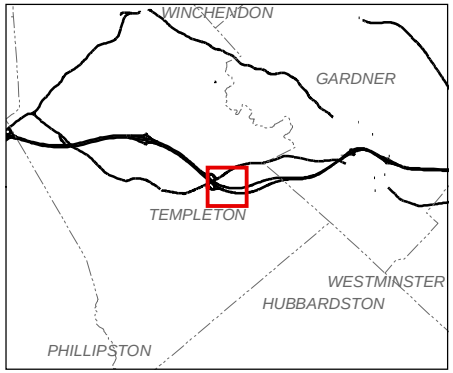

- Stormwater Outfalls
- MassDOT Directly Contributing Watersheds
- Impaired Stream Segment
- Impaired Water Bodies
- Non-Impaired Stream Segment
- NWI Wetland Areas
- MassDOT Roads in Urban Areas
- MassDOT Roads
- Town Boundaries

N

0 250 500 1,000 Feet

1 inch = 500 feet

Figure 2

Greenwood Pond Directly Contributing MassDOT Watershed MA35026

March 2012

Moving Massachusetts Forward. massDOT

Impaired Waters Assessment for Indian Lake (MA51073) – Progress Report

Impaired Water Body

Name: Indian Lake

Location: Worcester, MA

Water Body ID: MA51073

Impairments

Final *Massachusetts Year 2008 Integrated List of Waters* (MassDEP, 2008):

- Organic enrichment/ low DO
- Noxious aquatic plants

Final *Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2011):

- Aquatic plants (Macrophytes)
- Oxygen, dissolved

Indian Lake (MA51073) is listed in both MassDEP's final *Massachusetts Year 2008* and the final *Massachusetts Year 2010 Integrated List of Waters* as a Category 4a water body and is covered by MassDEP's *Total Maximum Daily Load of Phosphorus for Indian Lake* [CN 116.0] (MassDEP, 2002).

MassDEP's *Blackstone River Watershed 2003-2007 Water Quality Assessment Report* (MassDEP, 2010) states that the aquatic life use is assessed as impaired as a result of the presence of the non-native aquatic macrophyte *Myriophyllum spicatum*. The report recommends continued monitoring for the presence of invasive non-native aquatic vegetation and implementation of control practices to prevent the spreading of invasive aquatic plants.

The report states that in 2001, the Indian Lake Watershed Association (ILWA) received Section 319 funding to design and install a series of best management practices (BMPs) to prevent contaminated runoff from reaching Indian Lake. A long-term weed control plan was also implemented.

The TMDL report states that the impaired water quality of the lake is mainly a result of stormwater runoff of total phosphorus from the lake's urban watershed (MassDEP, 2002). The TMDL report recommends stormwater management and repairs and upgrades to the sanitary sewer pumps and sewer system to control nutrients.

Because Indian Lake has a TMDL, MassDOT used the TMDL Method (BMP 7R) to determine the amount of treatment provided by existing BMPs and the additional load reduction to meet the TMDL.

Relevant Water Quality Standards

Water Body Classification: Class B

Applicable State Regulations:

- *314 CMR 4.05 (3)(b) 1 Dissolved Oxygen*. Shall not be less than 6.0 mg/l in cold water fisheries and not less than 5.0 mg/l in warm water fisheries. Where natural background conditions are lower, DO shall not be less than natural background conditions. Natural seasonal and daily variations that are necessary to protect existing and designated uses shall be maintained.
- *314 CMR 4.05 (5) (c) Nutrients*. Unless naturally occurring, all surface waters shall be free from nutrients in concentrations that would cause or contribute to impairment of existing or designated uses and shall not exceed the site specific criteria developed in a TMDL or as otherwise established by the Department pursuant to 314 CMR 4.00. Any existing point source discharge containing nutrients in concentrations that would cause or contribute to cultural eutrophication, including the excessive growth of aquatic plants or algae, in any surface water shall be provided with the most appropriate treatment as determined by the Department, including, where necessary, highest and best practical treatment (HBPT) for POTWs and BAT for non POTWs, to remove such nutrients to ensure protection of existing and designated uses. Human activities that result in the nonpoint source discharge of nutrients to any surface water may be required to be provided with cost effective and reasonable best management practices for nonpoint source control.
- *314 CMR 4.05 (5) (a) Aesthetics*. All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.

Site Description

Indian Lake (MA51073) is a municipally-owned enlarged pond located in Worcester, MA and is approximately 186 acres with a contributing watershed area of approximately 1,964 acres (MassDEP, 2002). The lake was enlarged from its original 40-acre size by damming it in the 1930s. MassDEP's Total Phosphorus TMDL for Indian Lake states that the watershed is a mixture of residential and urban landuse and is approximately 50% wooded, 40% urban and 10% water. As shown in Figure 1, the lake lays upstream of Unnamed Tributary (Mill Brook) (MA51-08). Ararat Brook is the main tributary to Indian Lake and flows into the northwest side of the lake. There are several stormwater drains that feed into the lake, and sediment has been observed to wash into the lake near Barnstable Road and Hasting Avenue.

MassDOT's Grove Street (Route 122A) runs north-south to the west of Indian Lake. Stormwater runoff from Grove Street near the junction of Holden Street discharges directly to a non-impaired, unnamed stream that flows in to the western side of Indian Lake. This drainage is considered direct to Indian Lake because the stream is relatively short in length between Grove Street and Indian Lake and allows little opportunity for stormwater runoff to be treated. Stormwater runoff near Parkton Ave and Drummond Ave drains in to catch basins and discharges directly to Indian Lake.

Stormwater runoff from Grove Street north of the directly contributing watershed discharges to the eastern shoulder of Grove Street and flows to wetlands and wooded areas which eventually drain to the non-impaired Ararat Brook. Runoff from this area is not considered because it does not drain directly to the impaired water body.

MassDOT's Interstate 190 (I-190) runs north-south to the east of Indian Lake. Although the roadway is in close proximity to Indian Lake, no stormwater runoff from I-190 flows to Indian Lake. All stormwater runoff from this roadway drains directly to Unnamed Tributary (MA51-08).

The City of Worcester NPDES-permitted outfall (Permit MAS010002) discharges directly to Unnamed Tributary.

Assessment under BMP 7R (TMDL Method)

The phosphorus TMDL for Indian Lake addresses the impairments for dissolved oxygen and aquatic plants (macrophytes) for Indian Lake. Therefore, MassDOT assessed the contribution of phosphorus from MassDOT-owned property to this water body to address these impairments. The assessment was completed using the approach described in BMP 7R (TMDL Watershed Review).

TMDL

The Massachusetts Department of Environmental Protection's (MassDEP) TMDL report titled *Total Total Maximum Daily Load of Phosphorus for Indian Lake* [CN 116.0] (MassDEP, 2002) can be summarized as follows:

- Pollutant of Concern: Phosphorus
- Impairments for Indian Lake Addressed in TMDL: Organic enrichment/ low DO, Noxious aquatic plants
- Applicable Waste Load Allocation (WLA): See Table 1 (p. 14).
  - Current WLA (Watershed export) (TP): 383 kg/yr (843 lb/yr)
  - Target WLA (TP): 206 kg/yr (453 lb/yr)
  - Total Contributing Watershed: 795 ha (1964 acres)
  - Target Areal WLA (TP): 0.26 kg/ha/yr (0.23 lb/acre/yr)
- Applicable Recommendations: "Public Education, NPS Identification and Monitoring, Winter Lake Drawdown, Stormwater Runoff Erosion and Sediment Control, Residential BMPs, Urban BMPs, Highway BMPs, Carp Control, and Illicit Discharge Detection and Elimination" (Implementation section, page 15 and Table 2, page 18).

The TMDL provides a target WLA for the entire watershed and does not provide guidance for target loading based on specific landuse types. Therefore, MassDOT calculated its estimated TP loading based on property from all landuse types. This is a conservative approach because meeting this target load reduction would ensure MassDOT to treat more pollutant load than recommended if the TMDL had provided target TP WLAs based on associated landuse. (For example, including the forest landuse reduces the value for the target WLA because the TP loading for this landuse is much less than impervious surfaces).

Estimated Loading from MassDOT

The loading of total phosphorus (TP) from MassDOT property contributing storm water runoff to Indian Lake was estimated using the following assumptions and calculations:

- MassDOT estimates the TP loading from its impervious areas as 1.6 lb/acre/yr. This loading rate is based on data collected in a study of storm water runoff conducted by the United States Geological Survey (USGS) (Smith and Granato, 2010). The study analyzed storm water samples from 12 sites located on highways operated by MassDOT across

Massachusetts between September 2005 and September 2007. Samples were taken under a variety of weather conditions during this period.

- MassDOT estimates the TP loading from its pervious areas as 0.6 lb/acre/yr. This loading rate is based on the loading rate for hayland provided in the United States Environmental Protection Agency's (EPA) document EPA 440/5-80-011, "Modeling phosphorus loading and Pond response under uncertainty: a manual and compilation of export coefficients" (Reckhow, 1980). Hayland was chosen to represent the pervious right-of-way areas which are typically cleared areas that are mowed only once per year.
- MassDOT calculated the total estimated TP loading rate using the estimated loading rates listed above. MassDOT property contributing stormwater directly to Indian Lake is 3.9 acres of impervious area and 3.2 acres of pervious area. MassDOT's directly contributing watershed is shown in Figure 2. The TP loading is 8.2 lb/yr.
- MassDOT calculated the target TP WLA using the TMDL target areal WLA of 0.2 lb/ac/yr and the total area of MassDOT property within the TMDL watershed draining directly to Indian Lake (7.2 acres). The target TP WLA for MassDOT runoff is 1.7 lb/yr.

Assessment and Mitigation Plan

MassDOT calculated its current TP loading rate (8.2 lb/yr) and its target TP WLA (1.7 lb/yr) using values provided in MassDEP's TMDL report. The difference between these two values represents the target reduction in TP that MassDOT should aim to achieve to comply with the TMDL. For the watershed directly contributing to Indian Lake, this target reduction is about 6.6 lb/yr, or 80%. As explained in BMP 7R, MassDOT's pollutant loading analysis provides only a preliminary estimate of the targeted level of pollutant reductions. In light of the variability of data on stormwater discharges, MassDOT will rely on a variety of other factors apart from numeric guidelines, including site constraints, to determine the precise nature and extent of additional BMPs recommended for particular locations. This approach is consistent with the iterative, adaptive management BMP approach set forth in EPA guidelines.

During a site visit on November 22, 2011, no existing BMPs were identified at Indian Lake. Thus, there is currently no TP reduction being provided.

Conclusions

MassDOT evaluated its property within the directly contributing watershed to Indian Lake to identify existing BMPs. This assessment of Indian Lake has shown that MassDOT has no existing BMPs in place, and therefore, discharges storm water directly to Indian Lake without providing treatment.

To meet the TMDL for phosphorus, MassDOT should reduce its TP loading within the directly contributing watershed by 6.6 lb/yr to achieve the targeted reduction. MassDOT will now work with its design consultants to identify locations suitable for construction of one or more BMPs as part of MassDOT's Impaired Waters Retrofit Initiative. The design consultants will develop construction plans for the BMPs that aim to provide the target load reduction or treatment to the maximum extent practicable. Once the design of the proposed BMPs is finalized, MassDOT will develop a final assessment of this water body under the Impaired Waters program.

MassDOT will continue to identify opportunities to implement additional structural BMPs to address pollutant loading when road work is conducted under MassDOT"s programmed projects initiative. Work on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to addressing impairments. MassDOT will include an update in annual reports and biannual submittals to EPA regarding the design progress made towards meeting the load reduction, plans for construction of the BMPs and finalized assessments.

Furthermore, MassDOT will continue to implement non-structural BMPs that reduce the impacts of storm water.

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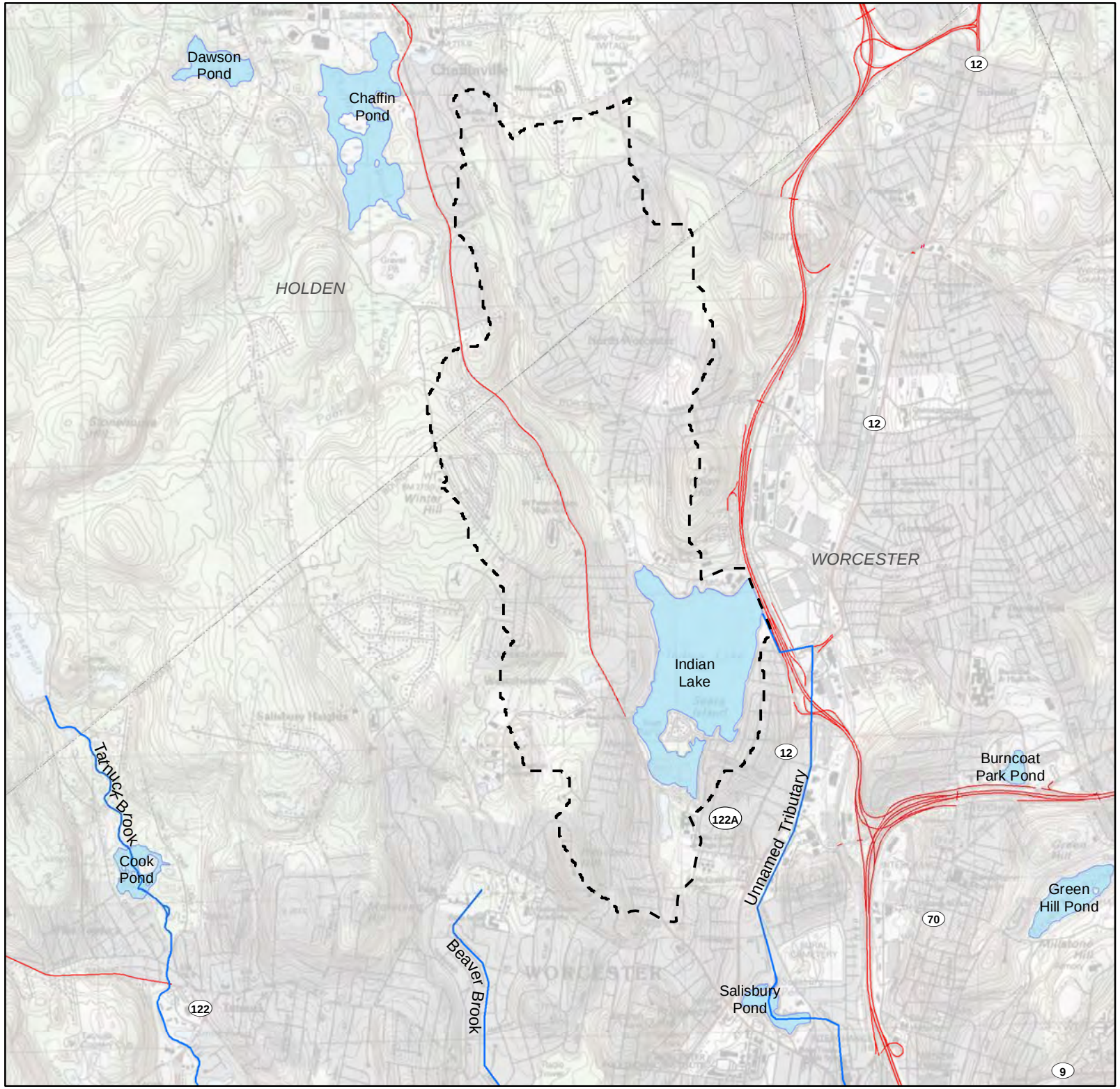
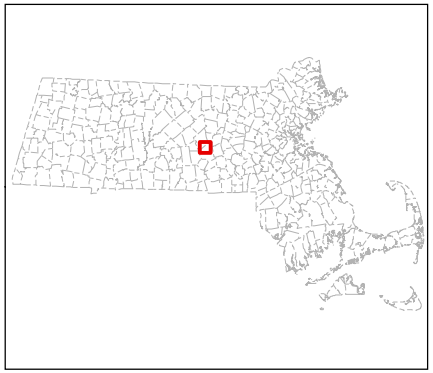




MA51073 Subwatershed
Impaired Stream Segment
Impaired Water Body
MassDOT Roads in Urban Areas
Town Boundaries

N

0 1,500 3,000 6,000

Feet

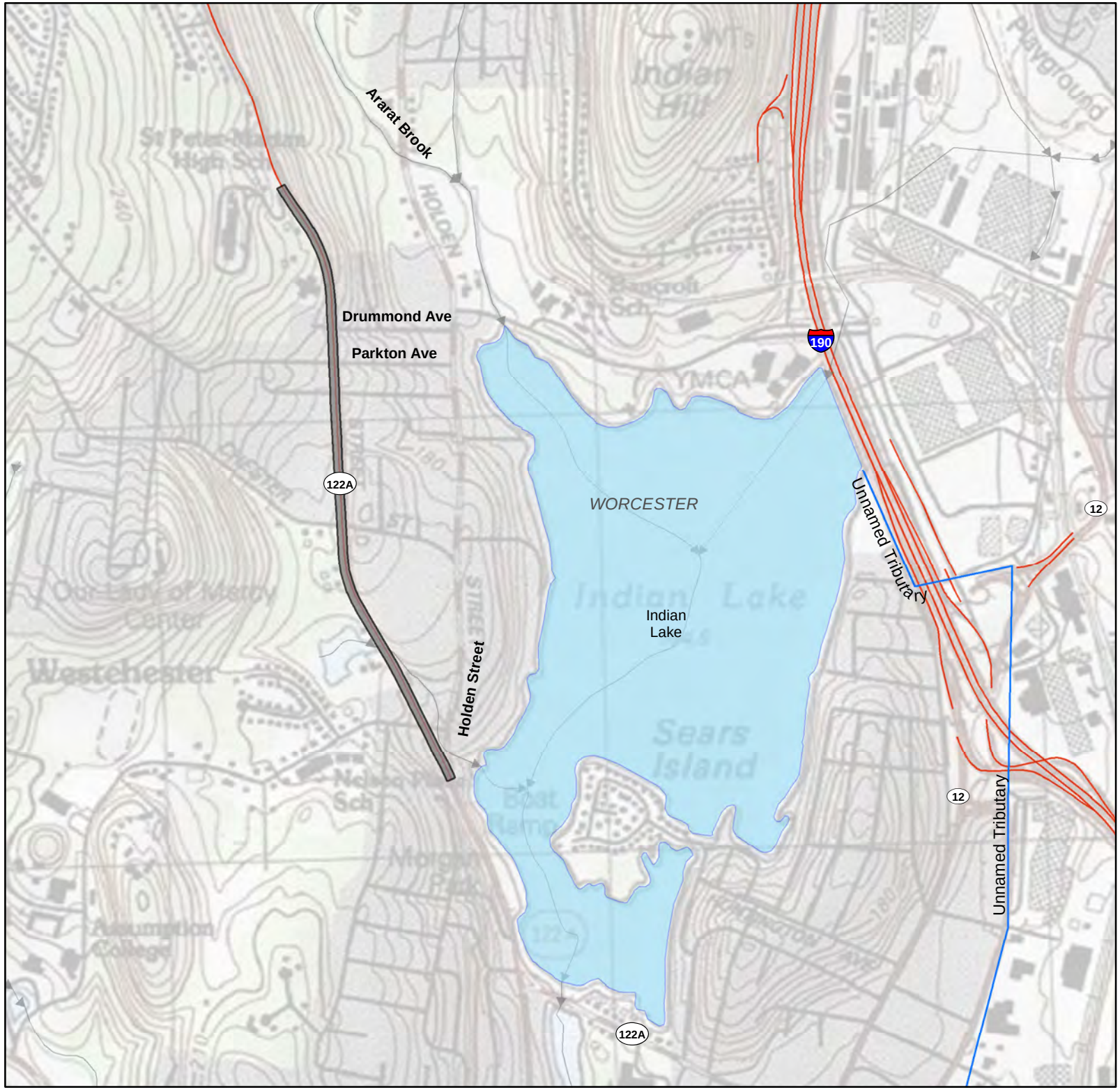
1 in = 3,000 feet

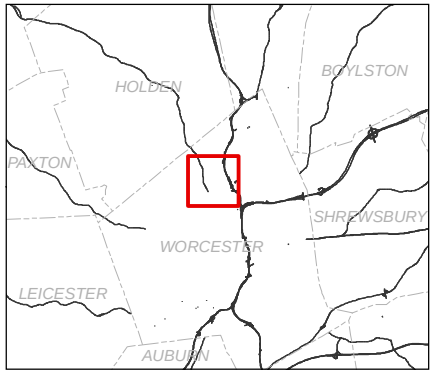
Figure 1

Indian Lake (MA51073)
Subwatershed
Worcester, MA

December 2011

Moving Massachusetts Forward. massDOT





MassDOT Contributing Watershed
Impaired Stream Segment
Impaired Water Body
Non-Impaired Stream Segment
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

N

0 500 1,000 2,000

Feet

1 in = 1,000 feet

Figure 2

Indian Lake (MA51073)
MassDOT Contributing Watershed
Worcester, MA

January 2012

Moving Massachusetts Forward. massDOT

Impaired Waters Assessment for Unnamed Tributary (MA51-08) – Progress Report

Impaired Water Body

Name: Unnamed Tributary (Mill Brook)

Location: Worcester, MA

Water Body ID: MA51-08

Impairments

Final *Massachusetts Year 2008 Integrated List of Waters* (MassDEP, 2008):

- Priority organics
- Metals
- Unionized ammonia
- Nutrients
- Organic enrichment/low DO
- Other habitat alterations
- Pathogens
- Oil and grease
- Taste
- Odor and color
- Suspended solids
- Turbidity
- Objectionable deposits.

Final *Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2011):

- Nutrient/Eutrophication Biological Indicators
- Physical substrate habitat alterations
- Other
- Aquatic plants (macrophytes)
- Fecal coliform
- Ammonia (un-ionized)
- Foam/flocs/scum/oil slicks
- Turbidity
- Taste and odor
- Sedimentation/siltation
- Debris/floatables/trash

Unnamed Tributary (MA51-08) (also known as Mill Brook) is listed under Category 5, "Waters Requiring a TMDL", on both MassDEP's final *Massachusetts Year 2008* and the final *Massachusetts Year 2010 Integrated List of Waters*. According to MassDEP's *Blackstone River Watershed 2003-2007 Water Quality Assessment Report* (MassDEP, 2010), Salisbury Pond (MA51142), which runs through the approximately 5.6-mile Unnamed Tributary, will no longer be assessed as its own lake segment and will now be considered a run of the river impoundment. Salisbury Pond is covered by a TMDL for phosphorus titled *Total Maximum Daily Loads of*

Phosphorus for Salisbury Pond [CN 114.0] (MassDEP, 2002). Salisbury Pond is on the final *Year 2008 Integrated List of Waters* under Category 5 for the following impairments: taste, odor and color, noxious aquatic plants, and turbidity. For the purposes of this assessment, MassDOT only analyzed the Unnamed Tributary segment. Salisbury Pond is considered in a separate assessment to be consistent with the final *2008 Integrated List of Waters*.

Relevant Water Quality Standards

Water Body Classification: Class B

Applicable State Regulations:

- *314 CMR 4.05 (5) (e) Toxic Pollutants*. All surface waters shall be free from pollutants in concentrations or combinations that are toxic to humans, aquatic life or wildlife. For pollutants not otherwise listed in 314 CMR 4.00, the National Recommended Water Quality Criteria: 2002, EPA 822R-02-047, November 2002 published by EPA pursuant to Section 304(a) of the Federal Water Pollution Control Act, are the allowable receiving water concentrations for the affected waters, unless the Department either establishes a site specific criterion or determines that naturally occurring background concentrations are higher. Where the Department determines that naturally occurring background concentrations are higher, those concentrations shall be the allowable receiving water concentrations. The Department shall use the water quality criteria for the protection of aquatic life expressed in terms of the dissolved fraction of metals when EPA's 304(a) recommended criteria provide for use of the dissolved fraction. The EPA recommended criteria based on total recoverable metals shall be converted to dissolved metals using EPA's published conversion factors. Permit limits will be written in terms of total recoverable metals. Translation from dissolved metals criteria to total recoverable metals permit limits will be based on EPA's conversion factors or other methods approved by the Department. The Department may establish site specific criteria for toxic pollutants based on site specific considerations.
- *314 CMR 4.05 (5) (c) Nutrients*. Unless naturally occurring, all surface waters shall be free from nutrients in concentrations that would cause or contribute to impairment of existing or designated uses and shall not exceed the site specific criteria developed in a TMDL or as otherwise established by the Department pursuant to 314 CMR 4.00. Any existing point source discharge containing nutrients in concentrations that would cause or contribute to cultural eutrophication, including the excessive growth of aquatic plants or algae, in any surface water shall be provided with the most appropriate treatment as determined by the Department, including, where necessary, highest and best practical treatment (HBPT) for POTWs and BAT for non POTWs, to remove such nutrients to ensure protection of existing and designated uses. Human activities that result in the nonpoint source discharge of nutrients to any surface water may be required to be provided with cost effective and reasonable best management practices for nonpoint source control.
- *314 CMR 4.05 (3)(b) 1 Dissolved Oxygen*. Shall not be less than 6.0 mg/l in cold water fisheries and not less than 5.0 mg/l in warm water fisheries. Where natural background conditions are lower, DO shall not be less than natural background conditions. Natural seasonal and daily variations that are necessary to protect existing and designated uses shall be maintained.
- *314 CMR 4.05 (5) (b) Bottom Pollutants or Alterations*. All surface waters shall be free from pollutants in concentrations or combinations or from alterations that adversely affect the physical or chemical nature of the bottom, interfere with the propagation of fish or shellfish, or adversely affect populations of non-mobile or sessile benthic organisms.
- *314 CMR 4.05 (3)(b) 4 Bacteria*.

- a. At bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: where E. coli is the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 126 colonies per 100 ml and no single sample taken during the bathing season shall exceed 235 colonies per 100 ml; alternatively, where enterococci are the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 33 colonies per 100 ml and no single sample taken during the bathing season shall exceed 61 colonies per 100 ml;
- b. For other waters and, during the non bathing season, for waters at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: the geometric mean of all E. coli samples taken within the most recent six months shall not exceed 126 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 235 colonies per 100 ml; alternatively, the geometric mean of all enterococci samples taken within the most recent six months shall not exceed 33 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 61 colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department 314 CMR 4.05 (3)(b) 7 Oil and Grease. These waters shall be free from oil and grease, petrochemicals and other volatile or synthetic organic pollutants.

- *314 CMR 4.05 (3)(b) 8 Taste and Odor*. None in such concentrations or combinations that are aesthetically objectionable, that would impair any use assigned to this Class, or that would cause tainting or undesirable flavors in the edible portions of aquatic life.
- *314 CMR 4.05 (3)(b) 5 Solids*. These waters shall be free from floating, suspended and settleable solids in concentrations or combinations that would impair any use assigned to this class, that would cause aesthetically objectionable conditions, or that would impair the benthic biota or degrade the chemical composition of the bottom.
- *314 CMR 4.05 (3)(b) 6 Color and Turbidity*. These waters shall be free from color and turbidity in concentrations or combinations that are aesthetically objectionable or would impair any use assigned to this class.
- *314 CMR 4.05 (5) (a) Aesthetics*. All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.

Site Description

Unnamed Tributary (also known as Mill Brook) originates at the outlet of Indian Lake (MA51073) and flows approximately 1.8 miles to Salisbury Pond (MA51142), 0.4 miles through Salisbury Pond, and another 3.4 miles from Salisbury Pond to the confluence with Middle River at the downstream side of American Steel Dam in the town of Worcester, Massachusetts. At this point Unnamed Tributary and Middle River join to form the Blackstone River. Unnamed Tributary flows through Salisbury Pond, formerly segment MA51142, and according to MassDEP's *Blackstone River Watershed 2003-2007 Water Quality Assessment Report*, the pond will no longer be reported as an approximately 13-acre lake segment because the estimated retention time is less than 3 days. Unnamed Tributary runs parallel with Interstate 190, Interstate 290 and Route 146.

The subwatershed for Unnamed Tributary includes Weasel Brook and extends north to the towns of Holden and West Boylston, Massachusetts (See Figure 1). The downstream portion of Weasel

Brook, a non-impaired water, is culverted and drains into the Unnamed Tributary culvert southeast of Indian Lake. The subwatershed is estimated to be approximately 6,186 acres and is approximately 53% impervious. The subwatershed consists of heavy residential, commercial and industrial development.

Unnamed Tributary is almost entirely culverted and surfaces at one location, Salisbury Pond. Downstream of the pond, the brook is culverted to its confluence with Middle River to form the Blackstone River. During restructuring of Route 146 in 2007, the brook's confluence with Middle River was moved approximately 1,800 feet downstream of the Millbury Street Bridge to reduce flooding in the Green Island Area. This portion of the brook is also culverted.

MassDOT roadway directly contributing stormwater to Unnamed Tributary is comprised of portions of Interstate 190, Interstate 290, Route 146, Route 12 and their associated ramps. Figure 2 shows the extent of MassDOT's directly contributing property. The southern extents of MassDOT directly contributing watershed ends at the intersection of Providence Street (Route 122A) and Route 146. Stormwater from this section of roadway drains directly to Unnamed Tributary via a 42-inch trunk line. Stormwater from sections of roadway south of this intersection discharges downstream to Blackstone River. The northern extents of MassDOT's directly contributing watershed ends just north of the ramp connecting I-190 to Hockawum Way. Stormwater runoff north of this area flows to non-impaired wetlands. All MassDOT area between these intersections as shown on Figure 2 is considered direct drainage to Unnamed Tributary. Nearly all stormwater from MassDOT's directly contributing watershed drains to catch basins and flows via trunk lines to underground connections in to Unnamed Tributary. This area includes approximately 124 acres of impervious MassDOT-owned roadway.

The following NPDES-permitted outfalls discharge directly to Unnamed Tributary:

- City of Worcester (MAS010002)
- Saint-Gobain Abrasives, Inc. and Saint-Gobain Ceramics & Plastics, Inc. (MA0000817)
- City of Worcester (MA0102997) (Quinsigamond Avenue Combined Sewer Overflow Storage and Treatment Facility – QCSOSTF)

Assessment under BMP 7U

The following impairments for Unnamed Tributary have not been addressed by a TMDL:

- Nutrient/Eutrophication Biological Indicators
- Physical substrate habitat alterations
- Other
- Aquatic plants (macrophytes)
- Fecal coliform
- Ammonia (un-ionized)
- Foam/flocs/scum/oil slicks
- Turbidity
- Taste and odor
- Sedimentation/siltation
- Debris/floatables/trash

Therefore, MassDOT assessed these impairments using the approach described in BMP 7U of MassDOT's Storm Water Management Plan (*Water Quality Impaired Waters Assessment and Mitigation Plan*), which applies to impairments that have been assigned to a water body prior to completion of a TMDL. As described in MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT, 2011), impervious cover (IC) provides a measure of the potential impact of

stormwater on many impairments. For this water body, the IC method was used for all the impairments except debris/floatables/trash, physical substrate habitat alterations, and fecal coliform.

The impairments for debris/floatables/trash and physical substrate habitat alterations are not considered to be caused by a pollutant (MassDEP, 2011). Therefore, these impairments are not caused by pollutant discharges from MassDOT's stormwater runoff. However, MassDOT's current Storm Water Management Plan (SWMP) includes litter clean-up and prevention measures related to the debris/floatable/trash impairment under the following BMPs:

- BMP 1H: Anti-litter/ Dumping Messages on Variable Message Boards
- BMP 1I: Anti-litter/ Dumping Literature at Visitors Centers
- BMP 6A2: Source Control: Adopt-a-Highway Program
- BMP 6A1: Source Control: 511 Massachusetts Traveler Information System

The impairment for fecal coliform is assessed separately in the section below titled Assessment under BMP 7U for Pathogens.

MassDOT's Application of the Impervious Cover Method

MassDOT's Application of Impervious Cover Method in BMP 7U applies many aspects of USEPA Region I's Impervious Cover (IC) Method described in EPA's *Stormwater TMDL Implementation Support Manual* (ENSR, 2006) to MassDOT's program. This method assesses potential stormwater impacts on the impaired water and evaluates the impervious cover reduction required to ensure that stormwater is not the cause of the impairments. Consistent with findings of EPA and others, when a watershed had less than 9% impervious cover, MassDOT concluded that stormwater was not the likely cause of the impairment. Additional information regarding this method is provided in MassDOT's Application of IC Method document.

First, MassDOT calculated the percent IC of the water body's entire contributing watershed (total watershed upstream of the downstream end of an impaired segment) and that of the local watershed contributing to the impaired segment (referred to as the subwatershed in this analysis) to determine whether stormwater has a potential to cause the impairments of the receiving water body. The total watershed and subwatershed to the impaired water body were delineated using the USGS Data Series 451. When USGS Data Series watersheds did not delineate the subwatershed of the water body under review, the GIS shapefiles were modified by delineating to the water body based on USGS topography to add specificity. Impervious cover data was available as part of the USGS data layers Data Series 451 and MassGIS's impervious surfaces data layer. In cases where it was determined that stormwater was a potential cause of the impairment, MassDOT calculated the degree to which impervious cover would need to be reduced in the subwatershed to meet the 9% IC target. This reduction was then applied proportionally to the area of MassDOT roadways/properties directly discharging to the water body segment to identify MassDOT's target IC reduction. The 9% IC reduction serves only as a recommended target and is not meant to imply that failing to meet the target would cause an exceedance in water quality standards. As explained in BMP 7U, MassDOT will consider a variety of factors apart from numeric guidelines, including site constraints and the magnitude of any potential exceedances in water quality standards, to determine the precise nature and extent of additional BMPs recommended for particular locations. This approach is consistent with the iterative, adaptive management BMP approach set forth in EPA guidelines.

MassDOT calculated the effective impervious cover reduction afforded by the existing structural BMPs currently incorporated into the stormwater infrastructure of MassDOT's properties. This effective IC reduction was calculated by applying effective impervious cover reduction rates to existing BMPs based on their size, function and contributing watershed. BMP performances were

derived from EPA Region 1's *Stormwater Best Management Practices (BMP) Performance Analysis* report (EPA, 2010) and engineering judgment. More information on the approach used to calculate the effective impervious cover reductions is described in BMP 7U. When the reduction in effective impervious cover achieved by the existing BMPs was equal to or greater than the target reduction, no further measures were proposed. When this was not the case, MassDOT considered additional BMPs in order to meet the targeted reduction.

Using this approach, MassDOT derived the following site parameters for the total contributing watershed of the impaired water (Unnamed Tributary (MA51-08)):

Watershed		
Watershed Area	8,155	acres
Impervious Cover (IC) Area	3,665	acres
Percent Impervious	45	%
IC Area at 9% Goal	734	acres
Target Reduction % in IC	80	%
Subwatershed		
Subwatershed Area	6,186	acres
Impervious Cover (IC) Area	3,247	acres
Percent Impervious	53	%
IC Area at 9% Goal	557	acres
Target Reduction % in IC	83	%
Reductions Applied to DOT Direct Watershed		
MassDOT's IC Area **Directly** Contributing to Impaired Segment	124	acres
MassDOT's Target Reduction in Effective IC (83% of DOT Directly Contributing IC)	102	acres

The Unnamed Tributary subwatershed is greater than 9% impervious which indicates that stormwater likely contributes to water body's impairments. The subwatershed should target a reduction of its effective IC by 83% to reach the 9% goal. Therefore, MassDOT will aim to reduce its effective IC within the directly contributing watershed by the same percentage by removing 102 acres of effective IC.

Existing BMPs

There are no existing BMPs within MassDOT's directly contributing watershed to Unnamed Tributary that are mitigating potential stormwater quality impacts. Therefore, no effective IC reduction is provided by existing MassDOT BMPs.

Next Steps

Because the total mitigation of impervious surface achieved by MassDOT's existing BMPs is less than the target reduction of 102 acres, MassDOT will consider the implementation of additional BMPs. MassDOT's assessment provides only a preliminary estimate of the level of impervious cover to be considered. MassDOT will rely on a variety of other factors apart from numeric guidelines, including site constraints, to determine the precise nature and extent of additional BMPs

recommended for particular locations. This approach is consistent with the iterative, adaptive management BMP approach set forth in EPA guidelines.

MassDOT has initiated the design of twenty stormwater BMPs to address its direct and indirect stormwater discharges to Unnamed Tributary. Conceptual designs for the BMPs are documented in a memorandum prepared for Programmed Project # 605588, the resurfacing of Interstate 190 northbound from mile markers 0.0 to 3.5 in Worcester, titled "I-190 Resurfacing – Stormwater Improvement Recommendations" and dated 12/29/2011. Seven of the BMPs address MassDOT's direct stormwater discharges to Unnamed Tributary. These BMPs consist of two infiltration swales and five infiltration basins providing 14 acres of effective IC removal within MassDOT's directly contributing watershed. The remaining thirteen BMPs address MassDOT's indirect stormwater discharges to Unnamed Tributary and consist of six infiltration swales and seven infiltration basins providing 19 acres of effective IC reduction. Although the thirteen BMPs do not provide effective IC reduction within MassDOT's directly contributing watershed, they do have a positive impact on Unnamed Tributary because they are located upstream. Table 1 summarizes the percent reductions in effective IC provided by the BMPs.

Table 1: I-190 Resurfacing Project #605588 BMP Recommendations

BMP Name	BMP Type	Contributing Watershed Impervious Area (ac)	Effective IC Percent Reduction	Effective IC Reduction (ac.)
In MassDOT's Directly Contributing Watershed:				
Pr-BMP-1*	Infiltration Swale	0.8	94%	0.7
Pr-BMP-2*	Infiltration Basin	6.6	94%	6.2
Pr-BMP-3	Infiltration Basin	0.7	94%	0.7
Pr-BMP-4	Infiltration Basin	1.2	94%	1.1
Pr-BMP-5	Infiltration Basin	0.3	94%	0.3
Pr-BMP-6	Infiltration Basin	4.7	94%	4.4
Pr-BMP-7	Infiltration Swale	1.0	90%	0.9
Total		**15**		**14**
Outside of MassDOT's Directly Contributing Watershed and Within Project Limits:				
Pr-BMP-8	*Infiltration Swale*	*1.2*	*91%*	*1.1*
Pr-BMP-9	*Infiltration Swale*	*1.1*	*89%*	*1.0*
Pr-BMP-10	*Infiltration Basin*	*0.6*	*72%*	*0.4*
Pr-BMP-11	*Infiltration Basin*	*2.3*	*31%*	*0.7*
Pr-BMP-12	*Infiltration Swale*	*0.2*	*94%*	*0.2*
Pr-BMP-13	*Infiltration Basin*	*4.6*	*65%*	*3.0*
*Pr-BMP-14**	*Infiltration Basin*	*4.5*	*94%*	*4.3*
*Pr-BMP-15**	*Infiltration Swale*	*1.8*	*80%*	*1.5*
Pr-BMP-16	*Infiltration Basin*	*1.4*	*77%*	*1.1*
Pr-BMP-17	*Infiltration Basin*	*1.2*	*95%*	*1.1*
Pr-BMP-18	*Infiltration Basin*	*2.5*	*97%*	*2.4*
Pr-BMP-19	*Infiltration Swale*	*1.6*	*90%*	*1.5*
Pr-BMP-20	*Infiltration Swale*	*0.8*	*75%*	*0.6*
Total		*24*		*19*

*BMPs in series

The following paragraphs briefly describe the conceptual designs of the BMPs within MassDOT's directly contributing watershed to Unnamed Tributary. Refer to the memorandum for Resurfacing Project #605588 for additional details. Figure 3 shows the locations of the conceptual BMPs and their corresponding watersheds.

Pr-BMP-1

Between Millbrook Street and the Interstate-290 southbound on-ramp, at the junction of Interstate-190 and Interstate-290 there is available space to construct an infiltration swale. This space includes a grassed area approximately 40-feet by 640-feet between the two roadways. Currently stormwater is collected in catch basins and drains to a trunk line which runs through this area. The trunk line and catch basins could be modified to direct stormwater to a surface infiltration swale rather than to the piped system. Excavation would be required to remove the existing stormwater pipe and install the infiltration swale. The hydrologic soil group (HSG) for soil in this area is not known and soil testing would be required during design to ensure proper infiltration could occur. AECOM assumed soils to have characteristics of soil of HSG C for this evaluation. Approximately 0.8 acres of MassDOT-owned impervious cover (IC) could be redirected to this infiltration swale that could provide up to 94% effective IC removal. Pr-BMP-1 could be constructed to provide treatment in series with Pr-BMP-2.

Pr-BMP-1: Area for proposed infiltration swale

Pr-BMP-2

Downstream of Pr-BMP-1 there is a vegetated depression between Interstate-190 Southbound and Interstate-290. The vegetated area could be excavated to construct an infiltration basin to treat stormwater runoff in series with Pr-BMP-1. Currently two 24-inch trunk lines and one 48-inch trunk line drain into an approximately 66-inch trunk line at the northern end of the area of the proposed basin. Flow from these pipes could be redirected into the proposed basin. Two 18-inch culverts tie into the 66-inch culvert immediately downstream of the proposed basin. For this analysis, AECOM conservatively assumed that the two 24-inch trunk lines could be directed to the infiltration basin while the 48-inch trunk line and two 18-inch inch trunk lines would bypass the proposed basin, untreated. Detailed hydrologic and hydraulic analysis should be completed to determine the capacity of the proposed infiltration basin during design. During design, it may be determined that more or less stormwater could be treated by the proposed infiltration basin; this could include diverting additional stormwater from two 18-inch lines and 48-inch trunk lines to the proposed infiltration basin. The HSG for soil in this area is not known and soil testing would be required during

design to ensure proper infiltration could occur. AECOM assumed soils to have characteristics of soil of HSG C for this analysis. If soil in the area does not provide adequate infiltration a wet basin could be proposed. Based on the assumption that stormwater from only the two 24-inch trunk lines could be treated by the proposed infiltration basin, approximately 6.6 acres of MassDOT-owned impervious cover could be directed to the proposed basin providing up to 94% effective IC removal.

Pr-BMP-2: Area for proposed infiltration basin

Pr-BMP- 3

There is a grass covered area between the ramp from Interstate-190 to Route-12 northbound and the Greendale Mall parking lot on the southwest side of the building that could be excavated to construct a long infiltration basin. Currently a 30-inch trunk line runs below this area and collects approximately 3.0 acres of stormwater from Interstate-190 and its ramps. The basin could not handle stormwater from the entire drainage area; however, a diversion structure could be constructed or the scuppers from the elevated portion of Interstate-190 could be redirected to allow some water to drain to the proposed basin. The HSG for soil in this area is not known and soil testing would be required during design to ensure proper infiltration could occur. AECOM assumed soils to have characteristics of soil of HSG C. AECOM conservatively assumed 25% of the 3.0 acres could be treated. Assuming a contributing drainage area of 0.7 acres of MassDOT-owned impervious cover, the proposed basin could provide up to 94% effective IC removal.

Pr-BMP-3: Area for proposed infiltration basin

Pr-BMP- 4

On the west side of the ramp from Route-12 northbound to Interstate-190 northbound there is a grass and vegetated depression which could be converted to an infiltration basin. Currently catch basins along the ramp drain to a large 60-inch trunk line. The catch basins could be removed and paved outlets constructed to divert water to the shoulder. There is already and existing drop inlet in the grass which could be modified to become the basin outlet. The HSG for soil in this area is not known and soil testing would be required during design to ensure proper infiltration could occur. AECOM assumed soils to have characteristics of soil of HSG C. Modifying the two existing catch basins would allow up to 0.5 acres of MassDOT impervious area to drain to this area providing 94% effective IC removal. It is possible to alter the curb along the adjacent elevated portion of Interstate-190 northbound to allow an additional 0.7 acres of MassDOT-owned impervious cover to drain to the proposed basin providing 94% effective IC removal as well.

Pr-BMP-4: Area for proposed infiltration basin

Pr-BMP- 5

On the east side of the ramp from Route-12 northbound to Interstate-190 northbound there is a large grass depression which could be converted to an infiltration basin. Currently, approximately 0.3 acres of MassDOT-owned impervious cover is collected in two catch basins and drains to a manhole on the side of the ramp which drains to a 60-inch trunk line. The manhole could be modified to discharge stormwater to an infiltration basin. There is space to construct the basin, and the area is currently just covered in grass. However, it is unclear how much of the grass area is owned by MassDOT. The HSG for soil in this area is not known and soil testing would be required during design to ensure proper infiltration could occur. AECOM assumed soils to have characteristics of soil of HSG C. It might be possible during design to direct more MassDOT-owned impervious cover to the basin. The infiltration basin could provide up to 94% effective IC removal.

Pr-BMP-5: Area for proposed infiltration basin

Pr-BMP- 6

There is a large parcel of land adjacent to both I-190 southbound and Indian Lake which could be converted to an infiltration basin. The area is currently vegetated but the land is not developed. I-190 is elevated approximately 20-feet above the ground surface of this parcel. Stormwater from this portion of I-190 is collected in catch basins and drain to a 24-inch trunk line. The trunk line has a manhole just south of the I-190 revetment along Indian Lake that could be modified during resurfacing. The 24-inch trunk line could be redirected south to the proposed basin. The HSG for soil in this area is not known and soil testing would be required during design to ensure proper infiltration could occur. AECOM assumed soils to have characteristics of soil of HSG C. The 24-inch trunk line drains approximately 4.7 acres of MassDOT-owned impervious cover, and if redirected, the proposed infiltration basin could provide 94% effective IC removal.

Pr-BMP-7

North of Indian Lake between N Frontage Road and I-190 northbound there is a grassy area between the two roadways that is available to construct an infiltration swale. This area is approximately 25-feet in width. Currently stormwater is collected in catch basins and drain to a trunk line which runs through this area. The catch basins could be removed and paved outlets added to the curbing to allow stormwater runoff to drain to the proposed swale rather than the piped system. There is currently a drop inlet at the downstream end of the proposed swale that can be modified as an outlet control. The hydrologic soil group for soil in this area is B characteristic of loamy soils and provides good infiltration capability. Approximately 1.0 acres of MassDOT-owned impervious cover could be redirected to this infiltration swale that could provide up to 90% effective IC removal.

Pr-BMP-7: Area for proposed infiltration swale

In total, MassDOT's goal is to reduce effective IC within its directly contributing watershed to Unnamed Tributary by 102 acres to achieve the 9% target. As discussed above, MassDOT has no existing BMPs within Unnamed Tributary directly contributing watershed. The BMPs included in the memorandum prepared for Programmed Project # 605588 will reduce the amount of MassDOT's effective IC within its directly contributing watershed to Unnamed Tributary by approximately 14 acres. Therefore MassDOT's remaining retrofit target is 88 acres.

Assessment under BMP 7U for Pathogens

Pathogen concentrations in stormwater vary widely temporally and spatially; concentrations can vary by an order of magnitude within a given storm event at a single location (MassDEP, 2009b). Therefore, it is difficult to predict stormwater pathogen concentrations with accuracy. Due to this difficulty, MassDOT generally will not conduct site-specific assessments of loading at each location impaired for pathogens. Instead these sites will be assessed collectively based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to stormwater management.

In addition, while there is a positive relationship between impervious cover and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely solely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in stormwater runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliform organisms/100 ml. Concentrations of pathogens in stormwater runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform bacteria in

urban stormwater from other sources ranging between 14,000 and 17,000 fecal coliform organisms/100 ml have been reported (MassDEP, 2009b). This data suggests that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other stormwater systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles, and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the stormwater system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally cross them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from stormwater runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other stormwater systems and a large number of other factors.

Assessment and Mitigation Plan

Pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (MassDEP, 2009a)
- "The NPDES permit does not, however, establish numeric effluent limitations for stormwater discharges. Maximum extent practicable (MEP) is the statutory standard that

establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals."(MassDEP, 2009b)

- "Although the TMDL presents quantified WLAs for stormwater that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs." (MassDEP, no date).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of stormwater management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contains specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing stormwater discharges to pathogen impaired waters. Section 2.2.1(c) of the permit states "For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA." Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Storm Water Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure
- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System
- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

In addition, the structural BMPs that will be considered to reduce the IC will also have the effect of reducing pathogen loads.

MassDOT believes the existing and proposed efforts are consistent with the current and draft MS4 permit's requirements and TMDL recommendations. MassDOT's existing stormwater management plan outlines BMPs that include education and illicit discharge detection and elimination. Although not included in this permit term, MassDOT will be implementing a pet waste management program at its rest stops that have discharges to pathogen-impaired waters. In addition, MassDOT has requested coverage under an individual stormwater permit for the next permit term. This permit may contain additional programmatic BMPs to address pathogens.

Conclusions

MassDOT used the IC Method to assess Unnamed Tributary for many of the impairments identified in MassDEP's Final *Year 2010 Integrated List of Waters*. Results indicate that MassDOT should aim to reduce its effective IC within its directly contributing watershed to Unnamed Tributary by 102 acres to achieve the targeted reduction in effective IC.

MassDOT has initiated the design of stormwater BMPs under Programmed Project # 605588. These proposed BMPs provide a combined reduction in effective IC within MassDOT's directly contributing watershed to Unnamed Tributary of approximately 14 acres. MassDOT's remaining retrofit target after subtracting the reduction in effective IC provided by the proposed BMPs is 88 acres. Table 3 summarizes IC reductions within MassDOT's directly contributing watershed under existing and proposed conditions.

Table 3. Effective IC Reductions under Existing & Proposed Conditions

Impervious Cover Reduction		
MassDOT Target Reduction in Effective IC	102	acres
Effective IC Reduction under Existing Conditions	0	acres
IC Effective Reduction under Proposed Conditions for Programmed Project # 605588	14	acres
Remaining Target	**88**	**acres**

MassDOT will now work with its design consultants to identify opportunities for additional BMPs to meet the remaining target of 88 acres of effective IC. Note that this remaining target may change depending on the final designs for the conceptual BMPs included in the memorandum for Programmed Project # 605588. The design consultants will strive to meet the remaining target plus any difference in effective IC reduction resulting from final BMP designs. The final BMP designs will provide treatment to the maximum extent practicable given site constraints that are identified as the design process moves forward. Once the designs are finalized, MassDOT will perform a final assessment of this water body under the Impaired Waters program.

MassDOT will continue to identify opportunities to implement additional structural BMPs to address pollutant loading when road work is conducted under MassDOT''s Programmed Projects Initiative, such as Programmed Project #605588. Work on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to addressing impairments. MassDOT will include an update in annual reports and biannual submittals to EPA regarding the design progress made towards meeting the IC reduction, plans for construction of the

BMPs and finalized assessments. Furthermore, MassDOT will continue to implement non-structural BMPs that reduce the impacts of stormwater.

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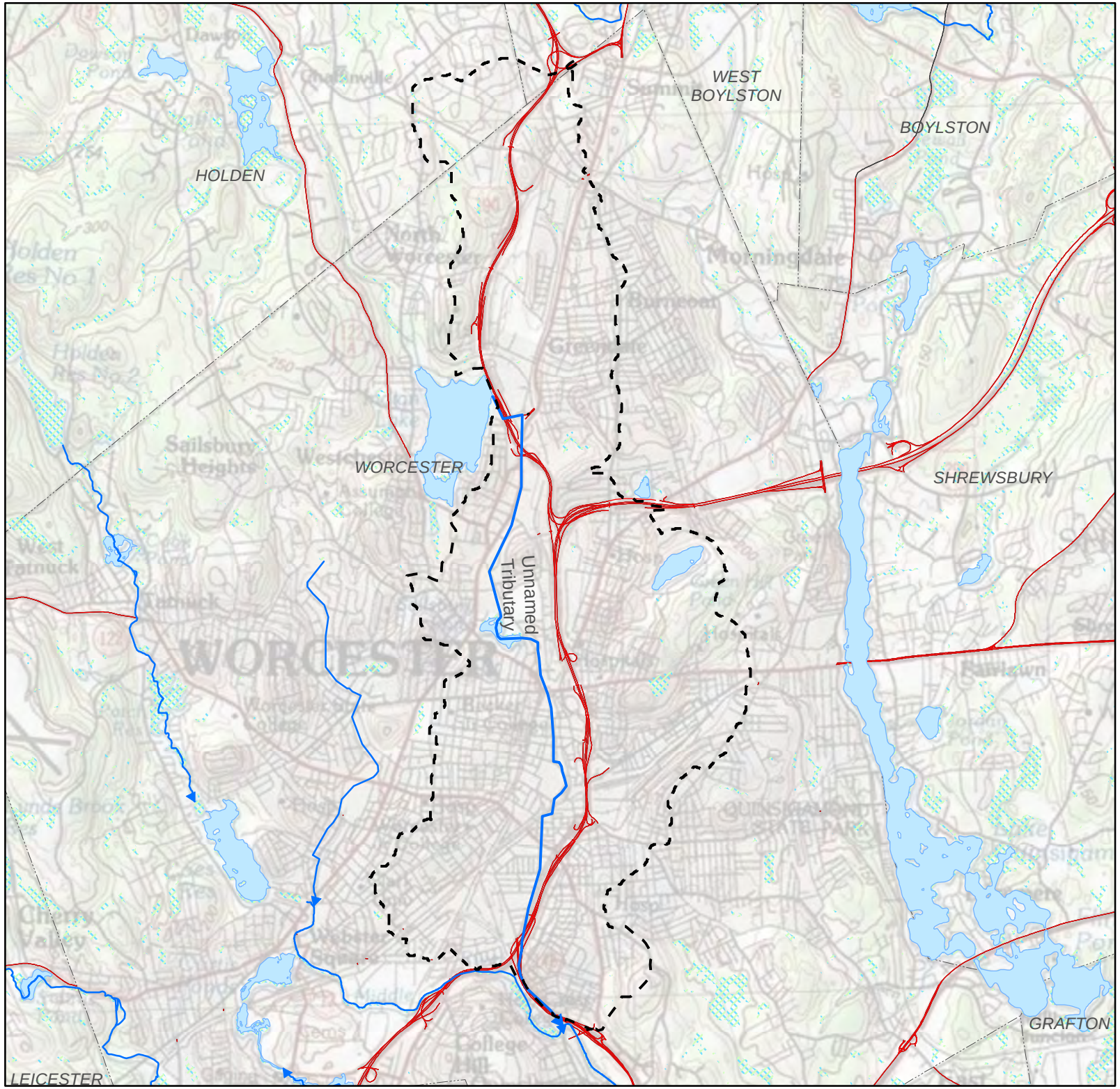
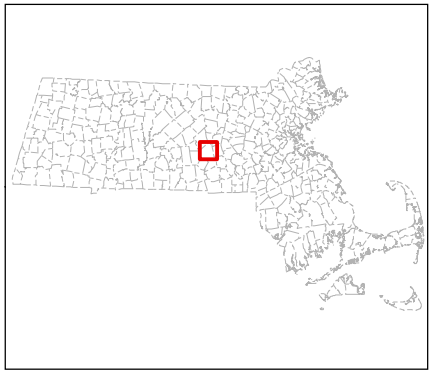




Unnamed Tributary Subwatershed
Unnamed Tributary
Impaired Stream Segment
Impaired Water Bodies
NWI Wetland Areas
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

N

0 2,500 5,000 10,000

Feet

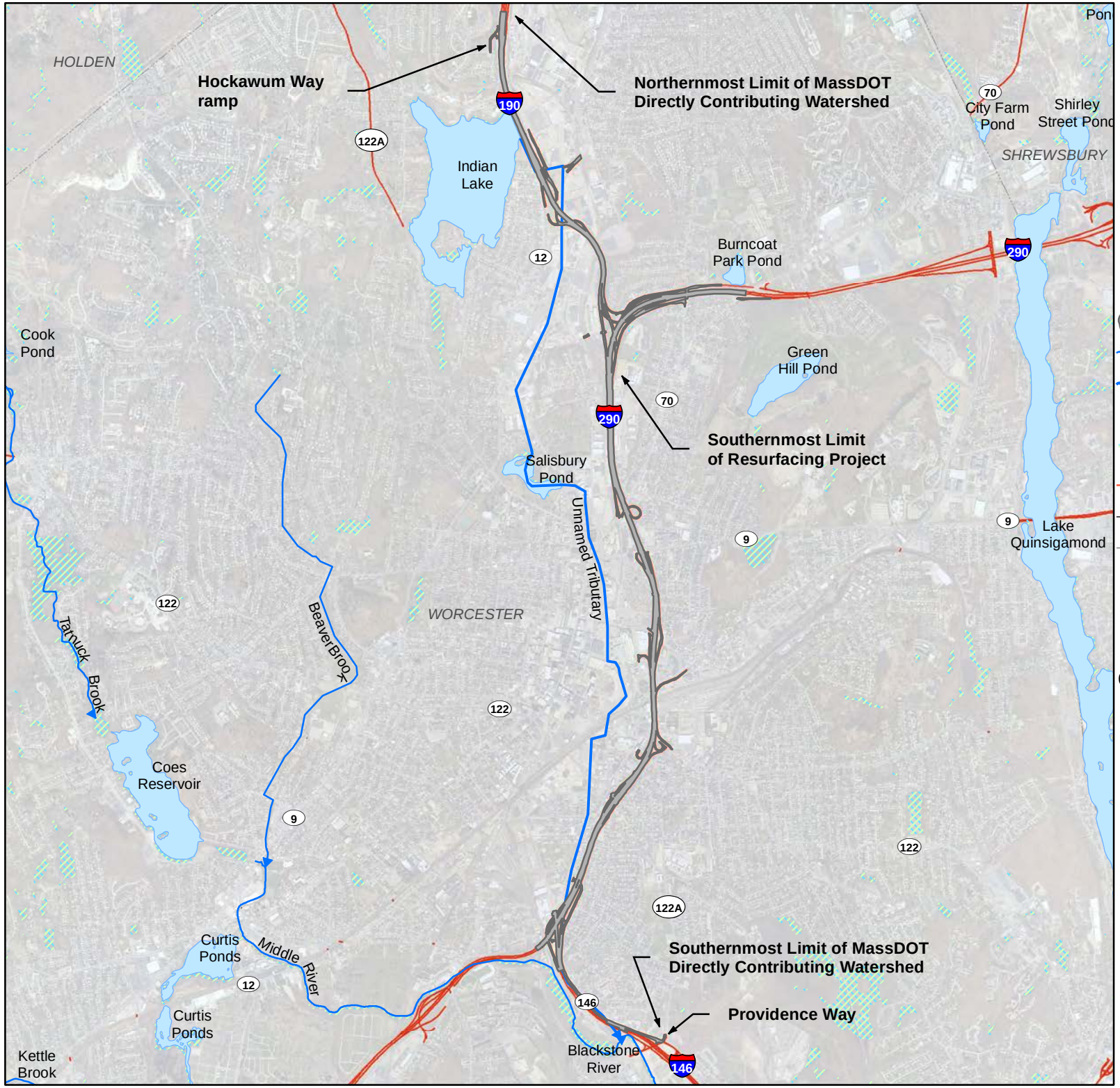
1 in = 5,000 feet

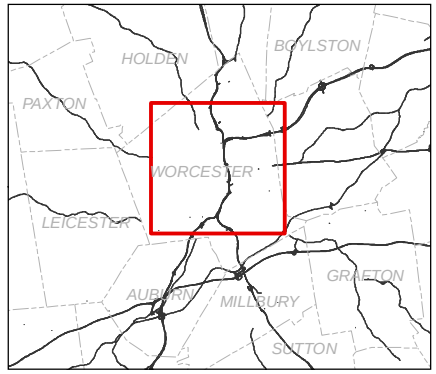
Figure 1

Unnamed Tributary (MA51-08)
Subwatershed
Worcester, MA

January 2012

Moving Massachusetts Forward. massDOT





- MassDOT Contributing Watershed
- Impaired Stream Segment
- Unnamed Tributary
- Impaired Water Bodies
- NWI Wetland Areas
- MassDOT Roads in Urban Areas
- MassDOT Roads
- Town Boundaries

N

0 2,000 4,000 8,000

Feet

1 in = 3,500 feet

Figure 2

Unnamed Tributary (MA51-08)
Directly Contributing IC
MassDOT Watershed
Worcester, MA

January 2012

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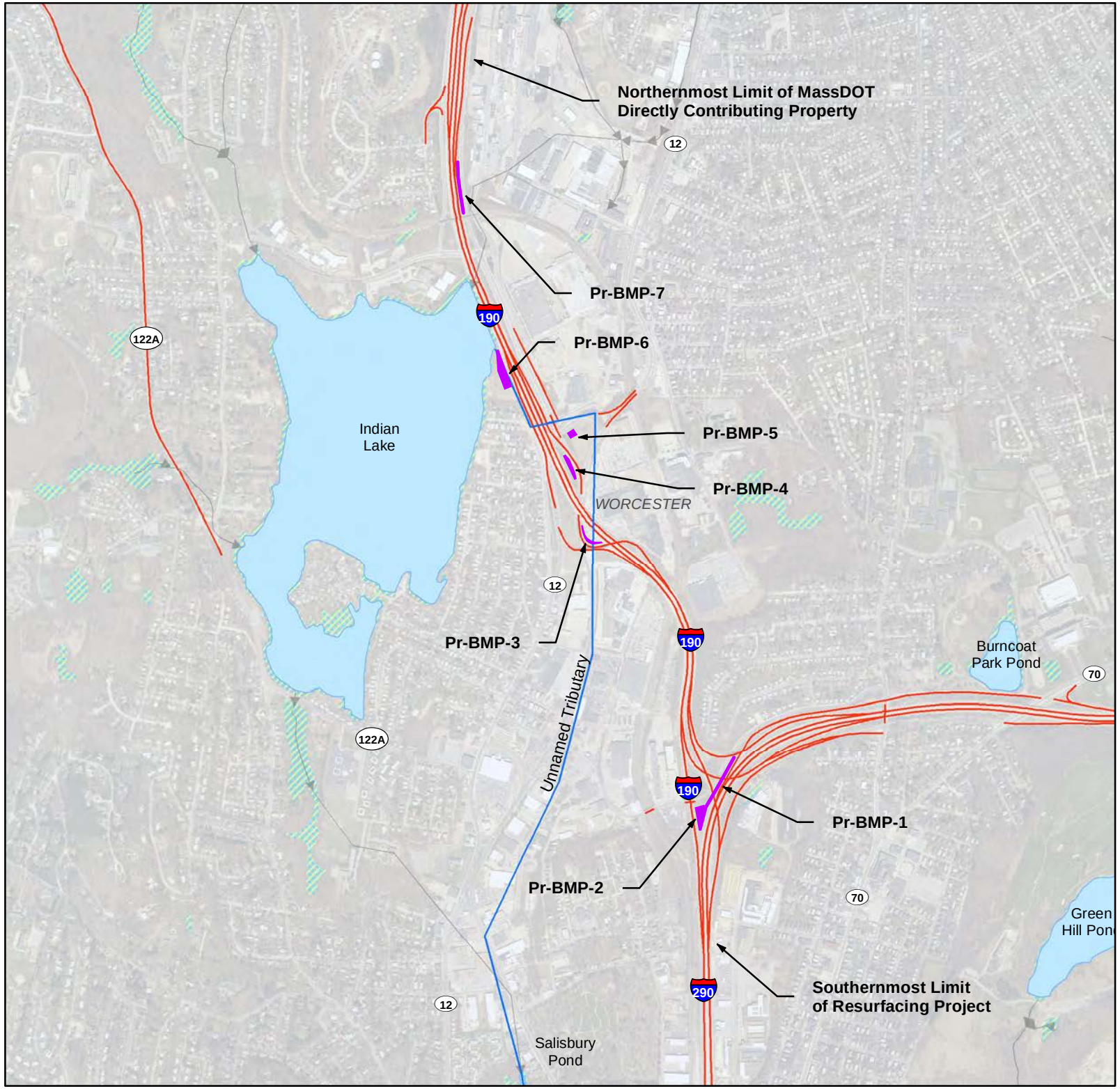

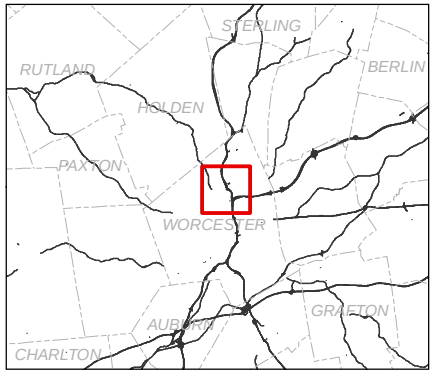

- Proposed BMP - Swale
- Proposed BMP - Basin
- Impaired Stream Segment
- Impaired Water Bodies
- Non-Impaired Stream Segment
- NWI Wetland Areas
- MassDOT Roads in Urban Areas
- MassDOT Roads
- Town Boundaries

N

0 750 1,500 3,000

Feet

1 in = 1,500 feet

Figure 3

Unnamed Tributary (MA51-08)
Proposed BMPs
Worcester, MA

January 2012

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Impaired Waters Assessment for Robinson Brook (MA62-14) – Progress Report

Impaired Water Body

Name: Robinson Brook

Location: Foxborough & Mansfield, MA

Water Body ID: MA62-14

Impairments

Final *Massachusetts Year 2008 Integrated List of Waters* (MassDEP, 2008):

- Cause Unknown
- Other Habitat Alterations

Final *Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2011):

- Aquatic Macro-invertebrate Bioassessments
- Physical Substrate Habitat Alterations

Robinson Brook (MA62-14) is listed under Category 5, Waters Requiring a TMDL, on MassDEP's Final *Year 2008* and *Year 2010 Integrated List of Waters*. According to MassDEP's *Taunton River Watershed 2001 Water Quality Assessment Report* (MassDEP, 2005), 1.855 miles of Robinson Brook, from the outlet of Hersey Pond in Foxborough to its confluence with the Rumford River (MA62-39) in Mansfield, are impaired due to organic enrichment and habitat quality degradation. Although the exact cause of the impairment is unknown, the report suggests that impairments are likely due to significant amounts of in-stream sedimentation from nonpoint source pollution inputs (*e.g.* highway, bridge, and road runoff).

As described below, MassDOT recommends the implementation of various Best Management Practices (BMPs) for Robinson Brook to improve water quality based on an assessment using the Impervious Cover (IC) Method. While these recommendations for BMPs address impairments specific to Robinson Brook, all receiving water bodies downstream of the BMPs will ultimately benefit from the improvements.

Relevant Water Quality Standards

Water Body Classification: Class B

Applicable State Regulations:

- *314 CMR 4.05 (3)(b) Class B.* These waters are designated as a habitat for fish, other aquatic life, and wildlife, including for their reproduction, migration, growth and other critical functions, and for primary and secondary contact recreation. Where designated in 314 CMR 4.06, they shall be suitable as a source of public water supply with appropriate treatment ("Treated Water Supply"). Class B waters shall be suitable for irrigation and other

agricultural uses and for compatible industrial cooling and process uses. These waters shall have consistently good aesthetic value.

- *314 CMR 4.05 (5)(b) Bottom Pollutants or Alterations.* All surface waters shall be free from pollutants in concentrations or combinations or from alterations that adversely affect the physical or chemical nature of the bottom, interfere with the propagation of fish or shellfish, or adversely affect populations of non-mobile or sessile benthic organisms.

Site Description

Robinson Brook is a small stream located in the towns of Foxborough and Mansfield, Massachusetts. The brook begins at Mechanic Street in Foxborough adjacent to the John J. Ahern Middle School and flows south-southeast for approximately 3.5 miles before discharging to the Rumford River (MA62-39) in Mansfield. This assessment report focuses only on the impaired segment of Robinson Brook, which begins at the outlet of Hersey Pond in Foxborough and flows southeast for approximately 1.9 miles to the Rumford River (MA62-39). Refer to Figure 1 for a map identifying the impaired segment of Robinson Brook and its subwatershed.

The impaired segment of Robinson Brook has a directly contributing subwatershed of approximately 602 acres. This subwatershed consists mainly of undeveloped, forested areas. However, there are a significant number of residential and commercial properties and roadways that contribute to a total impervious cover (IC) area within the subwatershed of 162 acres (approximately 27%).

The Massachusetts Department of Transportation (MassDOT) owns and maintains several of the roadways within the Robinson Brook subwatershed, including Central Street, Copeland Drive, Forbes Boulevard, Interstate 95 (I-95), and Route 140. Combined, approximately 37 acres of MassDOT's roadways contribute stormwater directly to Robinson Brook via MassDOT's stormwater collection systems. Refer to Figure 2 for the location of MassDOT's directly contributing IC watershed. The remaining 9 acres of MassDOT's roadways within the Robinson Brook subwatershed do not contribute stormwater directly to Robinson Brook, but instead discharge to other non-impaired wetlands and a small unnamed tributary found within the subwatershed.

Assessment under BMP 7U

None of the impairments for Robinson Brook have been addressed by a Total Maximum Daily Load (TMDL). Therefore, MassDOT assessed the impairments using the approach described in BMP 7U of MassDOT's Storm Water Management Plan (Water Quality Impaired Waters Assessment and Mitigation Plan), which applies to impairments that have been assigned to a water body prior to completion of a TMDL. As described in MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method; MassDOT 2011), impervious cover (IC) provides a measure of the potential impact of stormwater on many impairments. For this water body, MassDOT used the IC method to assess the following impairment:

- Aquatic macro-invertebrate bioassessments

According to the final *Year 2010 Integrated List of Waters*, physical substrate habitat alterations are considered a non-pollutant and unrelated to stormwater. Therefore, MassDOT has determined that further assessment of this impairment to the water body is not required.

MassDOT's Application of the Impervious Cover Method

MassDOT's Application of Impervious Cover Method in BMP 7U applies many aspects of USEPA Region I's Impervious Cover (IC) Method described in EPA's *Stormwater TMDL Implementation Support Manual* (ENSR, 2006) to MassDOT's program. This method assesses potential stormwater impacts on the impaired water and evaluates the impervious cover reduction required to ensure that storm water is not the cause of the impairments. Consistent with findings of EPA and others, when a watershed had less than 9% IC, MassDOT concluded that storm water was not the likely cause of the impairment. Additional information regarding this method is provided in MassDOT's Application of IC Method document.

First, MassDOT calculated the percent IC of the water body's entire contributing watershed (total watershed upstream of the downstream end of an impaired segment) and that of the local watershed contributing to the impaired segment (referred to as the subwatershed in this analysis) to determine whether storm water has a potential to cause the impairments of the receiving water body. The total watershed and subwatershed to the impaired water body were delineated using the USGS Data Series 451. When USGS Data Series watersheds did not delineate the subwatershed of the water body under review, the GIS shapefiles were modified by delineating to the water body based on USGS topography to add specificity. Impervious cover data was available as part of the USGS data layers Data Series 451 and MassGIS's impervious surfaces data layer. In cases where it was determined that storm water was a potential cause of the impairment, MassDOT calculated the degree to which impervious cover would need to be reduced in the subwatershed to meet the 9% IC target. This reduction was then applied proportionally to the area of MassDOT roadways/properties directly discharging to the water body segment to identify MassDOT's target IC reduction. The 9% IC reduction serves only as a recommended target and is not meant to imply that failing to meet the target would cause an exceedance in water quality standards. As explained in BMP 7U, MassDOT will consider a variety of factors apart from numeric guidelines, including site constraints and the magnitude of any potential exceedances in water quality standards, to determine the precise nature and extent of additional BMPs recommended for particular locations. This approach is consistent with the iterative, adaptive management BMP approach set forth in EPA guidelines.

MassDOT calculated the effective impervious cover reduction afforded by the existing structural BMPs currently incorporated into the stormwater infrastructure of MassDOT's properties. This effective IC reduction was calculated by applying effective impervious cover reduction rates to existing BMPs based on their size, function and contributing watershed. BMP performances were derived from EPA Region 1's *Stormwater Best Management Practices (BMP) Performance Analysis* report (EPA, 2010) and engineering judgment. More information on the approach used to calculate the effective impervious cover reductions is described in BMP 7U. When the reduction in effective impervious cover achieved by the existing BMPs was equal to or greater than the target reduction, no further measures were proposed. When this was not the case, MassDOT considered additional BMPs in order to meet the targeted reduction.

Using this approach, MassDOT derived the following site parameters for the total contributing watershed of the impaired water (Robinson Brook, MA62-14):

Table 1. Site Parameters for Robinson Brook (MA62-14)

Watershed		
Watershed Area	1,790	acres
Impervious Cover (IC) Area	464	acres
Percent Impervious	26	%
IC Area at 9% Goal	161	acres
Necessary Reduction % in IC	65	%
Subwatershed		
Subwatershed Area	602	acres
Impervious Cover (IC) Area	163	acres
Percent Impervious	27	%
IC Area at 9% Goal	54	acres
Necessary Reduction % in IC	67	%
MassDOT Directly Contributing Watershed		
MassDOT Directly Contributing IC	37	acres
MassDOT Target Reduction in Effective IC (67% of MassDOT Directly Contributing IC)	25	acres

The Robinson Brook subwatershed contains more than 9% IC, indicating that stormwater likely contributes to the water body's impairments. In order to reach the 9% threshold, effective IC within the subwatershed should be reduced by 67%. Therefore, MassDOT's target is to reduce its own effective IC within the directly contributing watershed by the same percentage by removing 25 acres of effective IC.

Existing BMPs

There are no existing BMPs within MassDOT's directly contributing watershed to Robinson Brook that are mitigating potential storm water quality impacts. Therefore, no effective IC reduction is currently provided.

Next Steps

Because the total mitigation of effective IC achieved by MassDOT's existing BMPs is less than the target reduction of 25 acres, MassDOT is considering the implementation of additional BMPs. While these considerations for BMPs address impairments specific to Robinson Brook, all receiving water bodies downstream will ultimately benefit from the resulting improvements in water quality and hydrology.

MassDOT has initiated the design of four stormwater BMPs to address its direct and indirect stormwater discharges to Robinson Brook. Conceptual designs for the BMPs are documented in a memorandum prepared for Programmed Project # 605596, the resurfacing of Interstate 95 in the towns of Foxborough and Sharon, titled "MassDOT Project # 605596 – Stormwater Improvement Recommendations" and dated 01/13/2012. Three of the BMPs address MassDOT's direct stormwater discharges to Robinson Brook. These BMPs consist of one infiltration basin and two

infiltration swales providing approximately 15 acres of effective IC reduction within MassDOT's directly contributing watershed. The fourth BMP addresses MassDOT's indirect stormwater discharges to Robinson Brook and consists of one infiltration swale providing approximately 0.6 acres of effective IC reduction within MassDOT's indirectly contributing watershed. Although this BMP does not provide effective IC reduction within MassDOT's directly contributing watershed to Robinson Brook, it does further reduce pollutant loading to the receiving non-impaired wetland. Table 2 summarizes the percent reductions in effective IC provided by the BMPs included in the memorandum.

Table 2. I-95 Resurfacing Project # 605596 BMP Recommendations

BMP Identifier	BMP Type	Contributing Watershed IC Area (ac.)	Resulting % Removal of Contributing Watershed IC	Effective IC Area Reduction (ac.)
BMPs in MassDOT's Directly Contributing Watershed				
Pr-BMP-1	Infiltration Basin	12.4	97%	12.0
Pr-BMP-2	Infiltration Swale	2.6	97%	2.5
Pr-BMP-3	Infiltration Swale	0.7	94%	0.6
Total		**16**		**15**
BMPs outside of MassDOT's Directly Contributing Watershed				
Pr-BMP-4	*Infiltration Swale*	*0.7*	*94%*	*0.6*
Total		*0.7*		*0.6*

The following paragraphs briefly describe each of the conceptual designs for BMPs included in the memorandum for Resurfacing Project #605596. Refer to the actual memorandum for additional details. Figures 3 through 6 show the locations of the conceptual BMPs and their corresponding watersheds.

Pr-BMP-1

Three large, piped stormwater systems collect runoff from I-95 and Rt. 140 and discharge to a ditch located within the northeast quadrant of the interchange between these two roadways. This ditch conveys stormwater directly into Robinson Brook. Additionally, several smaller stormwater systems collect stormwater from I-95 and Rt. 140 and also discharge to the northeast quadrant of the interchange. Combined, approximately 12.4 acres of I-95, Rt. 140, and the ramps between the two roadways drain to this area.

Currently the area is heavily vegetated. Local soils are classified as Hydrologic Soil Group (HSG) B indicating a moderate rate of infiltration. MassDOT will consider constructing an infiltration basin within the northeast quadrant of the interchange with an approximate surface area of 4.8 acres and an outlet invert that is approximately 2 feet above the bottom of the basin. A basin constructed to these specifications will achieve a 97% reduction in effective IC.

Outlets from Collection Systems along I-95 NB & SB Lanes

Outlet from Catch Basin along I-95

PR-BMP-2

Several small, piped stormwater collection systems along I-95 collect runoff and discharge to the median of the highway from its intersection with Rt. 140 to the Robinson Brook crossing. Within the median, stormwater flows overland and discharges directly to Robinson Brook. Approximately 2.6 acres of I-95 drain to the median in this area.

Currently the area is lightly vegetated and a significant amount of sediment and debris has begun to accumulate. Local soils are classified as HSG B indicating a moderate rate of infiltration. MassDOT will consider constructing an infiltration swale complete with check dams along the median to collect discharges from the various outfalls and provide treatment and attenuation while conveying the stormwater to Robinson Brook. A swale with a top width of 40 feet, a bottom width of 20 feet, and a length of approximately 1,366 feet will achieve a 97% reduction in effective IC.

Existing Conditions in the Median along I-95

Stormwater Outfall from Catch Basin along I-95 to Median

PR-BMP-3

Three small, piped stormwater collection systems along the entry/exit ramps between I-95 northbound and Rt. 140 northbound discharge to the shoulder of the roadway approximately 400 feet from Robinson Brook. Combined, approximately 0.7 acres of I-95 and its entry/exit ramps drain to this area.

Currently the area is heavily vegetated. Local soils are mostly classified as HSG B indicating a moderate rate of infiltration, although a small portion of the site is classified as HSG C and HSG D. MassDOT will consider constructing and infiltration swale complete with check dams along the shoulder of the roadway in this location to collect discharges from the three outfalls and provide some treatment and attenuation while conveying the stormwater to Robinson Brook. A swale with a top width of 20 feet, a bottom width of 10 feet, and a length of approximately 564 feet will achieve a 94% reduction in effective IC.

PR-BMP-4 (Indirect)

Four small, piped stormwater collection systems along the entry/exit ramps between I-95 southbound and Rt. 140 northbound discharge to the shoulder of the roadway approximately 250 feet from a non-impaired wetland. A small ditch conveys stormwater from the outlets at the toe of the slope adjacent to the roadway to the wetland. Combined, approximately 0.7 acres of I-95 and its entry/exit ramps drain to this area.

Currently the area is heavily vegetated. Local soils are classified as HSG C, indicating a low rate of infiltration. MassDOT will consider constructing an infiltration swale complete with check dams along the shoulder of the roadway in this location to collect discharges from the four outfalls and provide some treatment and attenuation while conveying the stormwater to the receiving wetland. A swale with a top width of 20 feet, a bottom width of 10 feet, and a length of approximately 638 feet will achieve a 94% reduction in effective IC.

In total, MassDOT's goal is to reduce effective IC within its directly contributing watershed to Robinson Brook by 25 acres to achieve the 9% target. As discussed above, MassDOT has no existing BMPs within the Robinson Brook directly contributing watershed. The BMPs included in the memorandum prepared for Programmed Project # 605596 will reduce the amount of MassDOT's effective IC within its directly contributing watershed to Robinson Brook by approximately 15 acres. Therefore MassDOT's remaining retrofit target is 10 acres.

Conclusions

MassDOT used the IC Method to assess Robinson Brook for the impairments identified in MassDEP's Final *Year 2010 Integrated List of Waters*. Results indicate that MassDOT should reduce its effective IC within its directly contributing watershed to Robinson Brook by 25 acres to achieve the targeted reduction in effective IC.

MassDOT has initiated the design of stormwater BMPs under Programmed Project # 605596. These proposed BMPs provide a combined reduction in effective IC within MassDOT's directly contributing watershed to Robinson Brook of approximately 15 acres. MassDOT's remaining retrofit target after subtracting the reduction in effective IC provided by the proposed BMPs is 10 acres. Table 3 summarizes IC reductions within MassDOT's directly contributing watershed under existing and proposed conditions.

Table 3. Effective IC Reductions under Existing & Proposed Conditions

Effective IC Reductions	
MassDOT Target Reduction in Effective IC	25 acres
Effective IC Reduction under Existing Conditions	0 acres
Effective IC Reduction under Proposed Conditions for Programmed Project # 605596	15 acres
Remaining Target	**10 acres**

MassDOT will now work with its design consultants to identify opportunities for additional BMPs to meet the remaining target of 10 acres of effective IC. Note that this remaining target may change depending on the final designs for the conceptual BMPs included in the memorandum for Programmed Project # 605596. The design consultants should strive to meet the remaining target plus any difference in effective IC reduction resulting from final BMP designs. The final BMP designs will provide treatment to the maximum extent practicable given site constraints that are identified as the design process moves forward. Once the designs are finalized, MassDOT will perform a final assessment of this water body under the Impaired Waters program.

MassDOT will continue to identify opportunities to implement additional structural BMPs to address pollutant loading when road work is conducted under MassDOT's Programmed Projects Initiative, such as with Programmed Project # 605596. Work on Programmed Projects often includes broader

scale road layout changes that may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to addressing impairments. MassDOT will include an update in annual reports and biannual submittals to EPA regarding progress made towards meeting target IC reductions, plans for construction of proposed BMPs, and finalized assessments including reductions achieved by finalized BMP designs. Furthermore, MassDOT will continue to implement non-structural BMPs that reduce the impacts of storm water.

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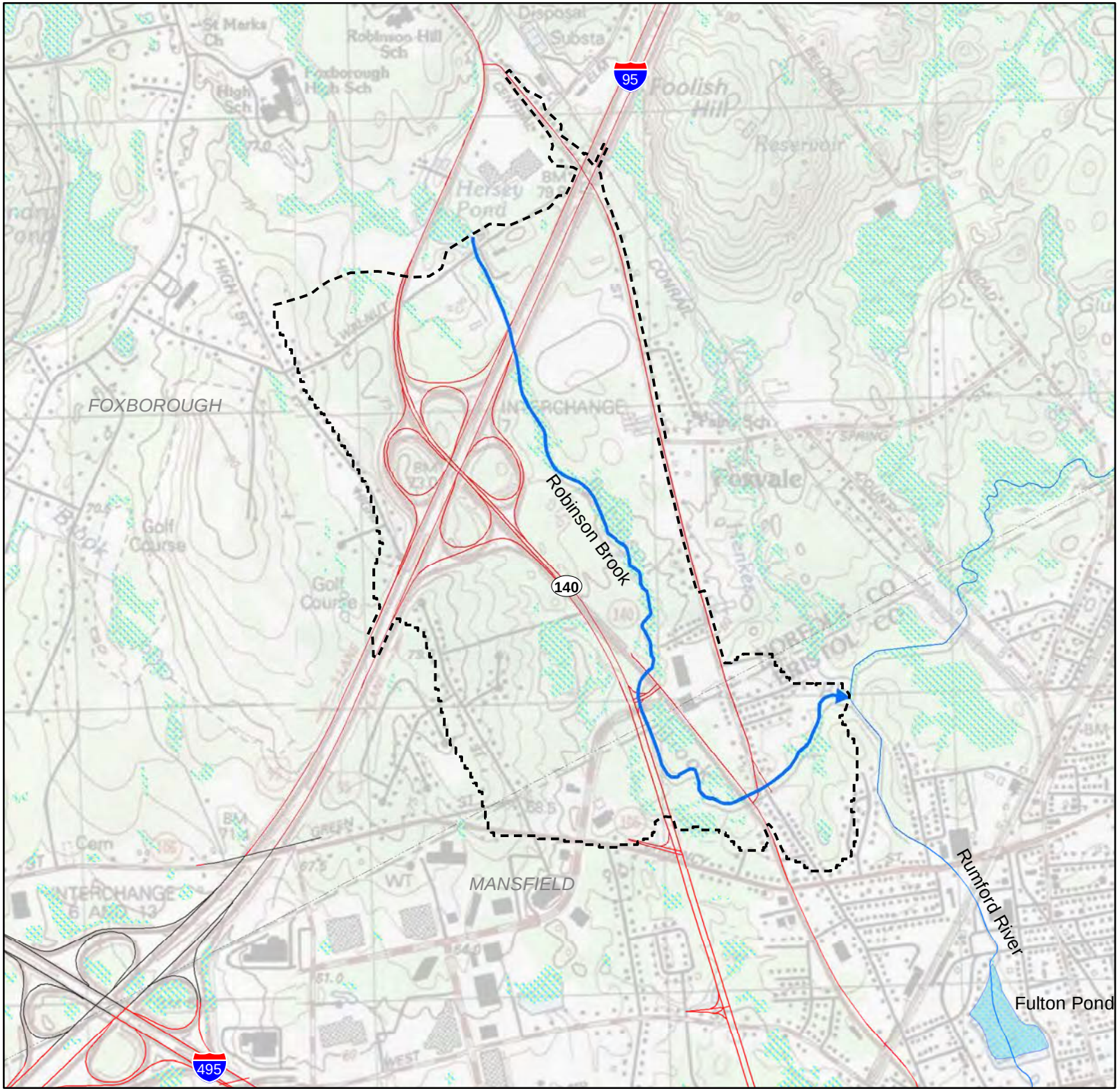

Figure 1

Robinson Brook (MA62-14) Subwatershed

January 2012

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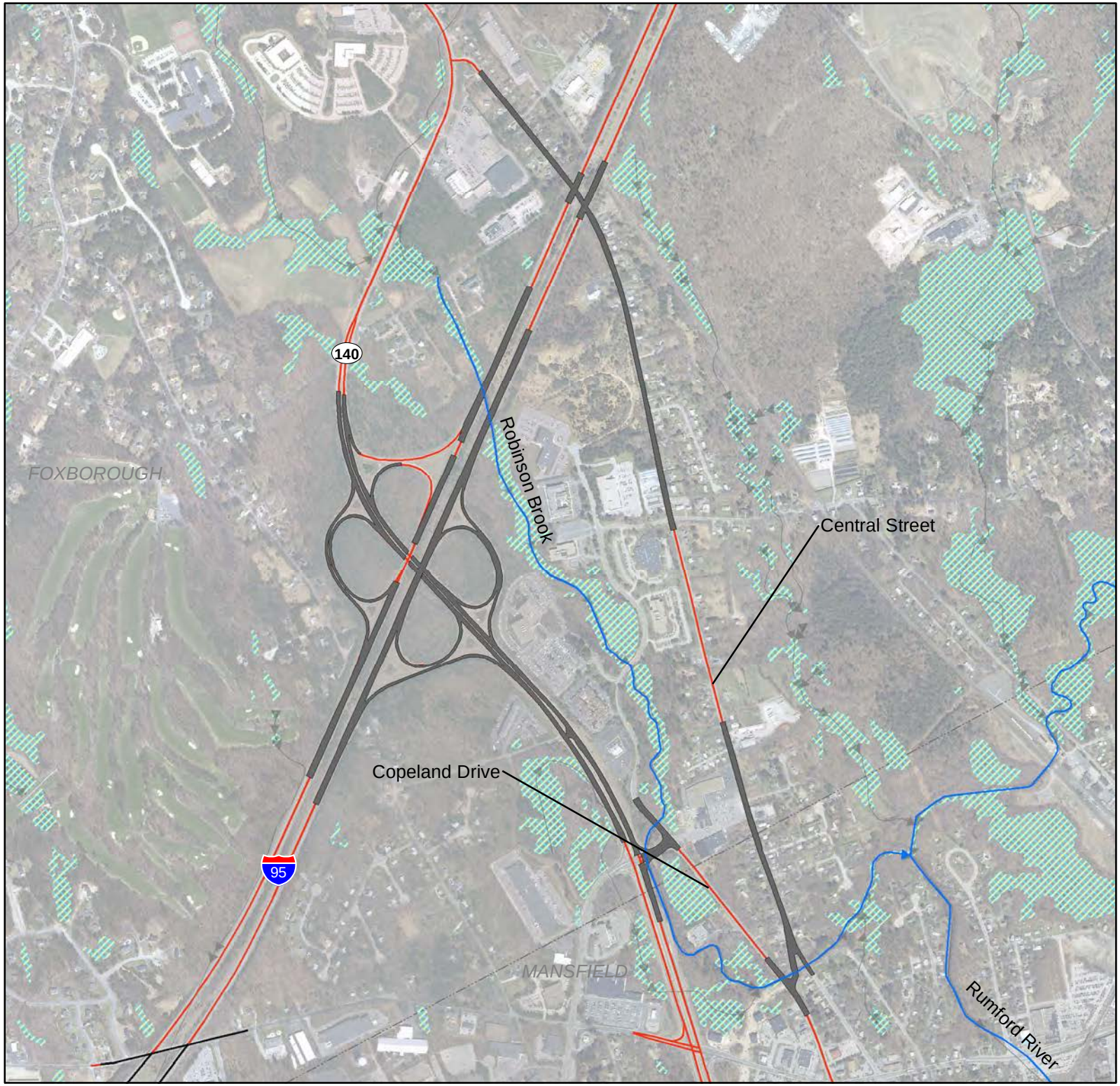

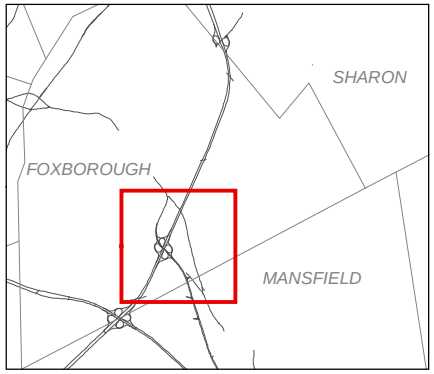

MassDOT Directly Contributing IC Watershed

Impaired Stream Segment

Non-Impaired Stream Segment

NWI Wetland Areas

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

N

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

Feet

1 inch = 1,200 feet

Figure 2

Robinson Brook (MA62-14)
MassDOT Directly Contributing IC Watershed

January 2012

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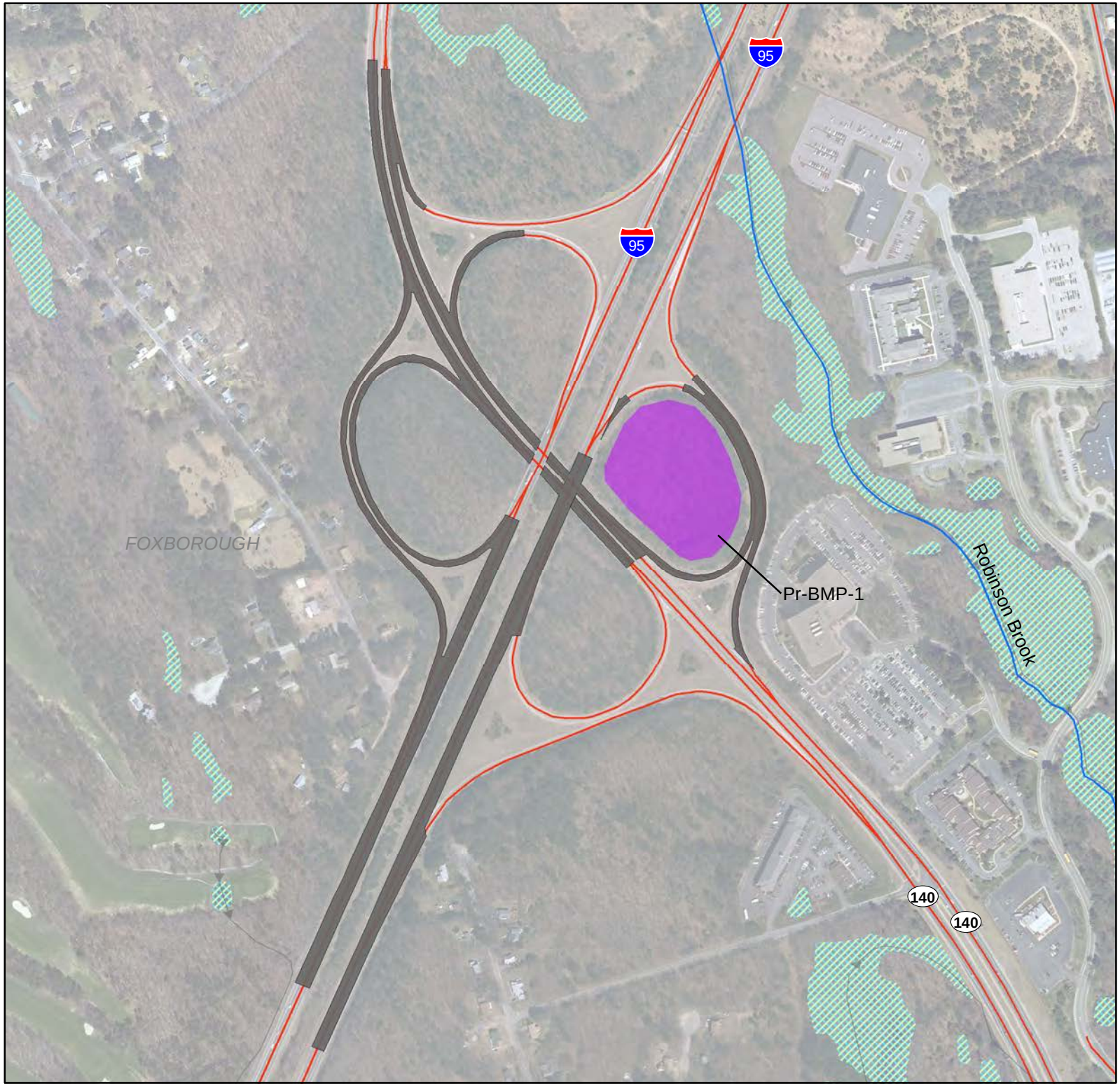

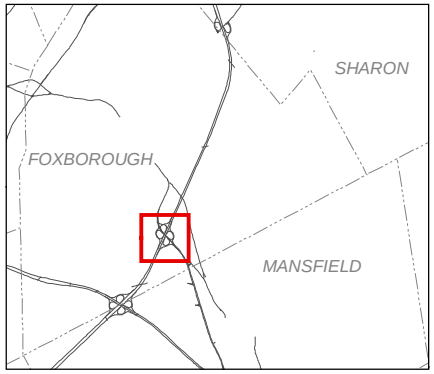

Proposed BMP - Swale

Proposed BMP - Basin

MassDOT Watershed to Pr-BMP-1

Impaired Stream Segment

Non-Impaired Stream Segment

NWI Wetland Areas

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

N

0 125 250 500 750 1,000

Feet

1 inch = 500 feet

Figure 3

Robinson Brook (MA62-14)
MassDOT Watershed
to Pr-BMP-1

January 2012

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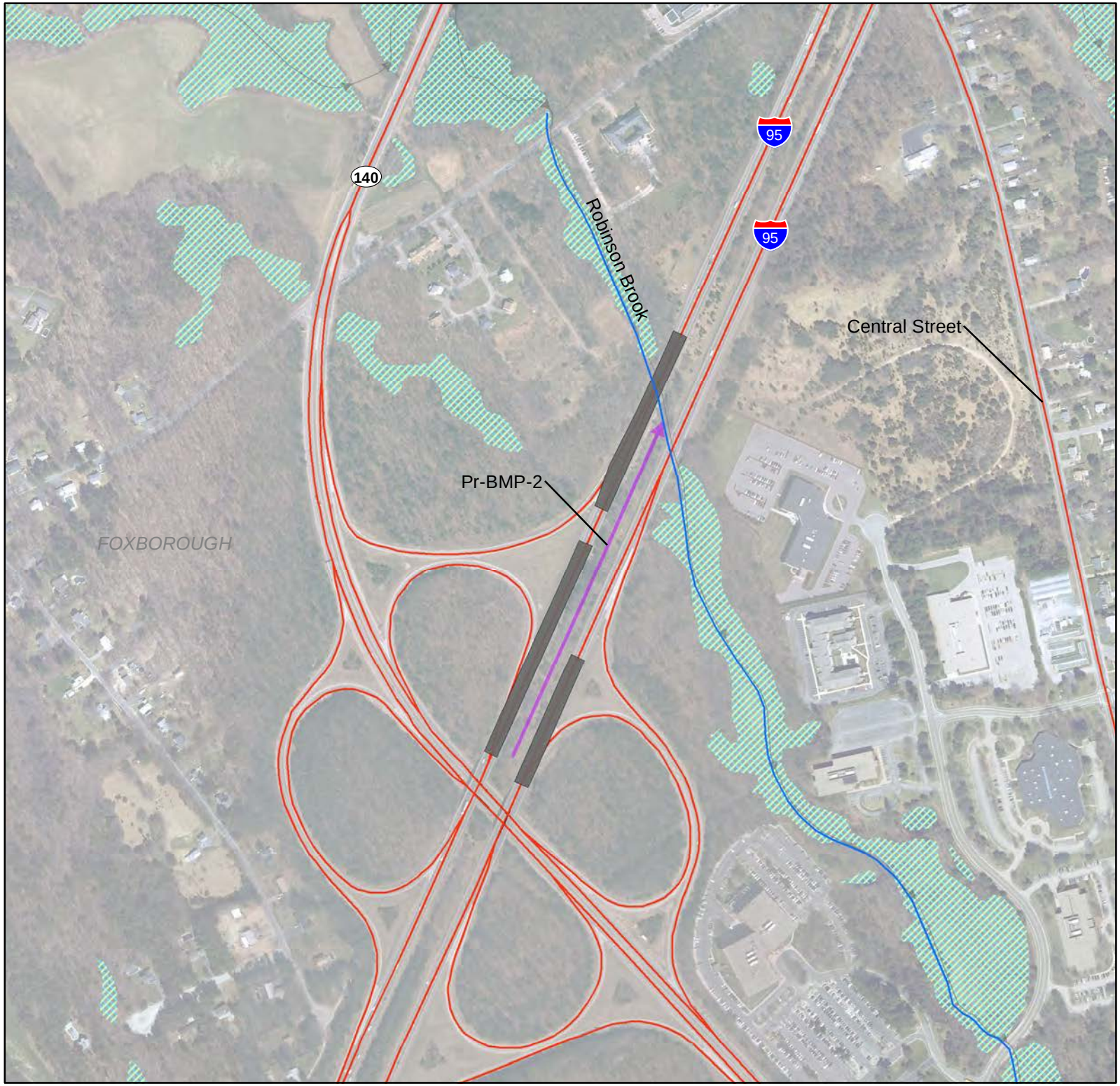

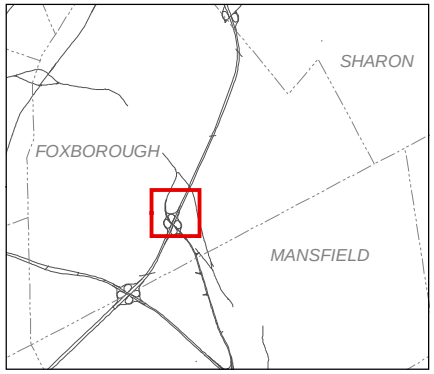

Proposed BMP - Swale

Proposed BMP - Basin

MassDOT Watershed to Pr-BMP-2

Impaired Stream Segment

Non-Impaired Stream Segment

NWI Wetland Areas

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

N

0 125 250 500 750 1,000

Feet

1 inch = 500 feet

Figure 4

Robinson Brook (MA62-14)
MassDOT Watershed
to Pr-BMP-2

January 2012

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Proposed BMP - Swale

Proposed BMP - Basin

MassDOT Watershed to Pr-BMP-3

Impaired Stream Segment

Non-Impaired Stream Segment

NWI Wetland Areas

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

N

0 62.5 125 250 375 500

Feet

1 inch = 250 feet

Figure 5

Robinson Brook (MA62-14)
MassDOT Watershed
to Pr-BMP-3

January 2012

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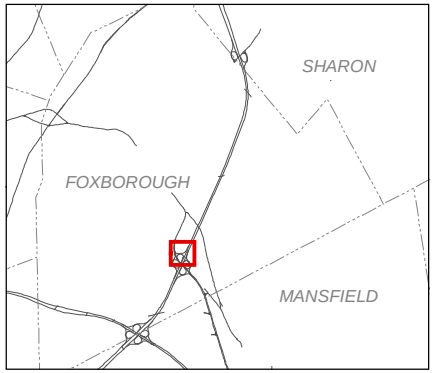

Proposed BMP - Swale

Proposed BMP - Basin

MassDOT Watershed to Pr-BMP-4

Impaired Stream Segment

Non-Impaired Stream Segment

NWI Wetland Areas

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

N

0 62.5 125 250 375 500

Feet

1 inch = 250 feet

Figure 6

Robinson Brook (MA62-14)
MassDOT Watershed
to Pr-BMP-4 (Indirect)

January 2012

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Impaired Waters Assessment for Rumford River (MA62-39) – Progress Report

Impaired Water Body

Name: Rumford River

Location: Mansfield, MA

Water body ID: MA62-39

Impairments

Final *Massachusetts Year 2008 Integrated List of Waters* (MassDEP, 2008):

- pesticides
- siltation
- other habitat alterations
- pathogens

Final *Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2011):

- sedimentation/siltation
- pentachlorophenol (PCP)
- physical substrate habitat alterations
- aquatic macroinvertebrate bioassessments
- dioxin (including 2, 3, 7, 8-TCDD)
- fishes bioassessments
- fecal coliform

Rumford River (MA62-39) is listed under Category 5, Waters Requiring a TMDL, on MassDEP's Final *Year 2008* and *Year 2010 Integrated List of Waters*. According to MassDEP's *Taunton River Watershed 2001 Water Quality Assessment Report* (MassDEP, 2005a), the 8.0 miles of Rumford River flowing into Norton Reservoir (MA62134) are impaired for combined biota and habitat degradation. Suspected sources include runoff from highways, roads, and bridges as well as municipal separate storm sewers. In addition, Massachusetts Department of Public Health has issued a fish consumption advisory for the lower 5.0 miles of this river extent as a result of dioxin and pesticide contamination from the Hatheway and Patterson Company Superfund Site.

As described below, MassDOT recommends the implementation of various Best Management Practices (BMPs) for Rumford River based on the Impervious Cover (IC) Method. While these recommendations for BMPs address impairments specific to Rumford River, all receiving water bodies downstream of the BMPs will benefit from the improvements.

Relevant Water Quality Standards

Water body Classification: Class B

Applicable State Regulations:

- *314 CMR 4.05 (3) (b) 6 Color and Turbidity*. These waters shall be free from color and turbidity in concentrations or combinations that are aesthetically objectionable or would impair any use assigned to this class.
- *314 CMR 4.05 (3) (b) 4 Bacteria*.
    - a. At bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: where E. coli is the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 126 colonies per 100 ml and no single sample taken during the bathing season shall exceed 235 colonies per 100 ml; alternatively, where enterococci are the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 33 colonies per 100 ml and no single sample taken during the bathing season shall exceed 61 colonies per 100 ml.
    - b. For other waters and, during the non bathing season, for waters at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: the geometric mean of all E. coli samples taken within the most recent six months shall not exceed 126 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 235 colonies per 100 ml; alternatively, the geometric mean of all enterococci samples taken within the most recent six months shall not exceed 33 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 61 colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department.
- *314 CMR 4.05 (5) (a) Aesthetics*. All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.
- *314 CMR 4.05 (5) (e) Toxic Pollutants*. All surface waters shall be free from pollutants in concentrations or combinations that are toxic to humans, aquatic life or wildlife. For pollutants not otherwise listed in 314 CMR 4.00, the National Recommended Water Quality Criteria: 2002, EPA 822R-02-047, November 2002 published by EPA pursuant to Section 304(a) of the Federal Water Pollution Control Act, are the allowable receiving water concentrations for the affected waters, unless the Department either establishes a site specific criterion or determines that naturally occurring background concentrations are higher. Where the Department determines that naturally occurring background concentrations are higher, those concentrations shall be the allowable receiving water concentrations. The Department shall use the water quality criteria for the protection of aquatic life expressed in terms of the dissolved fraction of metals when EPA's 304(a) recommended criteria provide for use of the dissolved fraction. The EPA recommended criteria based on total recoverable metals shall be converted to dissolved metals using EPA's published conversion factors. Permit limits will be written in terms of total recoverable metals. Translation from dissolved metals criteria to total recoverable metals permit limits will be based on EPA's conversion factors or other methods approved by the Department. The Department may establish site specific criteria for toxic pollutants based on site specific considerations.

Site Description

Rumford River is a water body which flows from Gavins Pond (MA62077) in Sharon to its confluence with Wading River (MA62-47) and Threemile River (MA62-56) in Norton. Rumford River is divided into two segments, and this assessment pertains to the upper segment only (MA62-39). The 8.0-mile long segment flows through Vandys Pond (MA62112) in Foxborough and Fulton Pond

(MA62075), Hodges Pond (MA62091), and Cabot Pond (MA62029) in Mansfield before it crosses beneath Interstate 495 (I-495) and forms Norton Reservoir (see Figure 1).

The watershed of MassDOT property directly contributing storm water runoff to Rumford River is comprised of portions of I-495, both sets of I-495 ramps interchanging with Route 140 (at Commercial St. and at South Main St.), the intersection of Commercial St. and Chauncy St., Copeland Dr., and South Main St. (see Figure 2).

Storm water from approximately 28 acres of I-495 and its ramps discharges directly into Rumford River. Eighteen of the 28 acres drains to a trunk line in the median, and the remainder discharges from smaller outfalls. Field surveys could not definitively determine where drainage from the intersection of Commercial St. and Chauncy St. discharges; however for this assessment DOT assumed that it is piped along Chauncy St. directly to Rumford River. Storm water from Copeland Dr. is piped through a trunk line and elevated at a pumping station before it outfalls to Rumford River below Fulton Pond. The drainage system for South Main St. is a combination of short trunk lines and small systems that have confirmed or probable outfalls in Rumford River.

Assessment under BMP 7U

None of the impairments for Rumford River have been addressed by a Total Maximum Daily Load (TMDL). Therefore, MassDOT assessed these impairments using the approach described in BMP 7U of MassDOT's Stormwater Management Plan (Water Quality Impaired Waters Assessment and Mitigation Plan), which applies to impairments that have been assigned to a water body prior to completion of a TMDL. As described in MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method; MassDOT 2011), IC provides a measure of the potential impact of storm water on many impairments. For this water body, MassDOT used the IC method to assess the following impairments:

- sedimentation/siltation
- aquatic macroinvertebrate bioassessments
- fishes bioassessments

The impairment for fecal coliform is assessed separately in the section titled Assessment under BMP 7U for Pathogens.

According to the final *Year 2010 Integrated List of Waters*, pentachlorophenol (PCP) and physical substrate habitat alterations are considered a non-pollutant and unrelated to stormwater. Therefore, MassDOT has determined that further assessment of these impairments to the water body is not required.

According to the *Taunton River Watershed 2001 Water Quality Assessment Report* (MassDEP, 2005a), the impairment for dioxins (including 2, 3, 7, 8-TCDD) is associated with the Hatheway and Patterson Company (HPC) Superfund site. HPC was a former wood preserving facility and ceased operation in 1993. Based on this information, MassDOT concluded that this impairment is not related to highway runoff.

MassDOT's Application of the Impervious Cover Method

MassDOT's Application of Impervious Cover Method in BMP 7U applies many aspects of USEPA Region I's Impervious Cover (IC) Method described in EPA's *Stormwater TMDL Implementation Support Manual* (ENSR, 2006) to MassDOT's program. This method assesses potential storm water impacts on the impaired water and evaluates the impervious cover reduction required to ensure that storm water is not the cause of the impairments. Consistent with findings of EPA and others, when a watershed has less than 9% impervious cover, MassDOT concludes that storm

water is not the likely cause of the impairment. Additional information regarding this method is provided in MassDOT's Application of IC Method document.

First, MassDOT calculated the percent IC of the water body's entire contributing watershed (total watershed upstream of the downstream end of an impaired segment) and that of the local watershed contributing to the impaired segment (referred to as the subwatershed in this analysis) to determine whether storm water has a potential to cause the impairments of the receiving water body. The total watershed and subwatershed to the impaired water body were delineated using the USGS Data Series 451. When USGS Data Series watersheds did not delineate the subwatershed of the water body under review, the GIS shapefiles were modified by delineating to the water body based on USGS topography to add specificity. Impervious cover data was available as part of the USGS data layers Data Series 451 and MassGIS's impervious surfaces data layer. In cases where it was determined that storm water was a potential cause of the impairment, MassDOT calculated the degree to which impervious cover would need to be reduced in the subwatershed to meet the 9% IC target. This reduction was then applied proportionally to the area of MassDOT roadways/properties directly discharging to the water body segment to identify MassDOT's target IC reduction. The 9% IC reduction serves only as a recommended target and is not meant to imply that failing to meet the target would cause an exceedance in water quality standards. As explained in BMP 7U, MassDOT will consider a variety of factors apart from numeric guidelines, including site constraints and the magnitude of any potential exceedances in water quality standards, to determine the precise nature and extent of additional BMPs recommended for particular locations. This approach is consistent with the iterative, adaptive management BMP approach set forth in EPA guidelines.

MassDOT calculated the effective impervious cover reduction afforded by the existing structural BMPs currently incorporated into the storm water infrastructure of MassDOT's properties. This effective IC reduction was calculated by applying effective impervious cover reduction rates to existing BMPs based on their size, function and contributing watershed. BMP performances were derived from EPA Region 1's *Stormwater Best Management Practices (BMP) Performance Analysis* report (EPA, 2010) and engineering judgment. More information on the approach used to calculate the effective impervious cover reductions is described in BMP 7U. When the reduction in effective impervious cover achieved by the existing BMPs was equal to or greater than the target reduction, no further measures were proposed. When this was not the case, MassDOT considered additional BMPs in order to meet the targeted reduction.

Using this approach, MassDOT derived the following site parameters for the total contributing watershed of the impaired water (Rumford River (MA62-39).

Watershed		
Watershed Area	8,755	acres
Impervious Cover (IC) Area	1,597	acres
Percent Impervious	18%	
IC Area at 9% Goal	788	acres
Necessary Reduction % in IC	51%	

Subwatershed		
Subwatershed Area	6,966	acres
Impervious Cover (IC) Area	1,132	acres
Percent Impervious	16%	
IC Area at 9% Goal	627	acres
Necessary Reduction % in IC	45%	

Reductions Applied to DOT Direct Watershed		
MassDOT's Urban IC Area **Directly** Contributing to Impaired Segment	21	acres
MassDOT's Target Reduction in Effective IC (45% of DOT Directly Contributing IC)	9.4	acres

The subwatershed is greater than 9% impervious which indicates that the storm water is likely contributing to the impairment. The subwatershed needs to reduce its effective IC by 45% to reach the 9% goal. Therefore, MassDOT should aim to reduce its effective IC in the directly contributing watershed by the same percentage by removing 9.4 acres of effective IC.

Existing BMPs

MassDOT has three existing BMPs in the directly contributing watershed to Rumford River that mitigate potential storm water quality impacts. In our analysis, existing BMPs receive credit for removing the effect of IC depending on their type, size relative to the IC that they process, and the local soil conditions. The soil in the area associated with the existing BMPs is characterized as hydrologic group A (sand or loamy sand). The total effective IC reduction provided by the existing MassDOT BMPs described below is approximately 1.0 acres (see Table 1, attached).

Ex-BMP-1

MassDOT is in the process of completing renovations and new construction at the ramps interchanging between I-495 and South Main St. As part of this project, two BMPs have been constructed in the Rumford River subwatershed. Ex-BMP-1 is a 200-foot long dry water quality swale that drains 0.32 acres of IC from the I-495 southbound (SB) off-ramp. The swale has a bottom width of approximately 5 feet and side slopes of 2H:1V. Water to a depth of 1.5 feet can be stored behind each stone check dam. This dry water quality swale achieves 100% effective IC removal for its treatment area.

Ex-BMP-1. Dry Water Quality Swale.

Ex-BMP-2

Ex-BMP-2 is the second of two dry water quality swales recently constructed as part of a MassDOT project at the interchange between I-495 and South Main St. Ex-BMP-2 is 200 feet long and drains 0.53 acres of IC from the I-495 northbound (NB) on-ramp. The swale has a bottom width of approximately 5 feet and side slopes of 2H:1V. Water to a depth of 1.5 feet can be stored behind each stone check dam. This dry water quality swale achieves 98% effective IC removal for its treatment area.

Ex-BMP-2. Dry Water Quality Swale.

Ex-BMP-3

Storm water from a 0.21-acre section of South Main St. at its intersection with Hall St. is collected in a catch basin and piped approximately 650 feet to a well-vegetated basin adjacent to Rumford River. The basin is irregularly shaped with a depth of approximately 17 feet and an area of approximately 2,180 square feet. The basin may also collect drainage from a nearby residential cul-de-sac; however, only one piped outfall was observed. Water appears to infiltrate the basin and would only overtop into the river in the event of very large storm events. No pipe or engineered outlet was observed. The basin achieves 100% effective IC removal under current conditions.

Ex-BMP-3. Infiltration Basin.

As shown in Table 1 attached, the existing BMPs provide effective impervious cover reduction of 1.0 acres.

Next Steps

MassDOT has initiated the design of two storm water BMPs to address its direct storm water discharges to Rumford River. Conceptual designs for the BMPs are documented in a memorandum prepared for Programmed Project # 605591, the resurfacing of Interstate 495 in the towns of Mansfield, Norton, and Taunton, titled "I-495 Mansfield, Norton, and Taunton – Stormwater Improvement Recommendations" and dated 01/06/2012. These BMPs will treat stormwater draining from a region of I-495 that is considered non-urban. As a result, the treatment that they provide is not factored into MassDOT's calculations for target IC reduction. Nevertheless, the two BMPs provide a total effective non-urban IC reduction of 18 acres, which will help improve the water quality of Rumford River and additional downstream receiving water bodies. The reduction calculations for these BMPs are summarized in Table 2, attached.

As shown in Figures 3 and 4, the conceptual BMPs being designed will treat the two largest trunk lines conveying drainage from I-495 and the ramps at its interchange with Commercial St. The direction of storm water flow through the BMPs is shown in these figures. The individual BMP watersheds are shown in Figures 5 and 6.

Pr-BMP-1
A trunk line runs along the outer shoulder of the I-495 NB collector distributor (CD) road beginning at the I-495 NB off-ramp onto Commercial St. and ending at the I-495 on-ramp from South Main St. Currently, the 30-inch reinforced concrete pipe daylights into a lined drainage ditch which conveys discharge directly to Rumford River. The trunk line drains 3.5 acres of IC. MassDOT is considering the design of an infiltration basin at the end of the pipe with bottom dimensions of 170 feet by 45 feet and an outlet invert that is 2.5 feet above the bottom of the basin. A basin to these specifications will achieve 91% effective IC removal.

Pr-BMP-2
For the section of I-495 within the Rumford River subwatershed, the largest outfall is from the trunk line in the median that begins just north of the interchange with Commercial St. and ends at Rumford River. The trunk line conveys water from both directions of traffic as well as portions of the on and off-ramps interchanging between I-495 SB and Commercial St. The total IC area contributing to this trunk line is 15.8 acres. MassDOT is considering a project to daylight the entire trunk line and create a 0.62-mile-long, continuous dry water quality swale within the median. The swale has been evaluated as eleven segments joined in series. Each point where features connect to the trunk line is the beginning of a new segment. The dimensions of the swale are assigned so its size increases as the drainage moves downgrade and more outlets are added. It will maintain a trapezoidal shape with side slopes of 2H:1V. A swale according to these specifications will achieve a 93.5% effective IC reduction.

Because the total mitigation of impervious surface achieved by MassDOT's existing BMPs is less than the target of 9.4 acres (see Table 1, attached), and because Pr-BMP-1 and Pr-BMP-2 treat non-urban storm water, MassDOT is considering the implementation of additional BMPs. Additional BMPs will be proposed to the maximum extent practicable given site constraints.

During site visits on October 26th and 28th as well as November 1st, 3rd, 7th, and 18th, 2011, three potential locations were identified for additional BMPs. Drainage from Copeland Drive between Chauncy Street and West Street is pumped from a trunkline to an outfall in Rumford River, just below Fulton Pond in a small park. The existing conditions at the outfall are shown in the picture below. Diverting this drainage through a BMP could provide up to 3.8 acres of additional urban IC reduction.

Storm water outfall to Rumford River below Fulton Pond.

On South Main St., just north of the on ramp to I-495 NB, 1.4 acres of IC could be treated if an outfall along the ramp was redirected through Ex-BMP-2. South of the off ramp from I-495 SB to South Main Street, 0.5 acres of IC are directed through what was specified in plans as a "constructed wetland." Conditions on site prevented the area getting credit as a BMP, but improvements could be made to turn the area into an effective BMP. If feasible, these three sites could treat up to 5.7 acres of IC, reducing MassDOT's target from 8.4 acres to 2.7 acres.

Assessment under BMP 7U for Pathogens

Pathogen concentrations in storm water vary widely temporally and spatially; concentrations can vary by an order of magnitude within a given storm event at a single location (MassDEP, 2009b). Therefore, it is difficult to predict storm water pathogen concentrations with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites will be assessed collectively based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to storm water management.

In addition, while there is a positive relationship between impervious cover and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely solely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in storm water runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliform organisms/100 ml. Concentrations of pathogens in storm water runoff from roadways can vary

widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform bacteria in urban storm water from other sources ranging between 14,000 and 17,000 fecal coliform organisms/100 ml have been reported (MassDEP, 2009b). This data suggests that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other storm water systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles, and investigation of more than 2,500 storm water features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the storm water system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to storm water in certain situations.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally cross them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from storm water runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other storm water systems and a large number of other factors.

Assessment and Mitigation Plan

Pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as storm water require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water

quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for storm water an iterative approach is needed…" (MassDEP, 2009a)

- "The NPDES permit does not, however, establish numeric effluent limitations for storm water discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals."(MassDEP, 2009b)
- "Although the TMDL presents quantified WLAs for storm water that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive storm water management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive storm water management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for storm water discharges in TMDLs." (MassDEP, no date).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of storm water management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contains specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing storm water discharges to pathogen impaired waters. Section 2.2.1(c) of the permit states "For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA." Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Storm Water Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure
- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System

- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

In addition, the structural BMPs that will be considered to reduce the IC will also have the effect of reducing pathogen loads.

MassDOT believes the existing and proposed efforts are consistent with the current and draft MS4 permit's requirements and TMDL recommendations. MassDOT's existing storm water management plan outlines BMPs that include education and illicit discharge detection and elimination. Although not included in this permit term, MassDOT will be implementing a pet waste management program at its rest stops that have discharges to pathogen-impaired waters. In addition, MassDOT has requested coverage under an individual storm water permit for the next permit term. This permit may contain additional programmatic BMPs to address pathogens.

Conclusions

MassDOT used the IC Method to assess Rumford River for the impairments identified in MassDEP's Final *Year 2010 Integrated List of Waters*. Results indicate that MassDOT should reduce its effective IC within its directly contributing watershed to Rumford River by 9.4 acres to achieve the targeted reduction in effective IC.

MassDOT evaluated its property within the directly contributing watershed to Rumford River to identify existing BMPs. The existing conditions are presented in the sections above and are summarized as follows:

Summary of Existing Conditions

BMP Name	BMP Type	Effective IC Percent Reduction	Effective IC Reduction (acres)	Notes for Consideration during design*
Ex-BMP-1	Infiltration Swale	100%	0.3	Confirm construction has been completed according to specifications
Ex-BMP-2	Infiltration Swale	98%	0.5	Confirm construction has been completed according to specifications
Ex-BMP-3	Infiltration Basin	100%	0.2	
Total			1.0	

* See sections titled Existing BMPs and Proposed BMPs for more details on notes.

This assessment of Rumford River (MA62-39) has shown that, under the proposed conditions, the existing BMPs provide 11% of the target reduction in IC. The following table summarizes the remaining target reduction under existing conditions. Attached Figures 3 and 4 show the locations of the existing BMPs.

Effective IC Reductions under Existing Conditions

IC in Directly Contributing Watershed	21 acres
MassDOT Target Reduction in Effective IC	9.4 acres
Effective IC Reduction by Existing BMPs	1.0 acres
Remaining Target	**8.4 acres**

MassDOT has initiated the design of two storm water BMPs to address its direct storm water discharges to Rumford River, which will provide a total effective non-urban IC reduction of 18 acres. These BMPs will treat stormwater draining from a region of I-495 that is considered non-urban. As a result, the treatment that they provide is not factored into MassDOT's calculations for target IC reduction. However, they will have the same affect on the water quality of the Rumford River as treating runoff from urban areas.

In addition, MassDOT will consider projects to reduce its effective IC within the directly contributing watershed by an additional 8.4 acres to achieve the targeted reduction in IC. MassDOT will now work with its design consultants to identify locations suitable for construction of additional BMPs to treat directly contributing IC as part of MassDOT's Impaired Waters Retrofit Initiative. The design consultants will develop construction plans for BMPs that will aim to provide the target IC reduction or treatment to the maximum extent practicable.

MassDOT will continue to identify opportunities to implement additional structural BMPs to address pollutant loading when road work is conducted under MassDOT's programmed projects initiative, such as Programmed Project # 605591. Work on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to addressing impairments. MassDOT will include an update in annual reports and biannual submittals to EPA regarding the design progress made towards meeting the IC reduction, plans for construction of the BMPs and finalized assessments. Furthermore, MassDOT will continue to implement non-structural BMPs that reduce the impacts of storm water.

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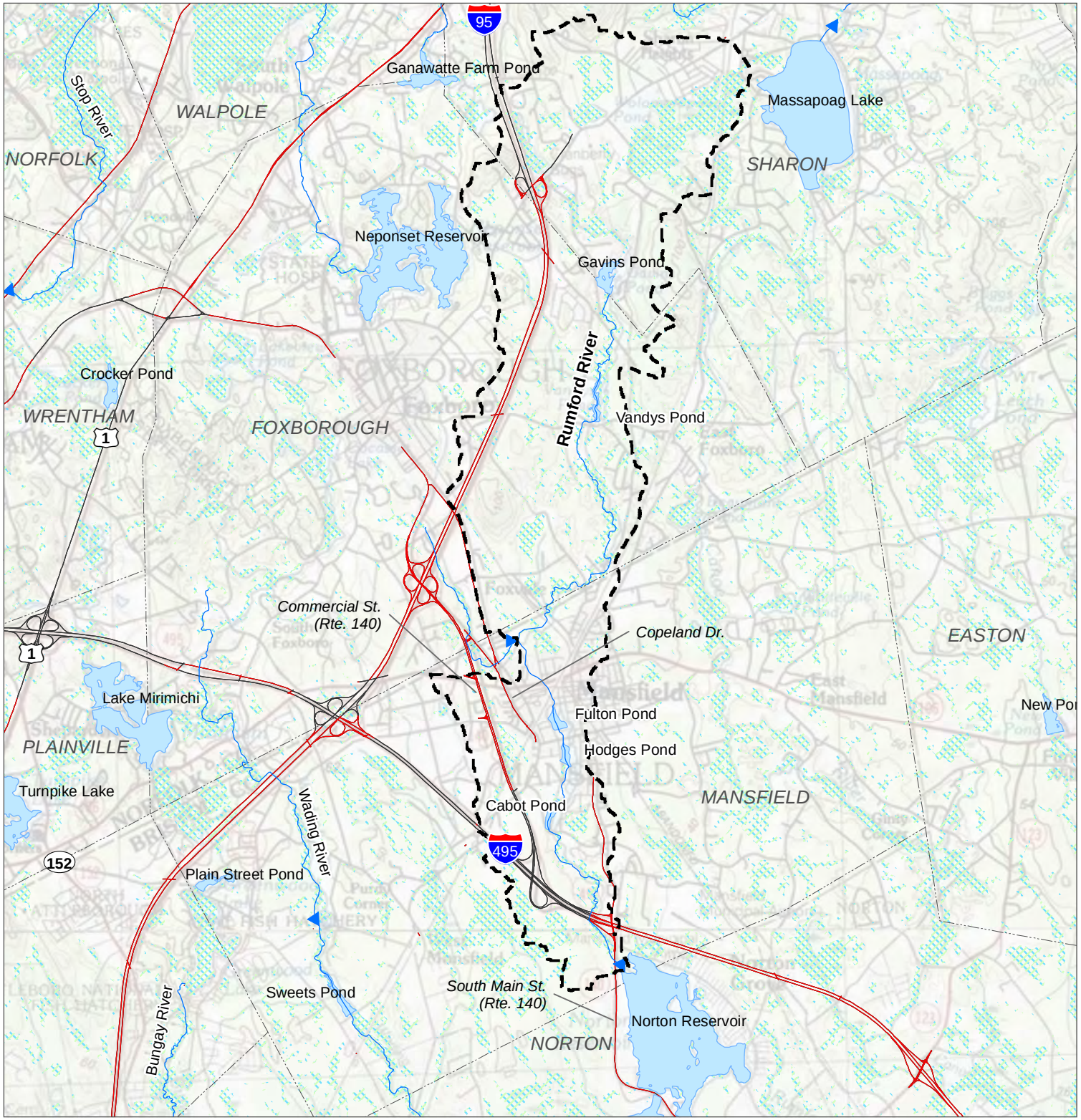
TABLE 1: Reduction Provided by MassDOT BMPs under Existing Conditions

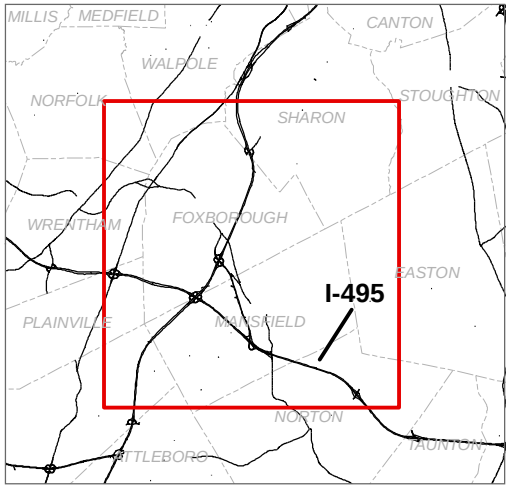
BMP Identifier	BMP Type	Soil Classification	Contributing Watershed IC Area (acres)	BMP Storage Volume (cu. ft.)	BMP Surface Area (sq. ft.)	Depth of Runoff Treated by BMP (in)	Resulting % Removal of Contributing Watershed IC	Effective IC Area Reduction (acres)
Ex-BMP-1	Infiltration Swale	A - Loamy Sand 2.41 in/hr	0.3	2,330	2,135	1.8	100%	0.3
Ex-BMP-2	Infiltration Swale	A - Loamy Sand 2.41 in/hr	0.5	2,690	2,110	1.3	98%	0.5
Ex-BMP-3	Infiltration Basin	A - Loamy Sand 2.41 in/hr	0.2	26,824	2,184	28	100%	0.2
Total			1.1				5%	1.0

TABLE 2: Reduction Provided by MassDOT Non-Urban BMPs under Proposed Conditions of Programmed Project #605591

BMP Identifier	BMP Type	Soil Classification	Contributing Watershed IC Area (acres)	BMP Storage Volume (cu. ft.)	BMP Surface Area (sq. ft.)	Depth of Runoff Treated by BMP (in)	Resulting % Removal of Contributing Watershed IC	Effective IC Area Reduction (acres)
Pr-BMP-1	Infiltration Basin	C - Sandy Clay Loam - 0.17 in/hr	3.5	22,508	9,003	1.7	91%	3.2
Pr-BMP-2A *	Infiltration Swale	C - Sandy Clay Loam - 0.17 in/hr	2.3	2,212	2,212	0.3	30%	0.7
Pr-BMP-2B *	Infiltration Swale	C - Sandy Clay Loam - 0.17 in/hr	1.0	1,936	1,936	0.2	25%	0.7
Pr-BMP-2C *	Infiltration Swale	C - Sandy Clay Loam - 0.17 in/hr	0.6	974	974	0.1	13%	0.3
Pr-BMP-2D *	Infiltration Swale	C - Sandy Clay Loam - 0.17 in/hr	1.7	694	694	0.0	6%	0.2
Pr-BMP-2E *	Infiltration Swale	C - Sandy Clay Loam - 0.17 in/hr	0.5	4,850	3,233	0.3	36%	1.5
Pr-BMP-2F *	Infiltration Swale	C - Sandy Clay Loam - 0.17 in/hr	0.3	4,337	2,891	0.4	43%	1.3
Pr-BMP-2G *	Infiltration Swale	C - Sandy Clay Loam - 0.17 in/hr	3.5	4,088	2,725	0.2	26%	1.4
Pr-BMP-2H *	Infiltration Swale	C - Sandy Clay Loam - 0.17 in/hr	0.3	4,898	3,265	0.3	36%	1.5
Pr-BMP-2I *	Infiltration Swale	C - Sandy Clay Loam - 0.17 in/hr	2.3	7,241	4,138	0.4	44%	2.2
Pr-BMP-2J *	Infiltration Swale	C - Sandy Clay Loam - 0.17 in/hr	1.3	14,194	8,111	0.9	75%	3.1
Pr-BMP-2K *	Infiltration Swale	C - Sandy Clay Loam - 0.17 in/hr	1.9	7,862	4,493	0.7	65%	1.9
Total			19				95%	18

* Denotes BMPs provides treatment in series.





- Rumford River (MA62-39) Subwatershed
- Impaired Water Bodies
- NWI Wetland Areas
- Impaired Stream Segments
- MassDOT Roads in Urban Areas
- MassDOT Roads
- Town Boundaries

N

0 0.6 1.2 2.4 Miles

1 in = 1.2 miles

Figure 1

Rumford River (MA62-39) Subwatershed

January 2012

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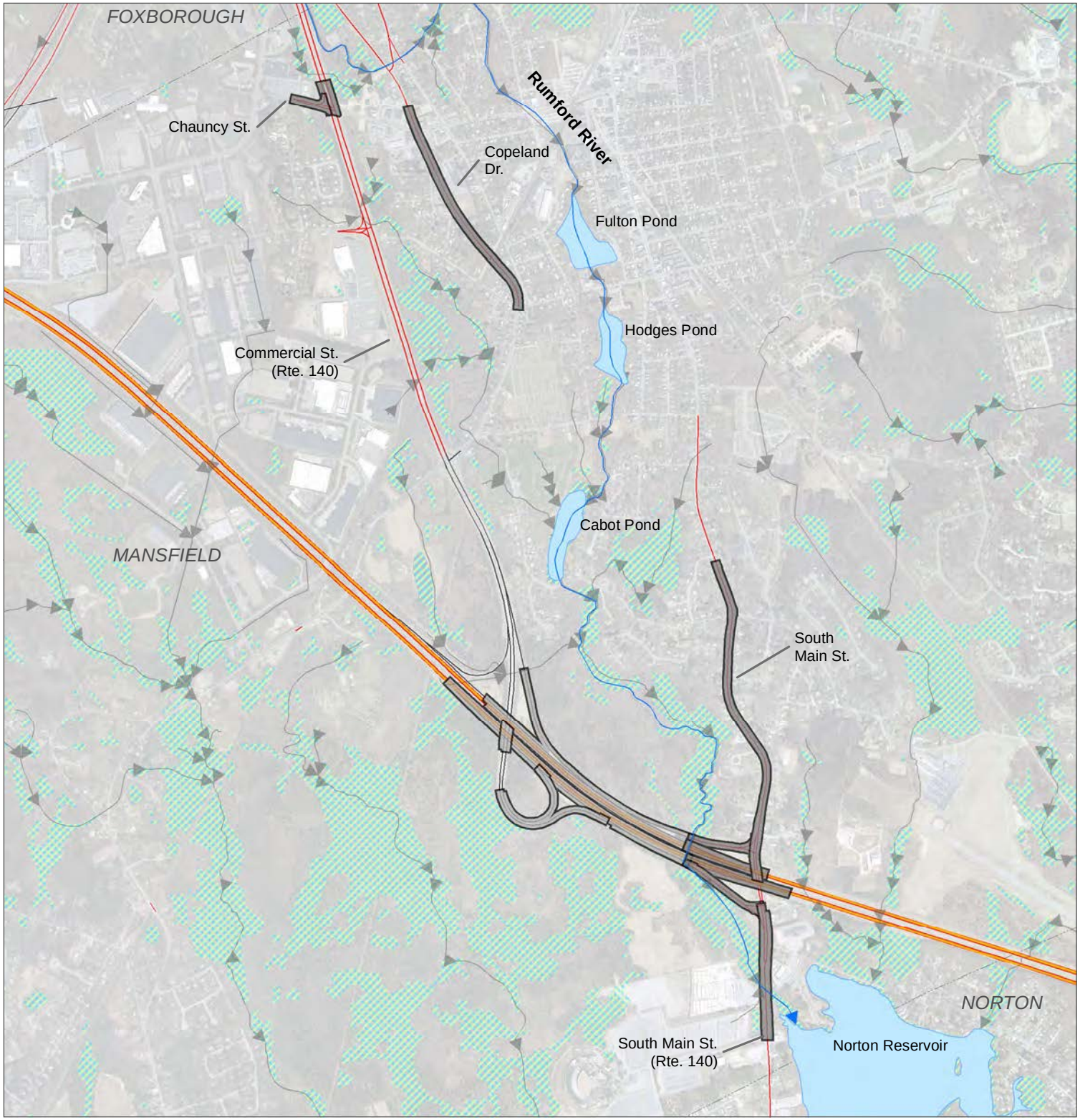

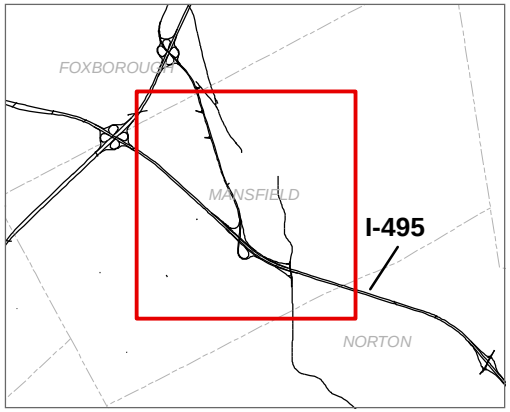

MassDOT Urban Watershed
MassDOT Non-Urban Watershed
Impaired Water Bodies
NWI Wetland Areas
Impaired Stream Segments
Non-Impaired Stream Segments
Project Roads
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

N

0 1,000 2,000 4,000 Feet

1 in = 2,000 ft

Figure 2

Rumford River (MA62-39)
Directly Contributing
MassDOT Watershed

January 2012

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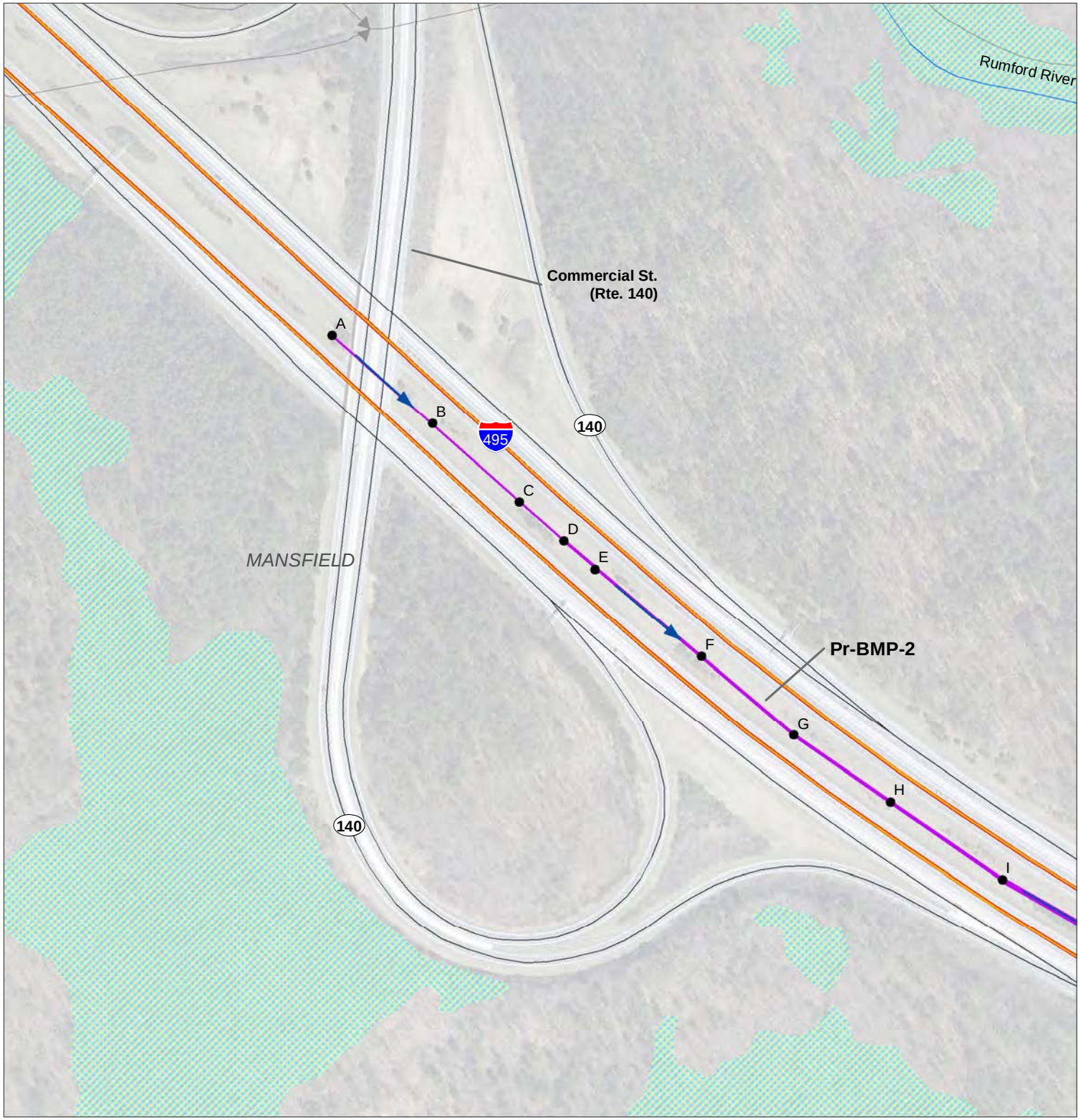

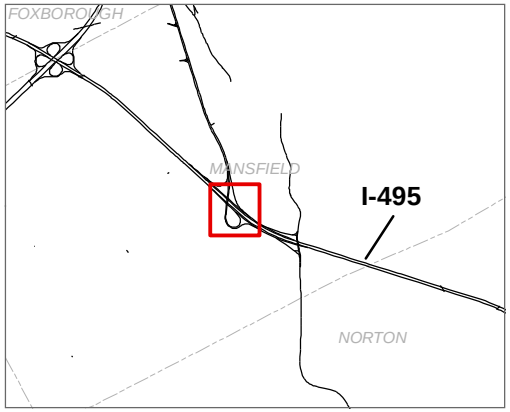

- Direction of Drainage
- Existing BMPs
- Proposed BMPs
- Impaired Water Bodies
- NWI Wetland Areas
- Impaired Stream Segments
- Non-Impaired Stream Segments
- Project Roads
- MassDOT Roads in Urban Areas
- MassDOT Roads
- Town Boundaries

N

0 165 330 660 Feet

1 in = 325 ft

Figure 3

Rumford River (MA62-39)
Existing and Proposed BMPs
Sheet 1 of 2

January 2012

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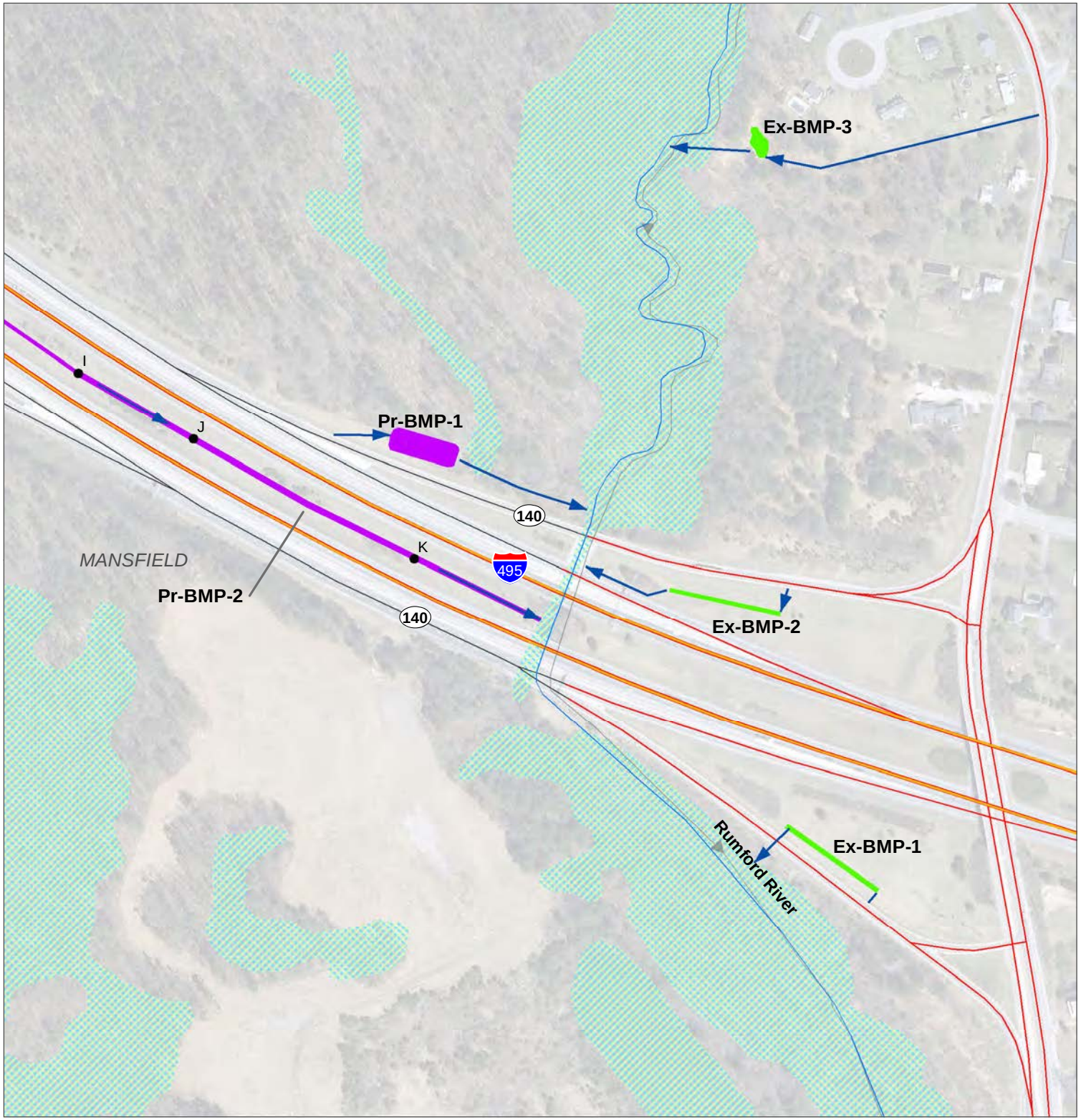

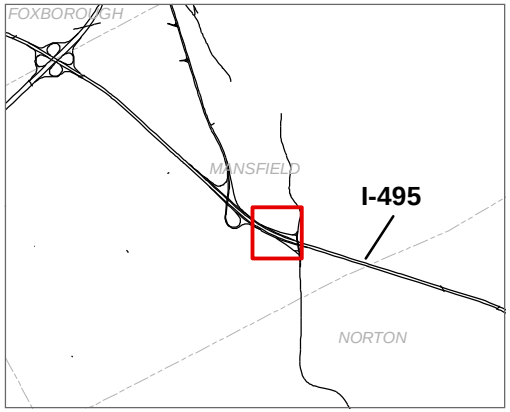

- Direction of Drainage
- Existing BMPs
- Proposed BMPs
- Impaired Water Bodies
- NWI Wetland Areas
- Impaired Stream Segments
- Non-Impaired Stream Segments
- Project Roads
- MassDOT Roads in Urban Areas
- MassDOT Roads
- Town Boundaries

N

0 100 200 400 600 Feet

1 in = 325 ft

Figure 4

Rumford River (MA62-39)
Existing and Proposed BMPs
Sheet 2 of 2

January 2012

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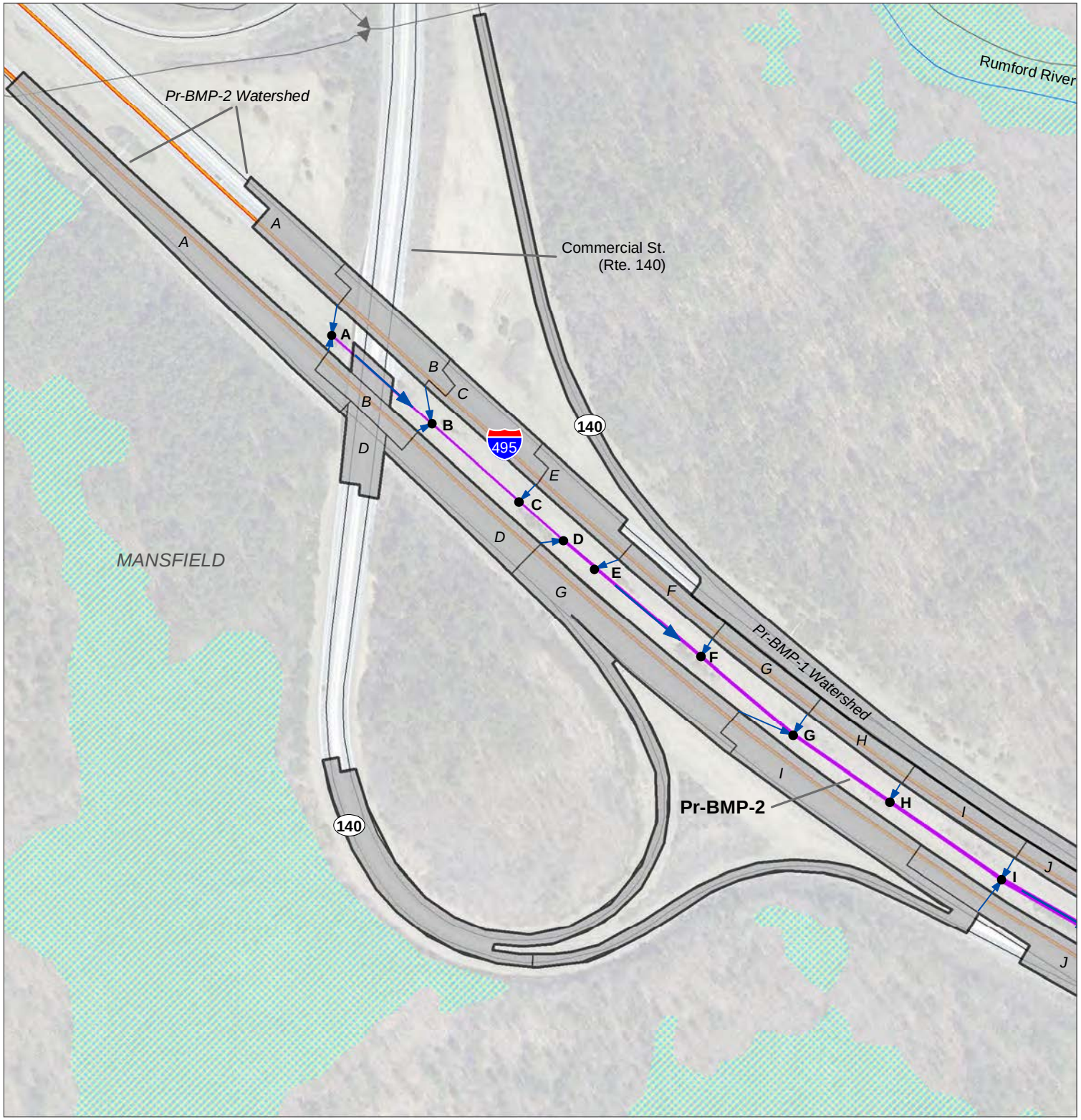

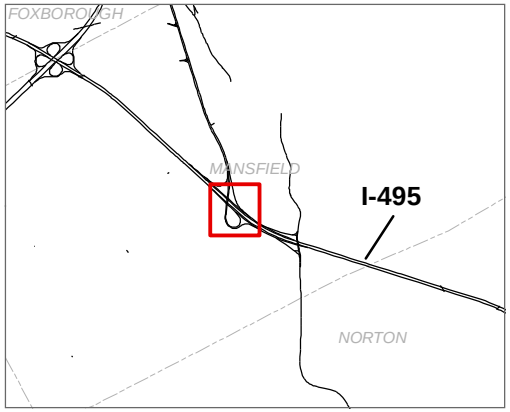

- Direction of Drainage
- Existing BMPs
- Proposed BMPs
- Non-urban BMP Watershed
- Impaired Water Bodies
- NWI Wetland Areas
- Impaired Stream Segments
- Non-Impaired Stream Segments
- Project Roads
- MassDOT Roads in Urban Areas
- MassDOT Roads
- Town Boundaries

N

0 110 220 440 660 Feet

1 in = 325 ft

Figure 5

Rumford River (MA62-39)
BMP Watersheds
Sheet 1 of 2

January 2012

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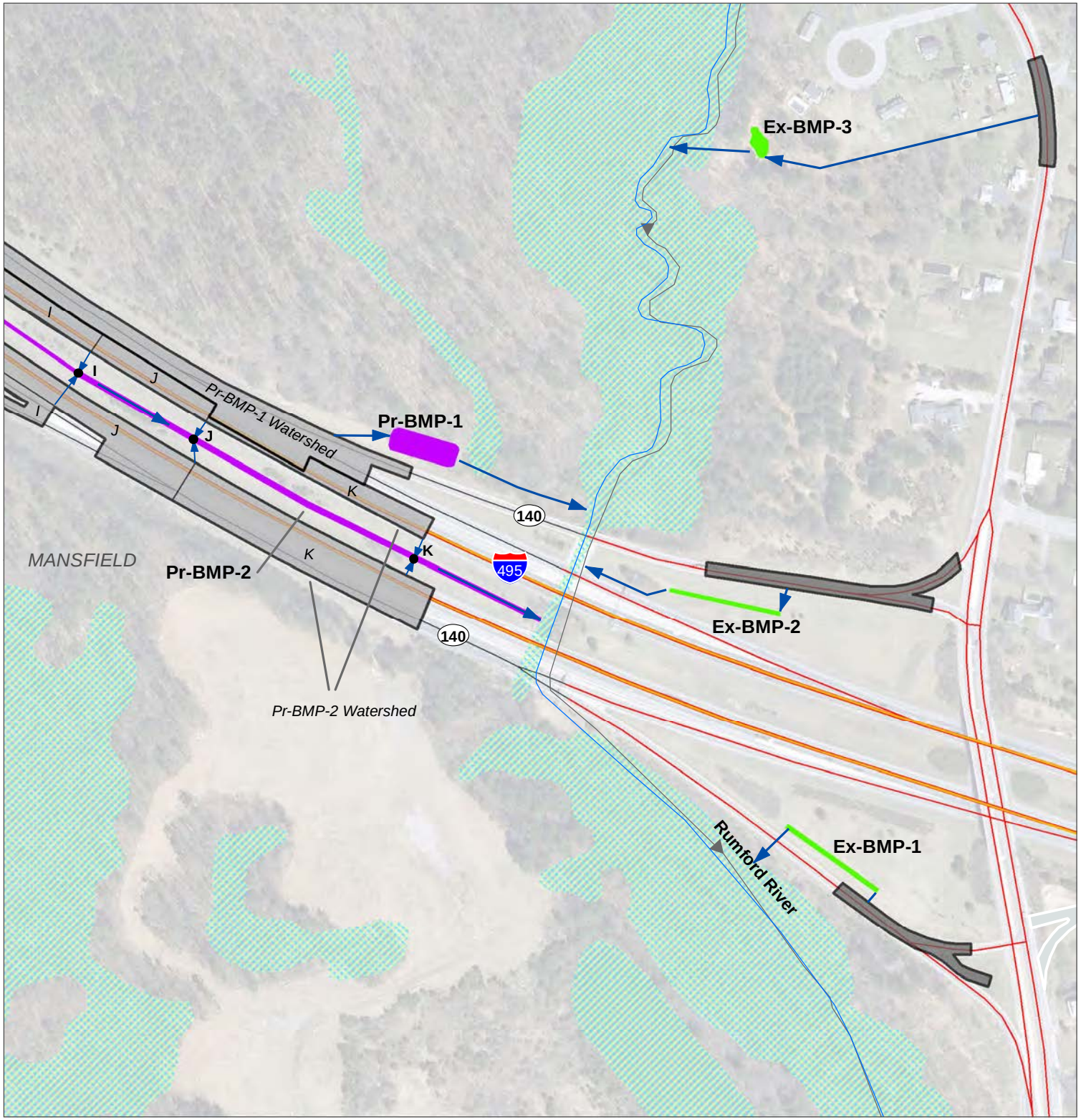

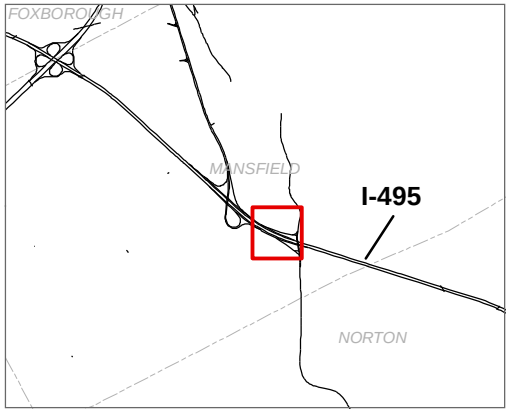

Direction of Drainage
Existing BMPs
Proposed BMPs
Urban BMP Watershed
Non-urban BMP Watershed
Impaired Water Bodies
NWI Wetland Areas
Impaired Stream Segments
Non-Impaired Stream Segments
Project Roads
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

N

0 110 220 440 660 Feet

1 in = 325 ft

Figure 6

Rumford River (MA62-39)
BMP Watersheds
Sheet 2 of 2

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Impaired Waters Assessment for Mystic River (MA71-02) – Progress Report

Impaired Water Body

Name: Mystic River

Location: Arlington, Medford, and Somerville, MA

Water Body ID: MA71-02

Impairments

Segment MA71-02 of the Mystic River is listed under Category 5, Waters Requiring a Total Maximum Daily Load (TMDL), on MassDEP's final *Massachusetts Year 2008*, final *Massachusetts Year 2010*, and proposed *Massachusetts Year 2012 Integrated List of Waters*. Table 1 below shows the impairments to Segment MA71-02 included on each list.

Table 1. Impairments to Segment MA71-02 of the Mystic River Included on the Massachusetts Integrated List of Waters

Massachusetts Integrated List of Waters		
Final 2008 List	**Final 2010 List**	**Proposed 2012 List**
Metals	Arsenic	Arsenic
Nutrients	Chlordane	Chlordane
Pathogens	DDT	Chlorophyll-a
Pesticides	Fecal Coliforms	DDT
Priority organics	PCBs in Fish Tissue	Dissolved oxygen saturation
	Phosphorus (Total)	Escherichia coli
		Fish-Passage Barrier
		PCBs in Fish Tissue
		Phosphorus (Total)
		Secchi disk transparency
		Sediment Bioassays -- Chronic Toxicity Freshwater

According to MassDEP's *Mystic River Watershed 2004-2008 Water Quality Assessment Report* (MassDEP, 2010), the sources of the impairments to MA71-02 include contaminated sediments, hydro structure impacts on fish passage, unspecified urban stormwater, and other unknown sources. The City of Somerville discharges a combined sewer overflow (CSO) to Segment MA71-02 under a National Pollutant Discharge Elimination System (NPDES) permit (MA0101982).

Relevant Water Quality Standards

Water Body Classification: Class B/WW CSO

Applicable State Regulations:

- *314 CMR 4.05 (3) (b) 4 Bacteria.*

    a. At bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: where E. coli is the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 126 colonies per 100 ml and no single sample taken during the bathing season shall exceed 235 colonies per 100 ml; alternatively, where enterococci are the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 33 colonies per 100 ml and no single sample taken during the bathing season shall exceed 61 colonies per 100 ml;

    b. for other waters and, during the non bathing season, for waters at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: the geometric mean of all E. coli samples taken within the most recent six months shall not exceed 126 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 235 colonies per 100 ml; alternatively, the geometric mean of all enterococci samples taken within the most recent six months shall not exceed 33 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 61 colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department; and

    c. consistent with Massachusetts Department of Public Health regulations for bathing beaches, the single sample maximum values in the primary contact bacteria criteria in 314 CMR 4.05(3)(b)4.a. and 4.05(3)(b)4.b. also are for use in the context of notification and closure decisions.

- *314 CMR 4.05 (5) (c) Nutrients*. Unless naturally occurring, all surface waters shall be free from nutrients in concentrations that would cause or contribute to impairment of existing or designated uses and shall not exceed the site specific criteria developed in a TMDL or as otherwise established by the Department pursuant to 314 CMR 4.00. Any existing point source discharge containing nutrients in concentrations that would cause or contribute to cultural eutrophication, including the excessive growth of aquatic plants or algae, in any surface water shall be provided with the most appropriate treatment as determined by the Department, including, where necessary, highest and best practical treatment (HBPT) for POTWs and BAT for non POTWs, to remove such nutrients to ensure protection of existing and designated uses. Human activities that result in the nonpoint source discharge of nutrients to any surface water may be required to be provided with cost effective and reasonable best management practices for nonpoint source control.

- *314 CMR 4.05 (5) (e) Toxic Pollutants*. All surface waters shall be free from pollutants in concentrations or combinations that are toxic to humans, aquatic life or wildlife. For pollutants not otherwise listed in 314 CMR 4.00, the National Recommended Water Quality Criteria: 2002, EPA 822R-02-047, November 2002 published by EPA pursuant to Section 304(a) of the Federal Water Pollution Control Act, are the allowable receiving water concentrations for the affected waters, unless the Department either establishes a site specific criterion or determines that naturally occurring background concentrations are higher. Where the Department determines that naturally occurring background concentrations are higher, those concentrations shall be the allowable receiving water concentrations. The Department shall use the water quality criteria for the protection of aquatic life expressed in terms of the dissolved fraction of metals when EPA's 304(a)

recommended criteria provide for use of the dissolved fraction. The EPA recommended criteria based on total recoverable metals shall be converted to dissolved metals using EPA's published conversion factors. Permit limits will be written in terms of total recoverable metals. Translation from dissolved metals criteria to total recoverable metals permit limits will be based on EPA's conversion factors or other methods approved by the Department. The Department may establish site specific criteria for toxic pollutants based on site specific considerations. The Department may establish site specific criteria for toxic pollutants based on site specific considerations. Site specific criteria, human health risk levels and permit limits will be established in accordance with the following:

1. Site Specific Criteria: Where EPA recommended criteria for a specific pollutant are not available or where the Department determines that they are invalid due to site specific physical, chemical or biological considerations, the Department shall use a site specific criterion as the allowable receiving water concentration for the affected waters. In all cases, at a minimum, site specific criteria shall not exceed safe exposure levels determined by toxicity testing using methods approved by the Department. The Department will adopt any such site specific criteria as revisions to 314 CMR 4.00 in accordance with M.G.L. c. 30A.
2. Human Health Risk Levels. Where EPA has not set human health risk levels for a toxic pollutant, the human health based regulation of the toxic pollutant shall be in accordance with guidance issued by the Department of Environmental Protection's Office of Research and Standards. The Department's goal is to prevent all adverse health effects which may result from the ingestion, inhalation or dermal absorption of toxins attributable to waters during their reasonable use as designated in 314 CMR 4.00. When this goal is not attainable, the Department will use a goal of 10-6 as the acceptable excess lifetime cancer risk level for individual carcinogens.
3. Accumulation of Pollutants. Where appropriate the Department shall use an additional margin of safety when establishing water quality based effluent limits to assure that pollutants do not persist in the environment or accumulate in organisms to levels that:
    a. are toxic to humans, wildlife or aquatic life; or
    b. result in unacceptable concentrations in edible portions of marketable fish or shellfish or for the recreational use of fish, shellfish, other aquatic life or wildlife for human consumption.
4. Public Notice. Where EPA recommended criteria are used to establish water quality based effluent limitations, the effluent limitations shall be documented and subject to full intergovernmental coordination and public participation as set forth in 314 CMR 2.00 "Permit Procedures".

Site Description

The Mystic River begins at the outlet of the Lower Mystic Lake (MA71027) along the corporate boundary between the City of Medford and the Town of Arlington. From there, the river flows southeast through the Cities of Somerville, Everett, Chelsea, and Boston before its confluence with the Chelsea River (MA71-06) at inner Boston Harbor (MA70-02). This assessment focuses on Segment MA71-02 of the Mystic River, which includes the 5-mile long stretch from the outlet of Lower Mystic Lake to the Amelia Earhart Dam in Somerville/Everett. Its directly contributing subwatershed is approximately 3,860 acres in size and consists mostly of heavily urbanized areas. The subwatershed has a total impervious cover (IC) area of approximately 59.8 percent. Refer to Figure 1 for the location of Segment MA71-02 and its contributing subwatershed.

MassDOT currently owns and maintains several major roadways within the subwatershed of Segment MA71-02. These roadways include Interstate 93 (I-93) and portions of Route 16/Mystic Valley Parkway (Rt. 16) and Route 38/Mystic Avenue (Rt. 38). Runoff from these roadways is collected by traditional piped stormwater systems and appears to discharge directly to Segment MA71-02 via several stormwater outfalls. Three of these outfalls are very large and appear to also drain interconnected municipal stormwater systems owned by the Cities of Medford and Somerville.

In addition to the roadways listed above, MassDOT owns and maintains 12 bridges along smaller, more urban roadways within the subwatershed of Segment MA71-02. Eleven of the 12 bridges span a railroad line that runs through the subwatershed beneath the following roadways:

- Broadway
- Cedar Street
- Central Street
- College Avenue
- Lowell Street
- Medford Street
- North Street
- School Street
- Sycamore Street
- Walnut Street
- Winthrop Street

The twelfth MassDOT-owned bridge, also along Winthrop Street, spans Segment MA71-02 of the Mystic River. Runoff from all 12 bridges flows into municipal stormwater systems along the adjacent roadways. These municipal systems likely discharge stormwater directly to Segment MA71-02.

In total, approximately 117 acres of MassDOT's IC within the subwatershed to Segment MA71-02 discharge directly to the water body. Refer to Figure 2 for the locations of MassDOT's directly contributing IC areas. AECOM conducted two field inspections of MassDOT's stormwater systems within the segment's subwatershed on behalf of MassDOT on April 3, 2012 and May 22, 2012. AECOM found no Best Management Practices (BMPs) in place to address the direct stormwater runoff from these roadways.

Assessment under BMP 7U

The MassDEP's final *Massachusetts Year 2008* and proposed *Massachusetts Year 2012 Integrated List of Waters* are included in this assessment as background information. The final *Massachusetts Year 2010 Integrated List of Waters* is used for this assessment of MA71-02.

The MassDEP's final *Massachusetts Year 2010 Integrated List of Waters* includes six impairments, none of which have been addressed by a TMDL. Of these impairments, three are potentially related to highway runoff including arsenic, fecal coliforms, and total phoshphorus. MassDOT assessed its potential contribution to arsenic and total phosphorus using the approach described in BMP 7U of MassDOT's Stormwater Management Plan (*Water Quality Impaired Waters Assessment and Mitigation Plan*; MassDOT, 2009), which applies to impairments that have been assigned to a water body prior to completion of a TMDL. MassDOT assessed these impairments using its Impervious Cover (IC) Method. As described in MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT, 2011), IC provides a measure of the potential impact of stormwater on many impairments. The impairment of fecal coliforms was assessed separately based on MassDOT's protocol for assessing waters impaired by bacteria. Refer to the section of this report titled "Assessment under BMP 7U for Pathogens" for MassDOT's assessment of this impairment.

The remaining three impairments, which include PCBs in fish tissue, chlordane, and DDT are not related to highway runoff and therefore were not considered under MassDOT's assessment. The impairment for PCBs in fish tissue typically indicates the presence of PCBs in the waterbody that comprises the fish habitat. The USEPA National Urban Runoff Program (NURP), however, found PCBs in only 1% of samples from highway runoff (EPA, 1983). Based on this evidence, MassDOT concluded that this impairment is not related to highway runoff.

The impairments for Chlordane and DDT refer to the presence of pesticide compounds in Segment MA71-02 of the Mystic River during sampling events. Pesticides (including Chlordane and DDT) are not used by MassDOT except in particular stand-alone cases. Pesticide use is regulated by the Vegetative Management Plan prepared by MassDOT every 5 -years and the annual Yearly Operational Plan (YOP) as described in BMP 6A-5 of MassDOT's SWMP (2009). Furthermore, the USEPA NURP detected DDT in only 1% of samples of urban runoff (EPA, 1983). Based on this information, MassDOT concluded that these impairments are not related to highway runoff.

MassDOT's Application of the Impervious Cover Method

MassDOT's Application of Impervious Cover Method in BMP 7U applies many aspects of USEPA Region I's Impervious Cover Method described in EPA's *Stormwater TMDL Implementation Support Manual* (ENSR, 2006) to MassDOT's program. This method assesses potential stormwater impacts on the impaired water and evaluates the IC reduction required to ensure that stormwater is not the cause of the impairments. Consistent with findings of EPA and others, when a watershed has less than 9% IC, MassDOT concludes that stormwater is not the likely cause of the impairment. Additional information regarding this method is provided in MassDOT's Application of IC Method document.

First, MassDOT calculated the percent IC of the water body's entire contributing watershed (total watershed upstream of the downstream end of an impaired segment) and that of the local watershed contributing to the impaired segment (referred to as the subwatershed in this analysis) to determine whether stormwater has a potential to cause the impairments of the receiving water body. The total watershed and subwatershed to the impaired water body were delineated using the USGS Data Series 451. When USGS Data Series watersheds did not delineate the subwatershed of the water body under review, the GIS shapefiles were modified by delineating to the water body based on USGS topography to add specificity. IC data was available as part of the USGS data layers Data Series 451 and MassGIS's impervious surfaces data layer. In cases where it was determined that stormwater was a potential cause of the impairment, MassDOT calculated the degree to which IC would need to be reduced in the subwatershed to meet the 9% IC target. This reduction was then applied proportionally to the area of MassDOT roadways/properties directly discharging to the water body segment to identify MassDOT's target IC reduction. The 9% IC reduction serves only as a recommended target and is not meant to imply that failing to meet the target would cause an exceedance in water quality standards. As explained in BMP 7U, MassDOT will consider a variety of factors apart from numeric guidelines, including site constraints and the magnitude of any potential exceedances in water quality standards, to determine the precise nature and extent of additional BMPs recommended for particular locations. This approach is consistent with the iterative, adaptive management BMP approach set forth in EPA guidelines.

MassDOT calculated the effective IC reduction afforded by the existing structural BMPs currently incorporated into the stormwater infrastructure of MassDOT's properties. This effective IC reduction was calculated by applying effective IC reduction rates to existing BMPs based on their size, function and contributing watershed. BMP performances were derived from EPA Region 1's *Stormwater Best Management Practices (BMP) Performance Analysis* report (EPA, 2010) and engineering judgment. More information on the approach used to calculate the effective IC reductions is described in BMP 7U. When the reduction in effective IC achieved by the existing BMPs was equal to or greater than the target reduction, no further measures were proposed. When

this was not the case, MassDOT considered additional BMPs in order to meet the targeted reduction.

Using this approach, MassDOT derived the following site parameters for Segment MA71-02 of the Mystic River:

Table 2. IC Method Site Parameters for Segment MA71-02 of the Mystic River

Total Watershed		
Watershed Area	33,240	acres
IC Area	12,521	acres
Percent Impervious	38	%
IC Area at 9% Goal	2,992	acres
Subwatershed		
Subwatershed Area	3,860	acres
IC (IC) Area	2,308	acres
Percent Impervious	60	%
IC Area at 9% Goal	347	acres
Target Reduction % in IC	85	%
Reductions Applied to DOT Direct Watershed		
MassDOT Directly Contributing IC	117	acres
MassDOT's Target Reduction in Effective IC (85% of DOT Directly Contributing IC)	100	acres

The subwatershed to Segment MA71-02 contains more than 9% effective IC, indicating that stormwater likely contributes to the impairments assessed under this methodology. In order to reach the 9% target, effective IC within the subwatershed should be reduced by 85%. Therefore, MassDOT's target is to reduce effective IC within its own directly contributing watershed by the same percentage, or 100 acres.

Existing BMPs

There are no existing BMPs within MassDOT's directly contributing watershed to Segment MA71-02 of the Mystic River that are mitigating potential stormwater quality impacts. Therefore, no effective IC reduction is currently provided.

Next Steps

Because the total mitigation of impervious surface achieved by MassDOT's existing BMPs is less than the target reduction of 100 acres, MassDOT will consider the implementation of additional BMPs to address those impairments to Segment MA71-02 assessed using the methodology described above.

Assessment under BMP 7U for Pathogens

Pathogen concentrations in stormwater vary widely temporally and spatially; concentrations can vary by an order of magnitude within a given storm event at a single location (MassDEP, 2009b). Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites will be assessed collectively based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to stormwater management.

In addition, while there is a positive relationship between IC and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely solely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in stormwater runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in stormwater runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform bacteria in urban stormwater from other sources ranging between 14,000 and 17,000 fecal coliform organisms/100 mL have been reported (MassDEP, 2009b). These data suggest that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than along other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other stormwater systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles, and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the stormwater system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally crosses them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from stormwater runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other stormwater systems and a large number of other factors.

Assessment and Mitigation Plan

Pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (MassDEP, 2009a)
- "The NPDES permit does not, however, establish numeric effluent limitations for stormwater discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals."(MassDEP, 2009b)
- "Although the TMDL presents quantified WLAs for stormwater that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs." (MassDEP, no date).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of stormwater management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contain specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing stormwater discharges to pathogen-impaired waters. Section 2.2.1(c) of the permit states "For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a

WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA." Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure
- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System
- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

In addition, the structural BMPs that will be considered to reduce the IC will also have the effect of reducing pathogen loads.

MassDOT believes the existing and proposed efforts are consistent with the current and draft MS4 permit's requirements and TMDL recommendations. MassDOT's existing stormwater management plan outlines BMPs that include education and illicit discharge detection and elimination. Although not included in this permit term, MassDOT will be implementing a pet waste management program at its rest stops that have discharges to pathogen impaired waters. In addition, MassDOT has requested coverage under an individual stormwater permit for the next permit term. This permit may contain additional programmatic BMPs to address pathogens.

Conclusions

MassDOT used the IC Method to assess Segment MA71-02 of the Mystic River for the impairments identified in MassDEP's final *Massachusetts Year 2010 Integrated List of Waters*. Results indicate that MassDOT should reduce its effective IC within its directly contributing subwatershed to Segment MA71-02 by 100 acres to achieve the targeted reduction in effective IC. This information is summarized in Table 3 below.

Table 3. Effective IC Reduction Required by MassDOT within the Subwatershed of Segment MA71-02 of the Mystic River

Impervious Cover Reduction		
IC in Directly Contributing Watershed	117	acres
Target Reduction in Effective IC	100	acres
IC Effectively Reduced by Existing BMPs	0	acres
IC Remaining to Mitigate with Proposed BMPs	100	acres

MassDOT should reduce its effective IC within the directly contributing watershed by 100 acres to achieve the targeted reduction in IC. MassDOT will now work with its design consultants to identify locations suitable for construction of additional BMPs to treat directly contributing IC as part of MassDOT's Impaired Waters Retrofit Initiative. The design consultants will develop construction plans for BMPs that will aim to provide the target IC reduction or treatment to the maximum extent practicable.

MassDOT has concluded, based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, and pathogen TMDLs for Massachusetts waters, that the BMPs outlined in the stormwater management plan and those under consideration for reducing effective IC from MassDOT areas are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions to the maximum extent practicable and are consistent with the intent of its existing stormwater permit and the applicable Pathogen TMDLs.

MassDOT will continue to identify opportunities to implement additional structural BMPs to address pollutant loading when road work is conducted under MassDOT's programmed projects initiative. Work on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to addressing impairments. MassDOT will include an update in annual reports and biannual submittals to EPA regarding progress made towards meeting target IC reductions, plans for construction of additional BMPs, and finalized assessments including reductions achieved by finalized BMP designs. Furthermore, MassDOT will continue to implement non-structural BMPs that reduce the impacts of stormwater.

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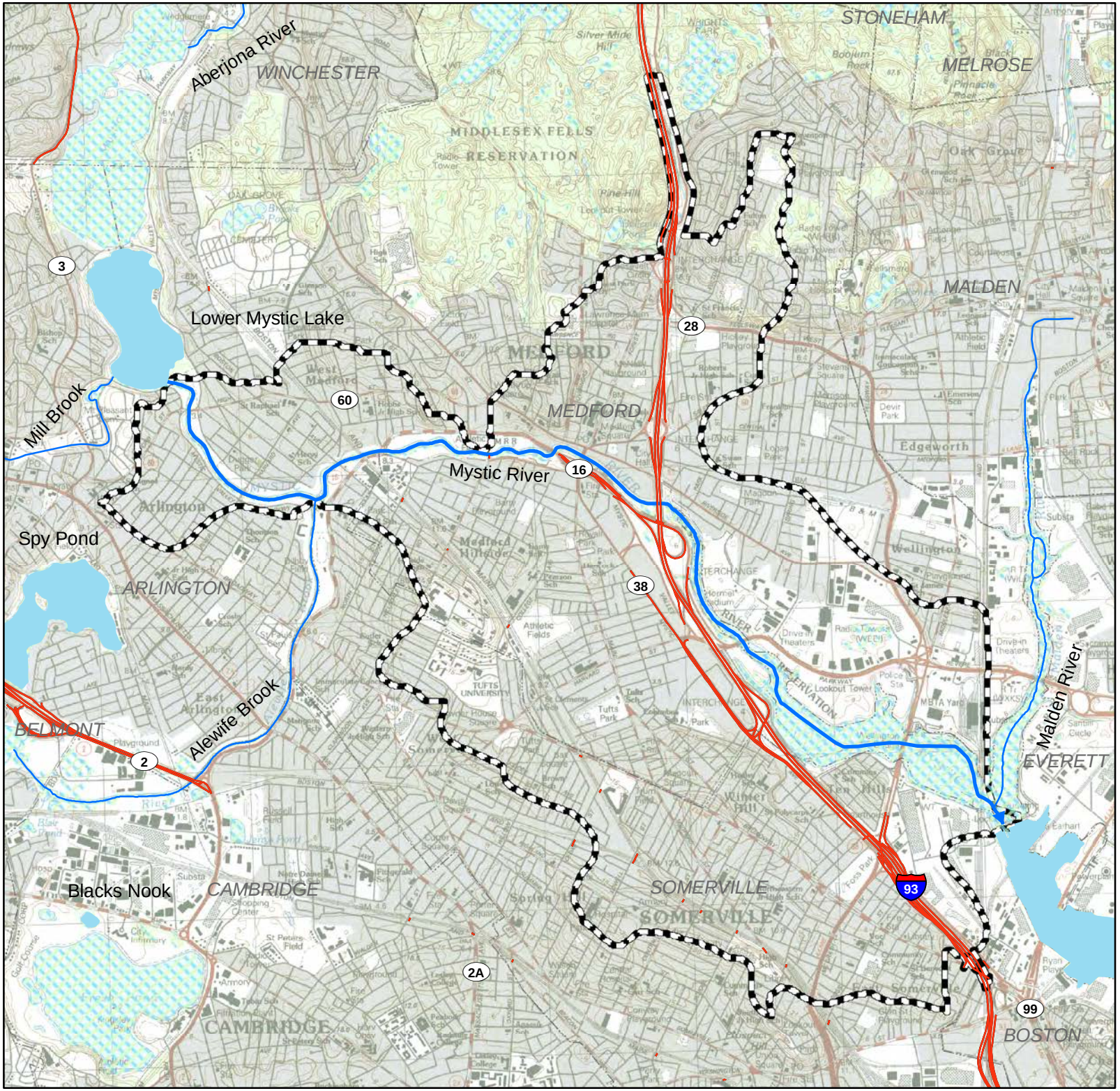

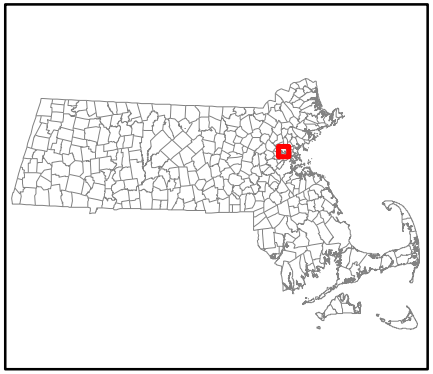

MA71-02 Subwatershed
Impaired Stream Segments
MA71-02
Impaired Water Bodies
NWI Wetland Areas
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

N

0 1,500 3,000 4,500 6,000
Feet

1 inch = 3,000 feet

Figure 1

Mystic River (MA71-02) Subwatershed

June 2012

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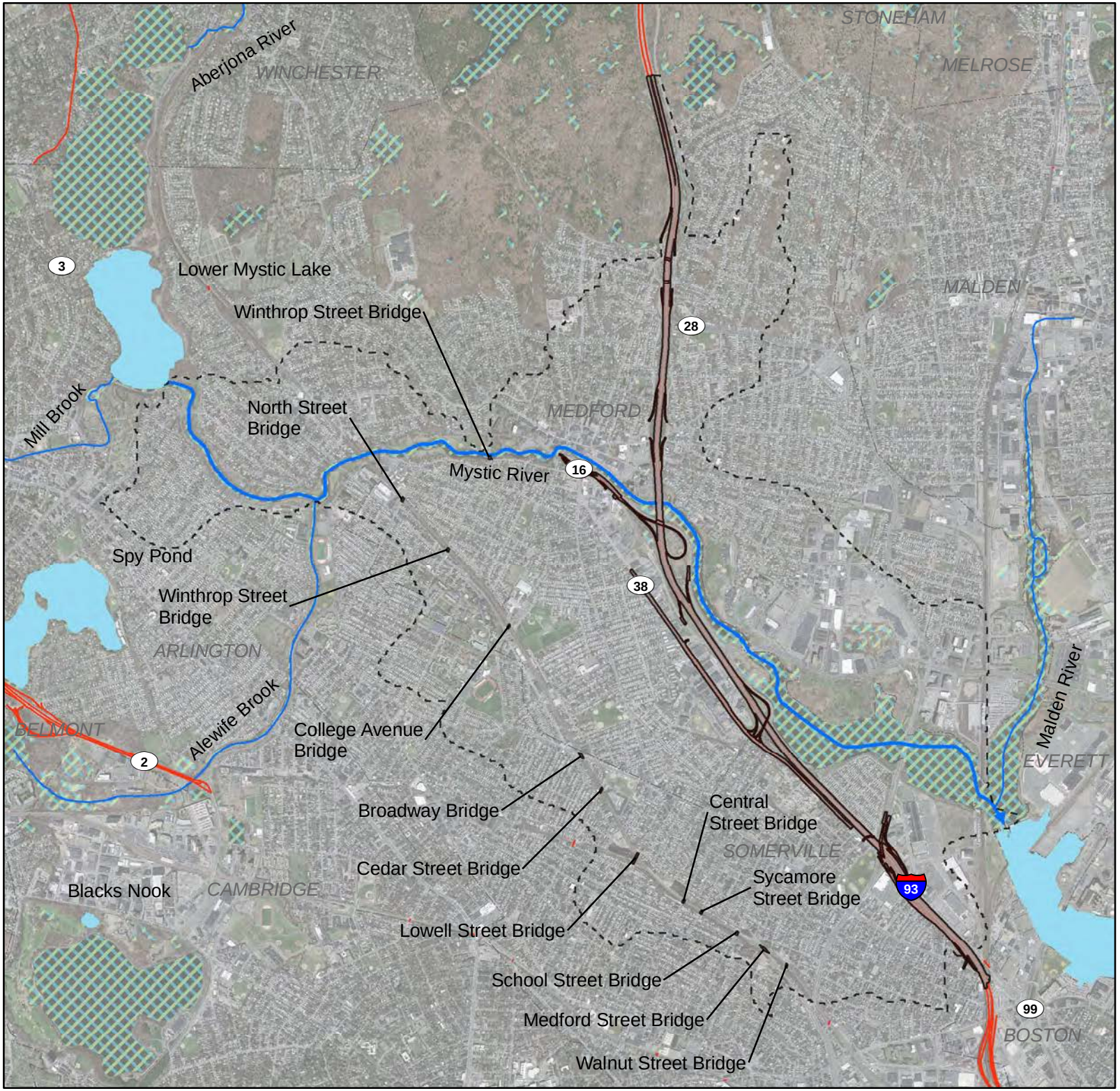

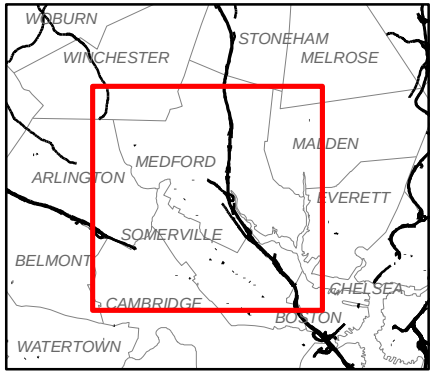

MA71-02 Subwatershed
MassDOT Direct Watershed
Impaired Stream Segments
MA71-02
Impaired Water Bodies
NWI Wetland Areas
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

N

0 1,500 3,000 4,500 6,000
Feet

1 inch = 3,000 feet

Figure 2

Mystic River (MA71-02) Directly Contributing MassDOT Watershed

June 2012

Moving Massachusetts Forward
massDOT

Impaired Waters Assessment for Mystic River (MA71-03) – Progress Report

Impaired Water Body

Name: Mystic River

Location: Boston, Chelsea, Everett, and Somerville, MA

Water Body ID: MA71-03

Impairments

Segment MA71-03 is listed under Category 5, Waters Requiring a Total Maximum Daily Load (TMDL), on MassDEP's final *Massachusetts Year 2008*, final *Massachusetts Year 2010*, and proposed *Massachusetts Year 2012 Integrated List of Waters*. Table 1 below shows the impairments to Segment MA71-03 included on each list.

Table 1. Impairments to Segment MA71-03 of the Mystic River Included on the Massachusetts Integrated List of Waters

Massachusetts Integrated List of Waters		
Final 2008 List	**Final 2010 List**	**Proposed 2012 List**
Metals	Ammonia (Un-ionized)	Ammonia (Un-ionized)
Oil and grease	Fecal Coliform	Fecal Coliform
Organic enrichment/Low DO	Foam/Flocs/Scum/Oil Slicks	Foam/Flocs/Scum/Oil Slicks
Other inorganics	Other	Other
Pathogens	Oxygen, Dissolved	Oxygen, Dissolved
Priority organics	PCBs in Fish Tissue	PCBs in Fish Tissue
Taste, odor and color	Petroleum Hydrocarbons	Petroleum Hydrocarbons
Unionized Ammonia	Taste and Odor	Sediment Bioassays -- Chronic Toxicity Freshwater
		Taste and Odor

According to MassDEP's *Mystic River Watershed 2004-2008 Water Quality Assessment Report* (MassDEP, 2010), the sources of the impairments to MA71-03 include contaminated sediments and other unknown sources. The following entities have a National Pollutant Discharge Elimination System (NPDES) permit to discharge combined sewer overflows (CSOs) to Segment MA71-03:

- City of Cambridge (MA0101974)

- City of Somerville (MA0101982)
- MWRA (MA0103284)

Relevant Water Quality Standards

Water Body Classification: Class SB

Applicable State Regulations:

- *314 CMR 4.05 (4) (b) 4 Bacteria*.

  a. Waters designated for shellfishing shall not exceed a fecal coliform median or geometric mean MPN of 88 organisms per 100 ml, nor shall more than 10% of the samples exceed an MPN of 260 per 100 ml or other values of equivalent protection based on sampling and analytical methods used by the Massachusetts Division of Marine Fisheries and approved by the National Shellfish Sanitation Program in the latest revision of the Guide For The Control of Molluscan Shellfish (more stringent regulations may apply, see 314 CMR 4.06(1)(d)(5));

  b. at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010, no single enterococci sample taken during the bathing season shall exceed 104 colonies per 100 ml and the geometric mean of the five most recent samples taken within the same bathing season shall not exceed 35 enterococci colonies per 100 ml. In non-bathing beach waters and bathing beach waters during the non bathing season, no single enterococci sample shall exceed 104 colonies per 100 ml and the geometric mean of all of the samples taken during the most recent six months typically based on a minimum of five samples shall not exceed 35 enterococci colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department; and

  c. consistent with Massachusetts Department of Public Health regulations for bathing beaches, the single sample maximum values in the primary contact recreation bacteria criteria in 314 CMR 4.05(4)(b)4.b. also are for use in the context of notification and closure decisions.

- *314 CMR 4.05 (5) (c) Nutrients*. Unless naturally occurring, all surface waters shall be free from nutrients in concentrations that would cause or contribute to impairment of existing or designated uses and shall not exceed the site specific criteria developed in a TMDL or as otherwise established by the Department pursuant to 314 CMR 4.00. Any existing point source discharge containing nutrients in concentrations that would cause or contribute to cultural eutrophication, including the excessive growth of aquatic plants or algae, in any surface water shall be provided with the most appropriate treatment as determined by the Department, including, where necessary, highest and best practical treatment (HBPT) for POTWs and BAT for non POTWs, to remove such nutrients to ensure protection of existing and designated uses. Human activities that result in the nonpoint source discharge of nutrients to any surface water may be required to be provided with cost effective and reasonable best management practices for nonpoint source control.

- *314 CMR 4.05 (5) (e) Toxic Pollutants*. All surface waters shall be free from pollutants in concentrations or combinations that are toxic to humans, aquatic life or wildlife. For pollutants not otherwise listed in 314 CMR 4.00, the National Recommended Water Quality Criteria: 2002, EPA 822R-02-047, November 2002 published by EPA pursuant to Section 304(a) of the Federal Water Pollution Control Act, are the allowable receiving water concentrations for the affected waters, unless the Department either establishes a site specific criterion or determines that naturally occurring background concentrations are higher. Where the Department determines that naturally occurring background

concentrations are higher, those concentrations shall be the allowable receiving water concentrations. The Department shall use the water quality criteria for the protection of aquatic life expressed in terms of the dissolved fraction of metals when EPA's 304(a) recommended criteria provide for use of the dissolved fraction. The EPA recommended criteria based on total recoverable metals shall be converted to dissolved metals using EPA's published conversion factors. Permit limits will be written in terms of total recoverable metals. Translation from dissolved metals criteria to total recoverable metals permit limits will be based on EPA's conversion factors or other methods approved by the Department. The Department may establish site specific criteria for toxic pollutants based on site specific considerations. The Department may establish site specific criteria for toxic pollutants based on site specific considerations. Site specific criteria, human health risk levels and permit limits will be established in accordance with the following:

1. Site Specific Criteria: Where EPA recommended criteria for a specific pollutant are not available or where the Department determines that they are invalid due to site specific physical, chemical or biological considerations, the Department shall use a site specific criterion as the allowable receiving water concentration for the affected waters. In all cases, at a minimum, site specific criteria shall not exceed safe exposure levels determined by toxicity testing using methods approved by the Department. The Department will adopt any such site specific criteria as revisions to 314 CMR 4.00 in accordance with M.G.L. c. 30A.
2. Human Health Risk Levels. Where EPA has not set human health risk levels for a toxic pollutant, the human health based regulation of the toxic pollutant shall be in accordance with guidance issued by the Department of Environmental Protection's Office of Research and Standards. The Department's goal is to prevent all adverse health effects which may result from the ingestion, inhalation or dermal absorption of toxins attributable to waters during their reasonable use as designated in 314 CMR 4.00. When this goal is not attainable, the Department will use a goal of 10-6 as the acceptable excess lifetime cancer risk level for individual carcinogens.
3. Accumulation of Pollutants. Where appropriate the Department shall use an additional margin of safety when establishing water quality based effluent limits to assure that pollutants do not persist in the environment or accumulate in organisms to levels that:
    a. are toxic to humans, wildlife or aquatic life; or
    b. result in unacceptable concentrations in edible portions of marketable fish or shellfish or for the recreational use of fish, shellfish, other aquatic life or wildlife for human consumption.
4. Public Notice. Where EPA recommended criteria are used to establish water quality based effluent limitations, the effluent limitations shall be documented and subject to full intergovernmental coordination and public participation as set forth in 314 CMR 2.00 "Permit Procedures".

Site Description

The Mystic River begins at the outlet of the Lower Mystic Lake (MA71027) along the corporate boundary between the City of Medford and the Town of Arlington. From there, the river flows southeast through the Cities of Somerville, Everett, Chelsea, and Boston before its confluence with the Chelsea River (MA71-06) at Inner Boston Harbor (MA70-02). This assessment focuses on Segment MA71-03 of the Mystic River, which includes the 1.8-mile long stretch from the Amelia Earhart Dam in Somerville/Everett to its confluence with the Chelsea River in Boston/Chelsea. Its directly contributing subwatershed is approximately 2,361 acres in size and consists mostly of heavily urbanized areas. The subwatershed has a total impervious cover (IC) area of approximately

71.2 percent. Refer to Figure 1 for the location of Segment MA71-03 and its contributing subwatershed.

MassDOT currently owns and maintains several major roadways within the subwatershed of Segment MA71-03. These roadways include Interstate 93 (I-93) and portions of Route 1/Northeast Expressway (Rt. 1). Runoff from I-93 is collected by traditional piped stormwater systems but appears to flow out of the subwatershed and discharges to a separate water body. The majority of Rt. 1 within the subwatershed of Segment MA71-03 is elevated. Runoff is collected by scuppers and discharged directly to Segment MA71-03 through several stormwater outfalls. Three of these outfalls are very large and appear to also drain interconnected municipal stormwater systems owned by the Cities of Chelsea and Everett.

In addition to the roadways listed above, MassDOT owns and maintains three bridges within the subwatershed of Segment MA71-03. Two of these bridges span railroad lines that run through the subwatershed beneath Route 38/Mystic Avenue and Washington Avenue. Runoff from the two bridges flows into municipal stormwater systems along the adjacent roadways. These municipal systems likely discharge stormwater directly to Segment MA71-03. The third bridge spans a portion of Inner Boston Harbor (MA70-02). Runoff from this bridge likely flows directly to Inner Boston Harbor.

In total, approximately 17 acres of MassDOT's IC within the subwatershed to Segment MA71-03 discharge directly to the water body. Refer to Figure 2 for the locations of MassDOT's directly contributing IC areas within the subwatershed of Segment MA71-03. AECOM conducted two field inspections of MassDOT's stormwater systems within the subwatershed of Segment MA71-03 on behalf of MassDOT on April 3, 2012 and May 22, 2012. AECOM found no Best Management Practices (BMPs) in place to address the direct stormwater runoff from these roadways.

Assessment under BMP 7U

The MassDEP's final *Massachusetts Year 2008* and proposed *Massachusetts Year 2012 Integrated List of Waters* are included in this assessment as background information. The final *Massachusetts Year 2010 Integrated List of Waters* is used for this assessment of MA71-03.

The MassDEP's final *Massachusetts Year 2010 Integrated List of Waters* includes eight impairments for Segment MA71-03 of the Mystic River, none of which have been addressed by a TMDL. Of these impairments, seven are potentially related to highway runoff including ammonia (un-ionized), fecal coliforms, foal/flocs/scum/oil slicks, other, dissolved oxygen, petrolueum hydrocarbons, and taste and odor. MassDOT assessed its potential contribution to these impairments using the approach described in BMP 7U of MassDOT's Stormwater Management Plan (*Water Quality Impaired Waters Assessment and Mitigation Plan*), which applies to impairments that have been assigned to a water body prior to completion of a TMDL. MassDOT assessed all seven of the impairments related to stormwater runoff using its Impervious Cover (IC) Method except for fecal coliforms. As described in MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT, 2011), IC provides a measure of the potential impact of stormwater on many impairments. The impairment of fecal coliforms was assessed separately based on MassDOT's protocol for assessing waters impaired by bacteria. Refer to the section of this report titled "Assessment under BMP 7U for Pathogens" for MassDOT's assessment of this impairment.

The remaining impairment, PCBs in fish tissue, is not related to highway runoff and therefore was not considered under MassDOT's assessment. The impairment for PCBs in fish tissue typically indicates the presence of PCBs in the waterbody that comprises the fish habitat. The USEPA National Urban Runoff Program (NURP), however, found PCBs in only 1% of samples from

highway runoff (EPA, 1983). Based on this evidence, MassDOT concluded that this impairment is not related to highway runoff.

MassDOT's Application of the Impervious Cover Method

MassDOT's Application of Impervious Cover Method in BMP 7U applies many aspects of USEPA Region I's Impervious Cover Method described in EPA's *Stormwater TMDL Implementation Support Manual* (ENSR, 2006) to MassDOT's program. This method assesses potential stormwater impacts on the impaired water and evaluates the IC reduction required to ensure that stormwater is not the cause of the impairments. Consistent with findings of EPA and others, when a watershed has less than 9% IC, MassDOT concludes that stormwater is not the likely cause of the impairment. Additional information regarding this method is provided in MassDOT's Application of IC Method document.

First, MassDOT calculated the percent IC of the water body's entire contributing watershed (total watershed upstream of the downstream end of an impaired segment) and that of the local watershed contributing to the impaired segment (referred to as the subwatershed in this analysis) to determine whether stormwater has a potential to cause the impairments of the receiving water body. The total watershed and subwatershed to the impaired water body were delineated using the USGS Data Series 451. When USGS Data Series watersheds did not delineate the subwatershed of the water body under review, the GIS shapefiles were modified by delineating to the water body based on USGS topography to add specificity. IC data was available as part of the USGS data layers Data Series 451 and MassGIS's impervious surfaces data layer. In cases where it was determined that stormwater was a potential cause of the impairment, MassDOT calculated the degree to which IC would need to be reduced in the subwatershed to meet the 9% IC target. This reduction was then applied proportionally to the area of MassDOT roadways/properties directly discharging to the water body segment to identify MassDOT's target IC reduction. The 9% IC reduction serves only as a recommended target and is not meant to imply that failing to meet the target would cause an exceedance in water quality standards. As explained in BMP 7U, MassDOT will consider a variety of factors apart from numeric guidelines, including site constraints and the magnitude of any potential exceedances in water quality standards, to determine the precise nature and extent of additional BMPs recommended for particular locations. This approach is consistent with the iterative, adaptive management BMP approach set forth in EPA guidelines.

MassDOT calculated the effective IC reduction afforded by the existing structural BMPs currently incorporated into the stormwater infrastructure of MassDOT's properties. This effective IC reduction was calculated by applying effective IC reduction rates to existing BMPs based on their size, function and contributing watershed. BMP performances were derived from EPA Region 1's *Stormwater Best Management Practices (BMP) Performance Analysis* report (EPA, 2010) and engineering judgment. More information on the approach used to calculate the effective IC reductions is described in BMP 7U. When the reduction in effective IC achieved by the existing BMPs was equal to or greater than the target reduction, no further measures were proposed. When this was not the case, MassDOT considered additional BMPs in order to meet the targeted reduction.

Using this approach, MassDOT derived the following site parameters for Segment MA71-03 of the Mystic River:

Table 2. IC Method Site Parameters for Segment MA71-03 of the Mystic River

Total Watershed		
Watershed Area	42,646	acres
IC Area	17,011	acres

Percent Impervious	40	%
IC Area at 9% Goal	3,838	acres
Subwatershed		
Subwatershed Area	2,361	acres
IC (IC) Area	1,682	acres
Percent Impervious	71	%
IC Area at 9% Goal	212.5	acres
Target Reduction % in IC	87	%
Reductions Applied to DOT Direct Watershed		
MassDOT Directly Contributing IC	17	acres
MassDOT's Target Reduction in Effective IC (87% of DOT Directly Contributing IC)	15	acres

The subwatershed contains more than 9% effective IC, indicating that stormwater may contribute to the impairments to Segment MA71-03. Effective IC within the subwatershed should be reduced by 87% to reach the 9% target. Therefore, MassDOT will aim to reduce the effective IC within its directly contributing watershed by the same percentage by removing 15 acres of effective IC.

Existing BMPs

There are no existing BMPs within MassDOT's directly contributing watershed to Segment MA71-03 of the Mystic River that are mitigating potential stormwater quality impacts. Therefore, no effective IC reduction is currently provided.

Next Steps

Because the total mitigation of impervious surface achieved by MassDOT's existing BMPs is less than the target reduction of 15 acres, MassDOT will consider the implementation of additional BMPs to address those impairments to Segment MA71-03 assessed using the methodology described above.

Assessment under BMP 7U for Pathogens

Pathogen concentrations in stormwater vary widely temporally and spatially; concentrations can vary by an order of magnitude within a given storm event at a single location (MassDEP, 2009b). Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites will be assessed collectively based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to stormwater management.

In addition, while there is a positive relationship between IC and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban

areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely solely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in stormwater runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliforms/100 ml. Concentrations of pathogens in stormwater runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform bacteria in urban stormwater from other sources ranging between 14,000 and 17,000 fecal coliform organisms/100 mL have been reported (MassDEP, 2009b). These data suggest that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than along other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other stormwater systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles, and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the stormwater system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally crosses them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from stormwater runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other stormwater systems and a large number of other factors.

Assessment and Mitigation Plan

Pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (MassDEP, 2009a)
- "The NPDES permit does not, however, establish numeric effluent limitations for stormwater discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals."(MassDEP, 2009b)
- "Although the TMDL presents quantified WLAs for stormwater that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs." (MassDEP, no date).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of stormwater management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contain specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing stormwater discharges to pathogen-impaired waters. Section 2.2.1(c) of the permit states "For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA." Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure

- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System
- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

In addition, the structural BMPs that will be considered to reduce the IC will also have the effect of reducing pathogen loads.

MassDOT believes the existing and proposed efforts are consistent with the current and draft MS4 permit's requirements and TMDL recommendations. MassDOT's existing stormwater management plan outlines BMPs that include education and illicit discharge detection and elimination. Although not included in this permit term, MassDOT will be implementing a pet waste management program at its rest stops that have discharges to pathogen impaired waters. In addition, MassDOT has requested coverage under an individual stormwater permit for the next permit term. This permit may contain additional programmatic BMPs to address pathogens.

Conclusions

MassDOT used the IC Method to assess Segment MA71-03 of the Mystic River for the impairments identified in MassDEP's final *Massachusetts Year 2010 Integrated List of Waters*. Results indicate that MassDOT should reduce its effective IC within its directly contributing subwatershed to Segment MA71-03 by 15 acres to achieve the targeted reduction in effective IC. This information is summarized in Table 3 below.

Table 3. Effective IC Reduction Required by MassDOT within the Subwatershed of Segment MA71-03 of the Mystic River

Impervious Cover Reduction		
IC in Directly Contributing Watershed	17	acres
Target Reduction in Effective IC	15	acres
IC Effectively Reduced by Existing BMPs	0	acres
IC Remaining to Mitigate with Proposed BMPs	15	acres

MassDOT should reduce its effective IC within the directly contributing watershed by 15 acres to achieve the targeted reduction in IC. MassDOT will now work with its design consultants to identify locations suitable for construction of additional BMPs to treat directly contributing IC as part of MassDOT's Impaired Waters Retrofit Initiative. The design consultants will develop construction plans for BMPs that will aim to provide the target IC reduction or treatment to the maximum extent practicable.

MassDOT has concluded, based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, and pathogen TMDLs

for Massachusetts waters, that the BMPs outlined in the stormwater management plan and those under consideration for reducing effective IC from MassDOT areas are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions to the maximum extent practicable and are consistent with the intent of its existing stormwater permit and the applicable Pathogen TMDLs.

MassDOT will continue to identify opportunities to implement additional structural BMPs to address pollutant loading when road work is conducted under MassDOT's programmed projects initiative. Work on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to addressing impairments. MassDOT will include an update in annual reports and biannual submittals to EPA regarding progress made towards meeting target IC reductions, plans for construction of additional BMPs, and finalized assessments including reductions achieved by finalized BMP designs. Furthermore, MassDOT will continue to implement non-structural BMPs that reduce the impacts of stormwater.

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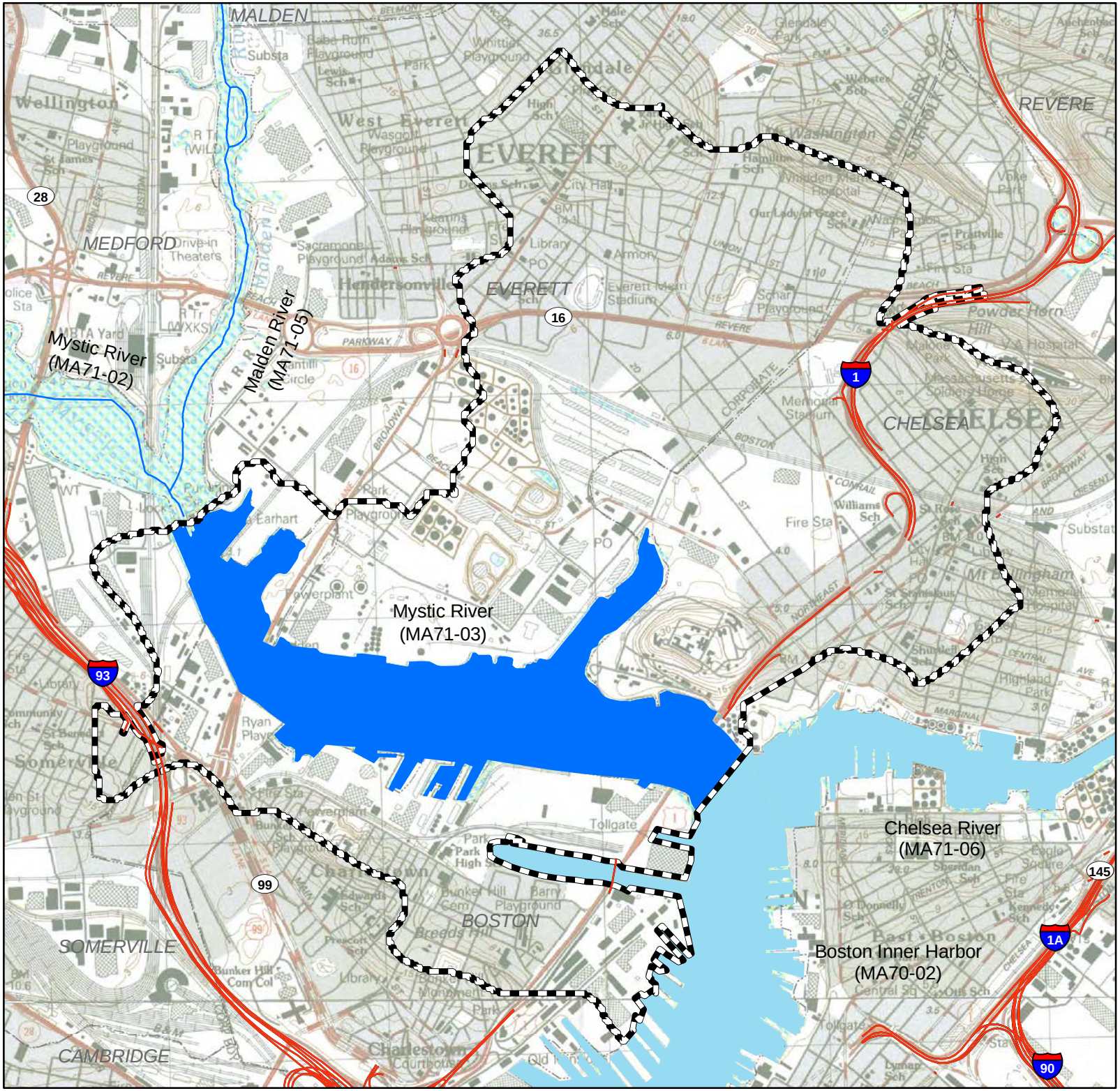

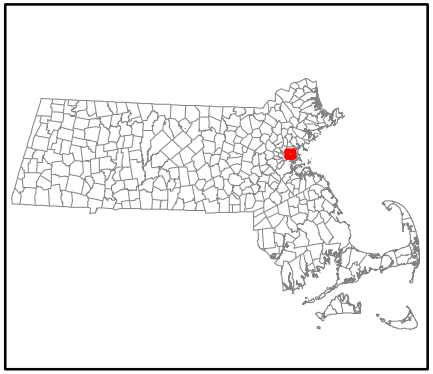

MA71-03 Subwatershed
Impaired Stream Segments
MA71-03
Impaired Water Bodies
NWI Wetland Areas
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

N

0 1,000 2,000 3,000 4,000
Feet

1 inch = 2,000 feet

Figure 1

Mystic River (MA71-03) Subwatershed

June 2012

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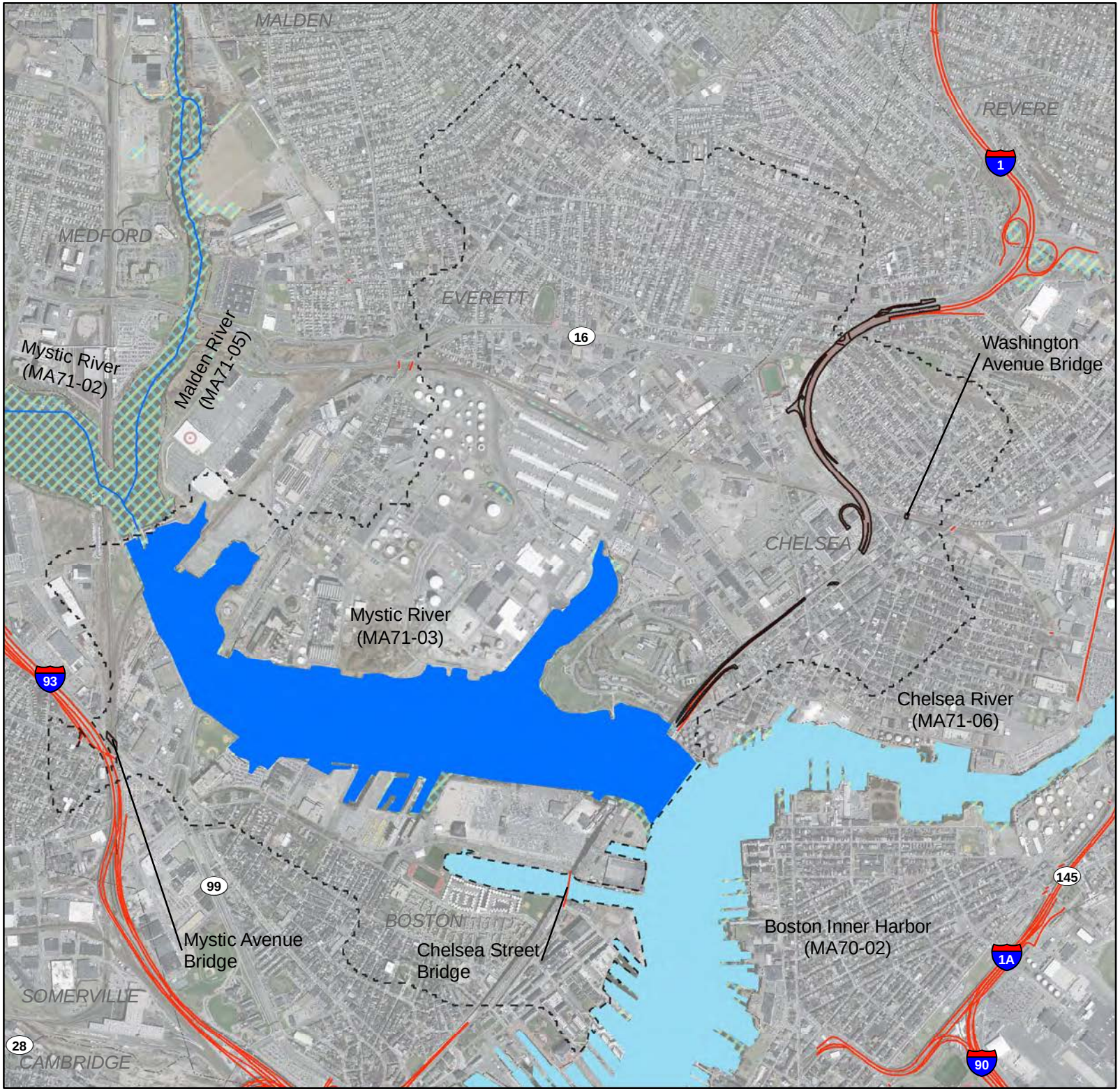

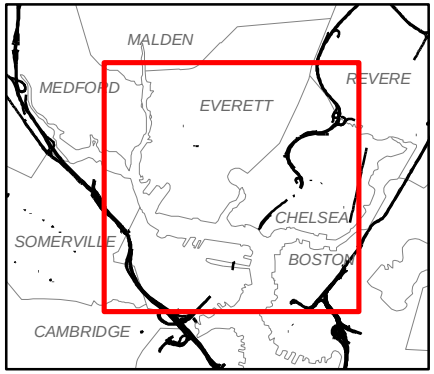

MA71-03 Subwatershed

MassDOT Direct Watershed

Impaired Stream Segments

MA71-03

Impaired Water Bodies

NWI Wetland Areas

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

N

0 1,000 2,000 3,000 4,000

Feet

1 inch = 2,000 feet

Figure 2

Mystic River (MA71-03) Directly Contributing MassDOT Watershed

June 2012

Moving Massachusetts Forward. massDOT

Impaired Waters Assessment for Neponset River (MA73-01) – Progress Report

Impaired Water Body

Name: Neponset River

Location: Foxborough, Walpole, Norwood and Canton, MA

Water Body ID: MA73-01

Impairments

The Neponset River (MA73-01) is listed under Category 5, "Waters Requiring a TMDL", on MassDEP's final *Massachusetts Year 2008*, final *Massachusetts Year 2010* and proposed *Massachusetts Year 2012 Integrated List of Waters*. Table 1 below shows the impairments to Segment MA73-01 included on each list.

Table 1. Impairments to Segment MA73-01 of the Neponset River Included on the Massachusetts Integrated List of Waters

Massachusetts Integrated List of Waters		
Final 2008 List	**Final 2010 List**	**Proposed 2012 List**
Suspended solids	Total suspended solids	Total suspended solids
Turbidity	Turbidity	Turbidity
Organic enrichment/low DO	Dissolved Oxygen	Dissolved Oxygen
Siltation	Sedimentation/siltation	Sedimentation/siltation
Nutrients	Total phosphorus	Total phosphorus
Noxious aquatic plants	Excess algal growth	Excess algal growth
Priority organics	PCB in fish tissue	PCB in fish tissue
Pathogens	Other	Other
Metals		DDT
		Escherichia coli

According to MassDEP's *Neponset River Watershed 2004 Water Quality Assessment Report* (MassDEP, 2010), 13.2 miles of the Neponset River are impaired due to low dissolved oxygen,

PCB contamination in fish, and high levels of E. coli. The report suggests that PCB contamination is likely due to contaminated sediment. The causes of the other impairments are unknown.

As described below, MassDOT recommends the implementation of various Best Management Practices (BMPs) for Neponset River Segment MA73-01, to improve water quality based on an assessment using the Impervious Cover (IC) Method. While these recommendations for BMPs address impairments specific to Neponset River Segment MA73-01, all receiving water bodies downstream of the BMPs will ultimately benefit from the improvements.

Relevant Water Quality Standards

Water Body Classification: Class B\ Warm Water Fishery (WWF)

Applicable State Regulations:

- *314 CMR 4.05 (3)(b) 5 Solids*. These waters shall be free from floating, suspended and settleable solids in concentrations or combinations that would impair any use assigned to this class, that would cause aesthetically objectionable conditions, or that would impair the benthic biota or degrade the chemical composition of the bottom.
- *314 CMR 4.05 (3)(b) 6 Color and Turbidity*. These waters shall be free from color and turbidity in concentrations or combinations that are aesthetically objectionable or would impair any use assigned to this class.
- *314 CMR 4.05 (5) (a) Aesthetics*. All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.
- *314 CMR 4.05 (5) (b) Bottom Pollutants or Alterations*. All surface waters shall be free from pollutants in concentrations or combinations or from alterations that adversely affect the physical or chemical nature of the bottom, interfere with the propagation of fish or shellfish, or adversely affect populations of non-mobile or sessile benthic organisms.
- *314 CMR 4.05 (5) (c) Nutrients*. Unless naturally occurring, all surface waters shall be free from nutrients in concentrations that would cause or contribute to impairment of existing or designated uses and shall not exceed the site specific criteria developed in a TMDL or as otherwise established by the Department pursuant to 314 CMR 4.00. Any existing point source discharge containing nutrients in concentrations that would cause or contribute to cultural eutrophication, including the excessive growth of aquatic plants or algae, in any surface water shall be provided with the most appropriate treatment as determined by the Department, including, where necessary, highest and best practical treatment (HBPT) for POTWs and BAT for non POTWs, to remove such nutrients to ensure protection of existing and designated uses. Human activities that result in the nonpoint source discharge of nutrients to any surface water may be required to be provided with cost effective and reasonable best management practices for nonpoint source control.
- *314 CMR 4.05 (5)(e) Toxic Pollutants*. All surface waters shall be free from pollutants in concentrations or combinations that are toxic to humans, aquatic life or wildlife. For pollutants not otherwise listed in 314 CMR 4.00, the National Recommended Water Quality Criteria: 2002, EPA 822R-02-047, November 2002 published by EPA pursuant to Section 304(a) of the Federal Water Pollution Control Act, are the allowable receiving water concentrations for the affected waters, unless the Department either establishes a site specific criterion or determines that naturally occurring background concentrations are higher. Where the Department determines that naturally occurring background concentrations are higher, those concentrations shall be the allowable receiving water

concentrations. The Department shall use the water quality criteria for the protection of aquatic life expressed in terms of the dissolved fraction of metals when EPA's 304(a) recommended criteria provide for use of the dissolved fraction. The EPA recommended criteria based on total recoverable metals shall be converted to dissolved metals using EPA's published conversion factors. Permit limits will be written in terms of total recoverable metals. Translation from dissolved metals criteria to total recoverable metals permit limits will be based on EPA's conversion factors or other methods approved by the Department. The Department may establish site specific criteria for toxic pollutants based on site specific considerations.

- *314 CMR 4.05 (3)(b) 1 Dissolved Oxygen*. Shall not be less than 6.0 mg/l in cold water fisheries and not less than 5.0 mg/l in warm water fisheries. Where natural background conditions are lower, DO shall not be less than natural background conditions. Natural seasonal and daily variations that are necessary to protect existing and designated uses shall be maintained.
- *314 CMR 4.05 (3)(b) 4 Bacteria*.
    - a. At bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: where E. coli is the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 126 colonies per 100 ml and no single sample taken during the bathing season shall exceed 235 colonies per 100 ml; alternatively, where enterococci are the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 33 colonies per 100 ml and no single sample taken during the bathing season shall exceed 61 colonies per 100 ml;
    - b.for other waters and, during the non bathing season, for waters at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: the geometric mean of all E. coli samples taken within the most recent six months shall not exceed 126 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 235 colonies per 100 ml; alternatively, the geometric mean of all enterococci samples taken within the most recent six months shall not exceed 33 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 61 colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

Site Description

The Neponset River is made up of four segments, MA73-01, MA73-02, MA73-03, and MA73-04. This assessment report focuses only on the beginning segment, Segment MA73-01, which spans the towns of Foxborough, Walpole, Norwood, and Canton, MA. This segment begins at the outlet of Neponset Reservoir in Foxborough and flows for approximately 13.2 miles to its confluence with East Branch in Canton (MassDEP, 2010). Segment MA73-01 flows through Bird Pond (MA73002) and Crackrock Pond (non-impaired). Refer to Figure 1 for a map identifying Segment MA73-01 of the Neponset River and its subwatershed.

Segment MA73-01 of the Neponset River has a subwatershed of approximately 12,995 acres. This subwatershed area was determined using USGS subbasin GIS shapefiles. Much of the land comprising the subwatershed is residential, commercial, or paved roadway. These areas contribute to a total impervious cover (IC) area of 2,738 acres (approximately 21%) within the subwatershed.

The Massachusetts Department of Transportation (MassDOT) owns and maintains several roadways within the Neponset River Segment MA73-01 subwatershed, including Route 1 (Rte 1), Route 1A (Rte 1A) and Interstate 95 (I-95), as well as small bridges on Main Street (Rte 1A), Kendall Street and Common Street.

An investigation performed in January 2011 as part of the I-95 resurfacing project from the Sharon/Walpole town line to the junction of Interstate 93 and I-95 confirmed that stormwater from I-95 discharges directly to Segment MA73-01 via stormwater systems and conveyance ditches. During subsequent site visits performed on January 5th and 18th, 2012, it was determined that stormwater from portions of Rte 1 and Rte 1A also discharge directly to Segment MA73-01 via stormwater collection systems. The bridges on Main Street (Rte 1A), Kendall Street and Common Street are located in the middle of municipal portions of roadway. Combined, approximately 22.7 acres of urban MassDOT roadway contributes stormwater directly to Segment MA73-01 of the Neponset River. A 0.4-acre portion of non-urban MassDOT roadway is treated by a BMP which also treats urban MassDOT roadway. This non-urban area is included in MassDOT's directly contributing IC watershed. MassDOT's total directly contributing IC watershed is shown in Figures 2 through 6.

Assessment under BMP 7U

None of the impairments for Segment MA73-01 of the Neponset River have been addressed by a Total Maximum Daily Load (TMDL). Therefore, MassDOT assessed the impairments using the approach described in BMP 7U, MassDOT Application of IC Method (MassDOT, 2011), of MassDOT's Storm Water Management Plan (*Water Quality Impaired Waters Assessment and Mitigation Plan*), which applies to impairments that have been assigned to a water body prior to completion of a TMDL. As described in MassDOT's Application of Impervious Cover Method in BMP 7U, impervious cover (IC) provides a measure of the potential impact of stormwater on many impairments. For this water body, MassDOT used the IC method to assess the following impairments:

- Sedimentation/siltation
- Total phosphorus
- Dissolved oxygen
- Total suspended solids
- Turbidity
- Excess algal growth
- Other

The impairment of PCBs in fish tissue is not likely related to stormwater runoff and is not addressed by the IC method herein. The USEPA National Urban Runoff Program found PCBs in only 1% of samples (EPA, 1983). In addition, the Water Quality Assessment Report indicates that the source of PCBs in this segment is likely contaminated sediments. Therefore, MassDOT did not consider this impairment to be potentially related to stormwater.

The impairment for pathogens is assessed separately in the section titled Assessment under BMP 7U for Pathogens.

MassDOT's Application of the Impervious Cover Method

MassDOT's Application of Impervious Cover Method in BMP 7U applies many aspects of USEPA Region I's Impervious Cover (IC) Method described in EPA's *Stormwater TMDL Implementation Support Manual* (ENSR, 2006) to MassDOT's program. This method assesses potential stormwater impacts on the impaired water and evaluates the impervious cover reduction required to

ensure that stormwater is not the cause of the impairments. Consistent with findings of EPA and others, when a watershed had less than 9% IC, MassDOT concluded that stormwater was not the likely cause of the impairment. Additional information regarding this method is provided in MassDOT's Application of IC Method document.

First, MassDOT calculated the percent IC of the water body's entire contributing watershed (total watershed upstream of the downstream end of an impaired segment) and that of the local watershed contributing to the impaired segment (referred to as the subwatershed in this analysis) to determine whether stormwater has a potential to cause the impairments of the receiving water body. The total watershed and subwatershed to the impaired water body were delineated using the USGS Data Series 451. When USGS Data Series watersheds did not delineate the subwatershed of the water body under review, the GIS shapefiles were modified by delineating to the water body based on USGS topography to add specificity. Impervious cover data was available as part of the USGS data layers Data Series 451 and MassGIS's impervious surfaces data layer. In cases where it was determined that stormwater was a potential cause of the impairment, MassDOT calculated the degree to which impervious cover would need to be reduced in the subwatershed to meet the 9% IC target. This reduction was then applied proportionally to the area of MassDOT roadways/properties directly discharging to the water body segment to identify MassDOT's target IC reduction. The 9% IC reduction serves only as a recommended target and is not meant to imply that failing to meet the target would cause an exceedance in water quality standards. As explained in BMP 7U, MassDOT will consider a variety of factors apart from numeric guidelines, including site constraints and the magnitude of any potential exceedances in water quality standards, to determine the precise nature and extent of additional BMPs recommended for particular locations. This approach is consistent with the iterative, adaptive management BMP approach set forth in EPA guidelines.

MassDOT calculated the effective impervious cover reduction afforded by the existing structural BMPs currently incorporated into the stormwater infrastructure of MassDOT's properties. This effective IC reduction was calculated by applying effective impervious cover reduction rates to existing BMPs based on their size, function and contributing watershed. BMP performances were derived from EPA Region 1's *Stormwater Best Management Practices (BMP) Performance Analysis* report (EPA, 2010) and engineering judgment. More information on the approach used to calculate the effective impervious cover reductions is described in BMP 7U. When the reduction in effective impervious cover achieved by the existing BMPs was equal to or greater than the target reduction, no further measures were proposed. When this was not the case, MassDOT considered additional BMPs in order to meet the targeted reduction.

Using this approach, MassDOT derived the following site parameters for the total contributing watershed of the impaired water (Neponset River (MA73-01)):

Table 2: Site Parameters for Neponset River (MA73-01)

Total Watershed		
Watershed Area	28,159	acres
Impervious Cover (IC) Area	5,021	acres
Percent Impervious	18	%
IC Area at 9% Goal	2,534	acres
Target Reduction % in IC	50	%
Subwatershed		
Subwatershed Area	12,995	acres
Impervious Cover (IC) Area	1,316	acres
Percent Impervious	21	%
IC Area at 9% Goal	1,170	acres
Target Reduction % in IC	57	%
Reductions Applied to DOT Direct Watershed		
MassDOT's IC Area **Directly** Contributing to Impaired Segment	23	acres
MassDOT's Target Reduction in Effective IC (57% of DOT Directly Contributing IC)	13	acres

The Segment MA73-01 subwatershed contains more than 9% IC, indicating that stormwater likely contributes to the water body's impairments. In order to reach the 9% threshold, effective IC within the subwatershed should be reduced by 57%. Therefore, MassDOT's target is to reduce its own effective IC within the directly contributing watershed by the same percentage by removing 13 acres of effective IC.

Existing BMPs

The memorandum prepared for the I-95 resurfacing project in January 2011, "I-95 Canton – Stormwater Improvement Recommendations," states that there are seven existing BMPs. However, some of the BMPs are documented to not be effective at reducing effective impervious cover. Two of the existing BMPs documented in the resurfacing memorandum are effective and are included in this assessment—Infiltration Basin 1 and Filter Strip 3 as indicated in the table below. The effective IC reduction achieved by these BMPs was estimated using the IC Method calculations under BMP 7U.

Table 3: Summary of Existing BMPs

BMP Identifier	BMP Type	Contributing Watershed IC Area (ac.)	Resulting % Removal of Contributing Watershed IC	Effective IC Area Reduction (ac.)
Filter Strip 3	Vegetated Filter Strip	0.3	75%	0.2
Infiltration Basin 1	Infiltration Basin	0.4	97%	0.4
Total		**0.7***		**0.6**

* These BMPs are in series. Infiltration Basin 1 receives stormwater from its own impervious watershed as well as the stormwater that was not effectively treated by Filter Strip 3. Therefore, the total contributing watershed is the sum of the individual watersheds.

No additional BMPs were identified for the Segment MA73-01 subwatershed during the site visits to review other MassDOT roads draining to the receiving water on January 5th and 18th, 2012.

Next Steps

Because the total mitigation of effective IC achieved by MassDOT's existing BMPs is less than the target reduction of 13 acres, MassDOT is considering the implementation of additional BMPs.

Based on recommendations documented in the memorandum prepared for the I-95 resurfacing project, MassDOT has initiated the design of six stormwater BMPs to address its direct and indirect stormwater discharges to the Neponset River. Conceptual designs for these BMPs are documented in a series of typicals entitled "I-95 Canton-Norwood-Sharon-Walpole Typical – Water Quality Check Dams" for Project Number 605590. Three of these BMPs will provide treatment for stormwater runoff from I-95 which discharges directly to MA73-01 and are listed in Table 4. Two BMPs will provide treatment for I-95 urban stormwater runoff which discharges directly to Segment MA73-02 (discussed further in the "Impaired Waters Assessment for Neponset River (MA73-02)"), and the sixth BMP will treat stormwater from only non-urban I-95 roadway, and therefore, is not included in this assessment because it does not treat any runoff from urban DOT roadway.

The table below summarizes the percent reductions in effective IC provided by the BMPs drawn up in MassDOT's conceptual designs which will treat stormwater which discharges directly to Segment MA73-01. As shown in the table, Pr-BMP-X will treat urban and non-urban roadway. The estimated reduction of effective non-urban IC does not receive credit towards the target IC reduction in this assessment.

Table 4: IC Resurfacing Project #605590 Recommendations

BMP Identifier	BMP Type	Contributing Watershed Urban IC Area (ac)	Contributing Watershed Non-Urban IC Area (ac)	Resulting Effective Urban IC Area Reduction (ac)	Resulting Effective Non-Urban IC Area Reduction (ac)
Pr-BMP-1	Infiltration Swale	0.4	-	0.3	-
Pr-BMP-2	Infiltration Swale	0.6	-	0.6	-
Pr-BMP-X*	Infiltration Swale	0.3	0.4	0.3	0.4
Total		1.3	0.4	1.2	0.4

*Pr-BMP-X treats urban roadway and non-urban roadway.

The following paragraphs briefly describe each of the conceptual designs for BMPs included in the typical for Project Number 605590, "I-95 Canton-Norwood-Sharon-Walpole Typical – Water Quality Check Dams". Refer to the actual set of drawings for additional details. Figures 7 and 8 show the locations of the conceptual BMPs.

Pr-BMP-1
A check dam will be installed at Norwood Station 45+50 in the existing ditch alongside the northbound shoulder. This check dam will be 2 feet high and 5 feet wide. The ditch behind the check dam is 652 feet long.

Pr-BMP-2
A check dam will be installed at Norwood Station 48+50 in the existing ditch alongside the southbound shoulder. This check dam will be 2 feet high and 3 feet wide. The ditch behind the check dam is 653 feet long.

Pr-BMP-X
A check dam will be installed at Canton Station 45+00 in the existing ditch alongside the northbound shoulder. This check dam will be 2 feet high and 5 feet wide. The ditch behind the check dam is 587 feet long.

Assessment under BMP 7U for Pathogens

Pathogen concentrations in stormwater vary widely temporally and spatially; concentrations can vary by an order of magnitude within a given storm event at a single location (MassDEP, 2009b). Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites will be assessed collectively based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to stormwater management.

In addition, while there is a positive relationship between impervious cover and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)."

Therefore, DOT did not rely solely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in stormwater runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliform organisms/100 ml. Concentrations of pathogens in stormwater runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform bacteria in urban stormwater from other sources ranging between 14,000 and 17,000 fecal coliform organisms/100 ml have been reported (MassDEP, 2009b). This data suggests that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other stormwater systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles, and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the stormwater system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally cross them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from stormwater runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other stormwater systems and a large number of other factors.

Assessment and Mitigation Plan

Pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (MassDEP, 2009a)
- "The NPDES permit does not, however, establish numeric effluent limitations for stormwater discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals."(MassDEP, 2009b)
- "Although the TMDL presents quantified WLAs for stormwater that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs." (MassDEP, no date).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of stormwater management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contains specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing stormwater discharges to pathogen-impaired waters. Section 2.2.1(c) of the permit states "For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA." Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Storm Water Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure

- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System
- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

In addition, the structural BMPs that will be considered to reduce the IC will also have the effect of reducing pathogen loads.

MassDOT believes the existing and proposed efforts are consistent with the current and draft MS4 permit's requirements and TMDL recommendations. MassDOT's existing stormwater management plan outlines BMPs that include education and illicit discharge detection and elimination. Although not included in this permit term, MassDOT will be implementing a pet waste management program at its rest stops that have discharges to pathogen impaired waters. In addition, MassDOT has requested coverage under an individual stormwater permit for the next permit term. This permit may contain additional programmatic BMPs to address pathogens.

Conclusions

MassDOT used the IC Method to assess Segment MA73-01 of the Neponset River for the impairments identified in MassDEP's Final *Year 2010 Integrated List of Waters*. Results indicate that MassDOT should reduce its effective IC within its directly contributing watershed to Segment MA73-01 by 13.0 acres to achieve the targeted reduction in effective IC.

The following table summarizes IC reductions within MassDOT's directly contributing watershed under existing and proposed conditions.

Table 5: Effective IC Reductions under Existing & Proposed Conditions

Effective IC Reductions	
MassDOT Target Reduction in Effective IC	13 acres
Effective IC Reduction Achieved by Existing BMPs	0.6 acres
Effective IC Reduction Achieved by Proposed BMPs for Project # 605590	1.2 acres
Remaining Target	**11 acres**

MassDOT will now work with its design consultants to identify opportunities for additional BMPs to meet the remaining target of 11 acres of effective IC as part of the Impaired Waters Retrofit Initiative. Note that this remaining target may change depending on the final designs for the conceptual BMPs included in the memorandum for Programmed Project Number 605590.

The design consultants will strive to meet the remaining target plus any difference in effective IC reduction resulting from final BMP designs. The final BMP designs will provide treatment to the maximum extent practicable given site constraints that are identified as the design process moves

forward. Once the designs are finalized, MassDOT will perform a final assessment of this water body under the Impaired Waters program.

MassDOT has concluded, based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, and pathogen TMDLs for Massachusetts waters, that the BMPs outlined in the stormwater management plan and those under consideration for reducing effective IC from MassDOT areas are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions to the maximum extent practicable and are consistent with the intent of its existing stormwater permit and the applicable Pathogen TMDLs.

MassDOT will continue to identify opportunities to implement additional structural BMPs to address pollutant loading when road work is conducted under MassDOT's Programmed Projects Initiative, such as with Programmed Project # 605590. Work on Programmed Projects often includes broader scale road layout changes that may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to addressing impairments. MassDOT will include an update in annual reports and biannual submittals to EPA regarding progress made towards meeting target IC reductions, plans for construction of proposed BMPs, and finalized assessments including reductions achieved by finalized BMP designs. Furthermore, MassDOT will continue to implement non-structural BMPs that reduce the impacts of stormwater.

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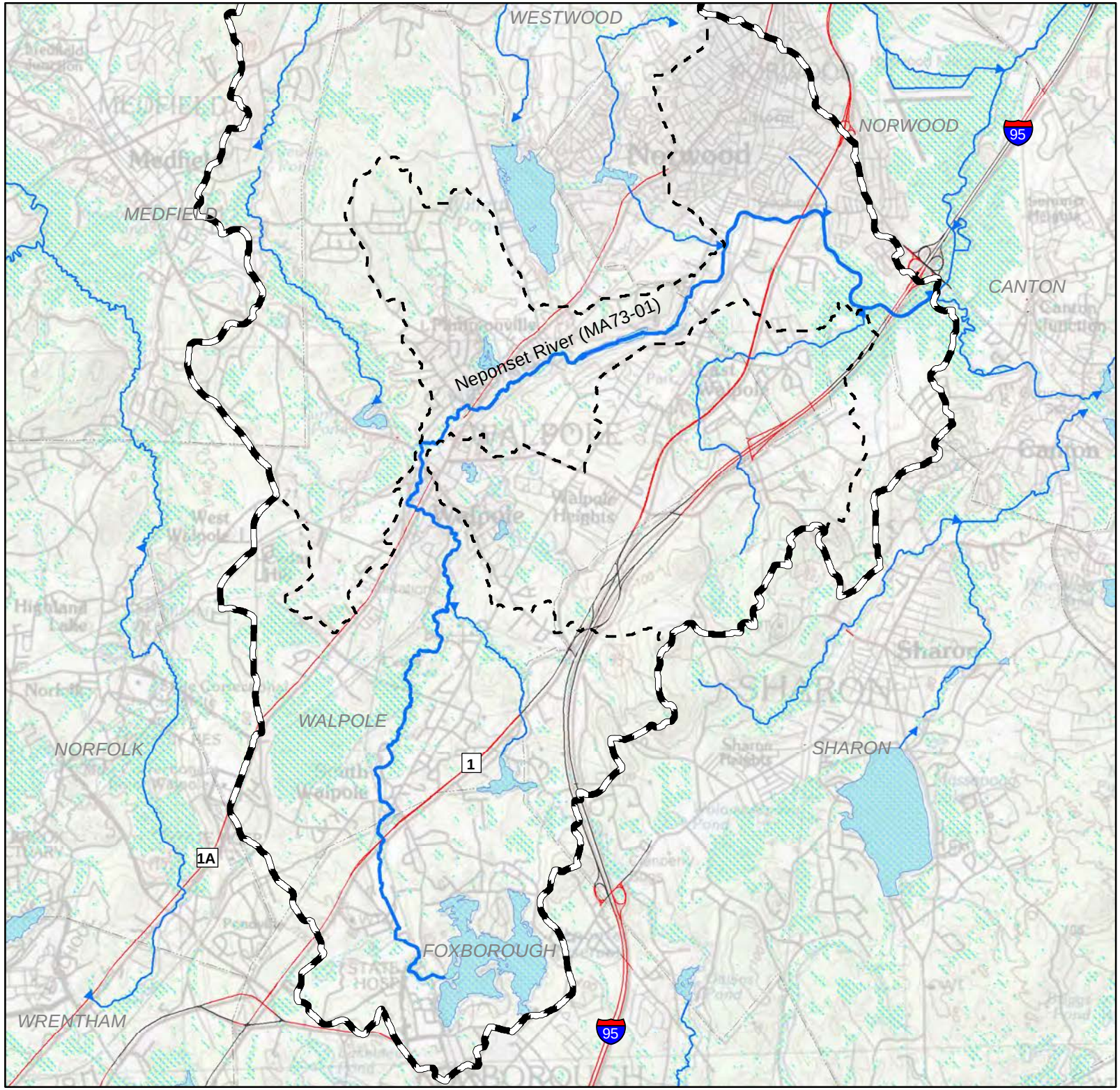

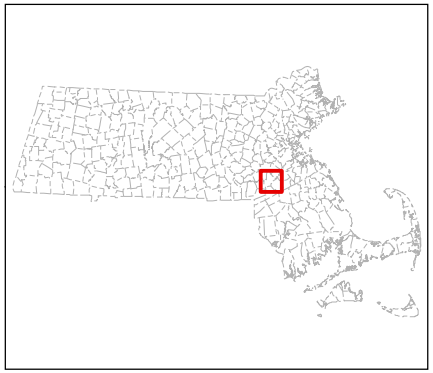

Neponset River Total Watershed
Neponset River Subwatershed
MA73-01
Impaired Stream Segments
Impaired Water Bodies
NWI Wetland Areas
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

N

0 0.250.5 1 1.5 2 Miles

1 in = 1 miles

Figure 1

Neponset River (MA73-01) Subwatershed

January 2012

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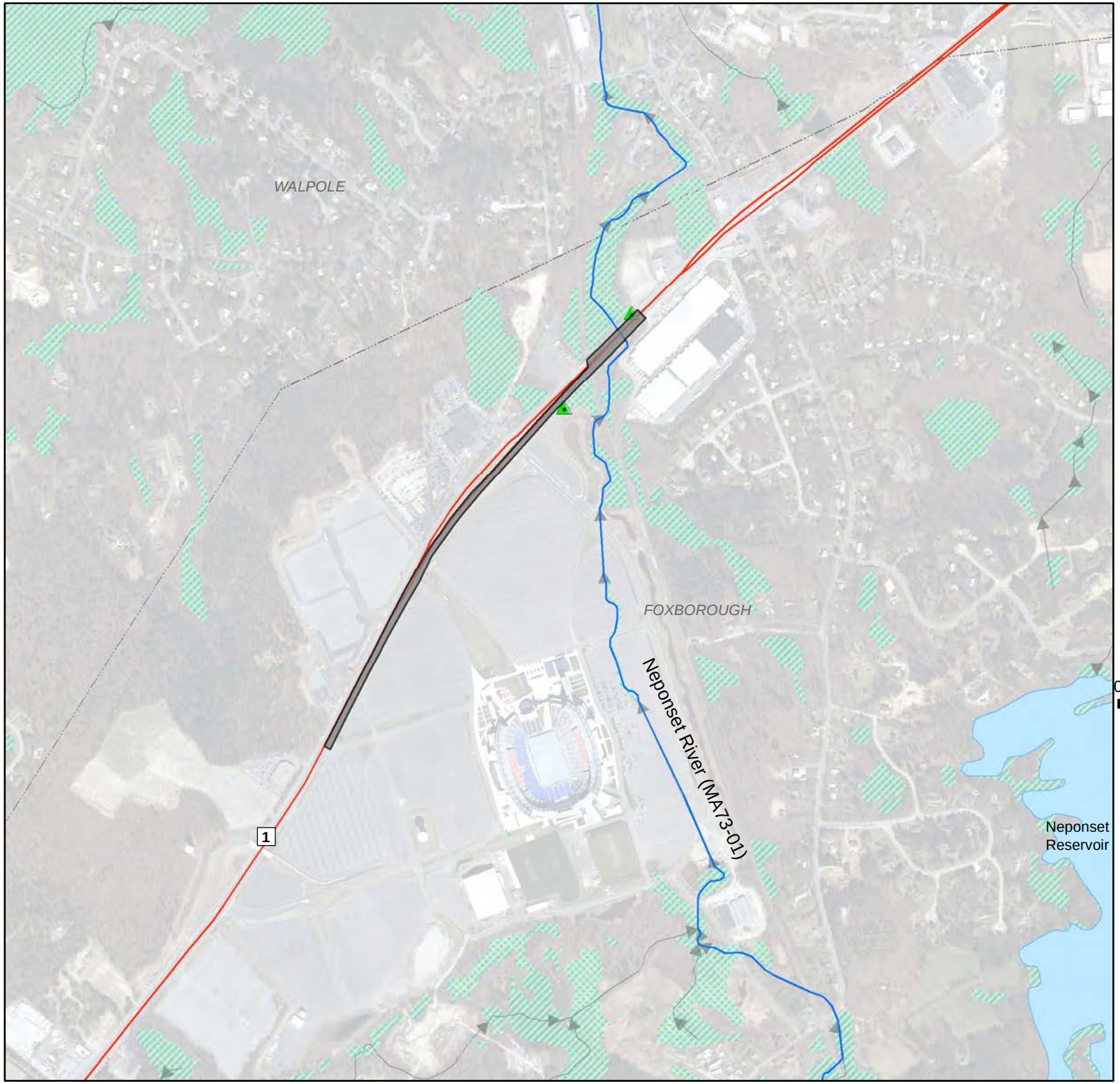

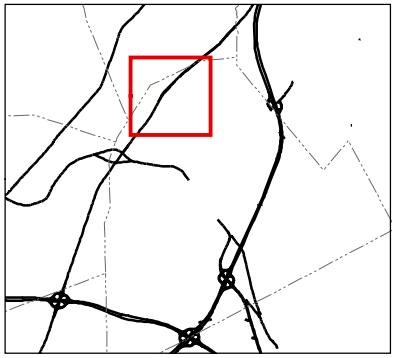

Stormwater Outfalls

MassDOT Directly Contributing Watersheds

Impaired Stream Segment

Non-Impaired Stream Segment

NWI Wetland Areas

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

N

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

1 inch = 1,000 feet

Figure 2

Neponset River (MA73-01) Directly Contributing MassDOT Watershed 1 of 5

January 2012

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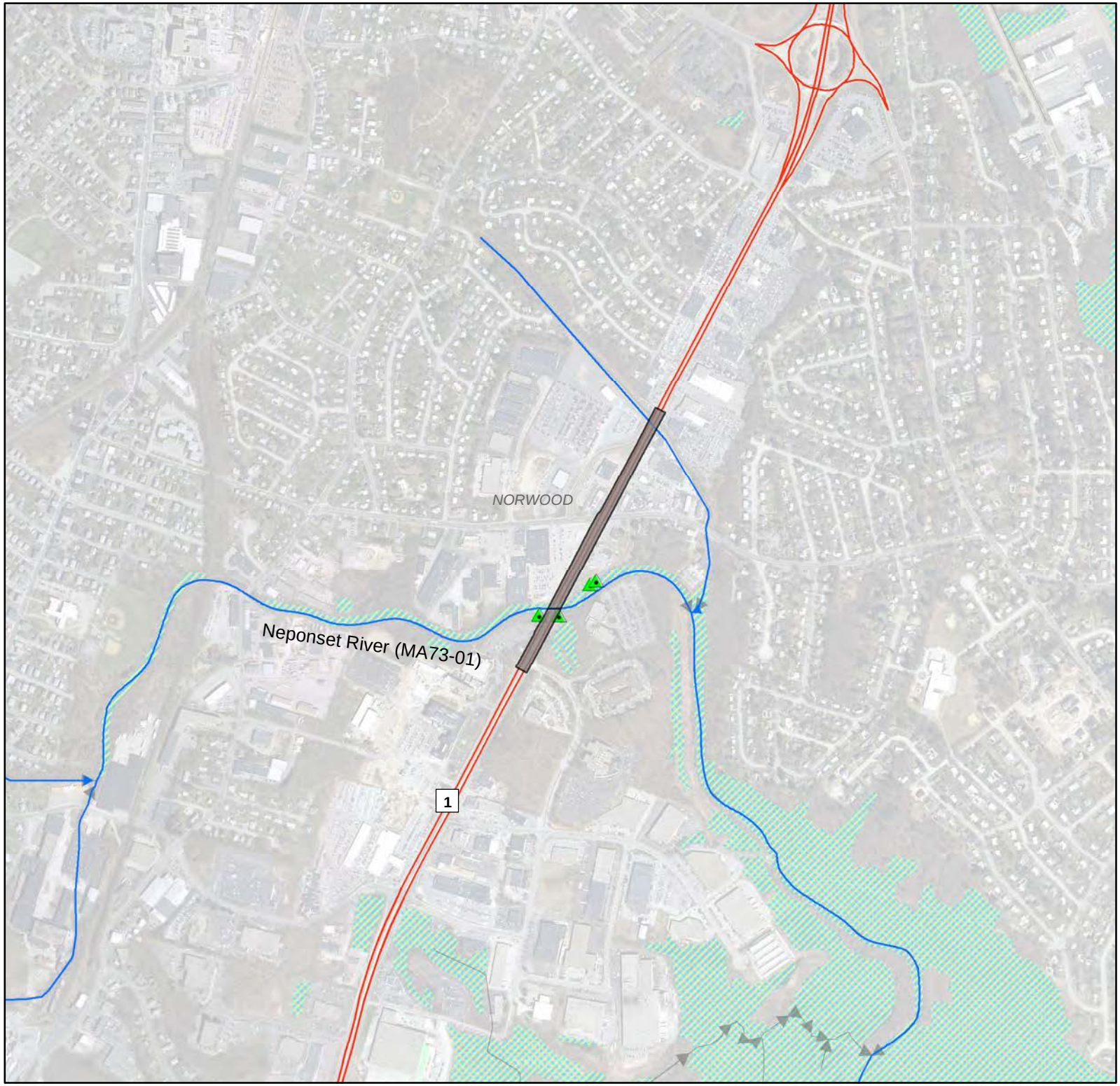

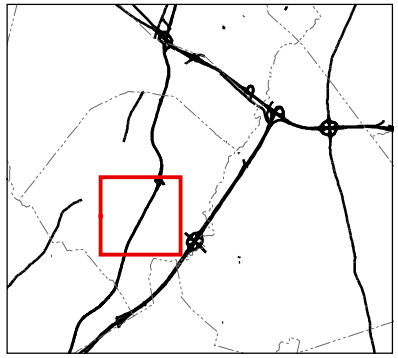

Stormwater Outfalls

MassDOT Directly Contributing Watersheds

Impaired Stream Segment

Non-Impaired Stream Segment

NWI Wetland Areas

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

N

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

1 inch = 1,000 feet

Figure 3

Neponset River (MA73-01)
Directly Contributing
2 of 5

January 2012

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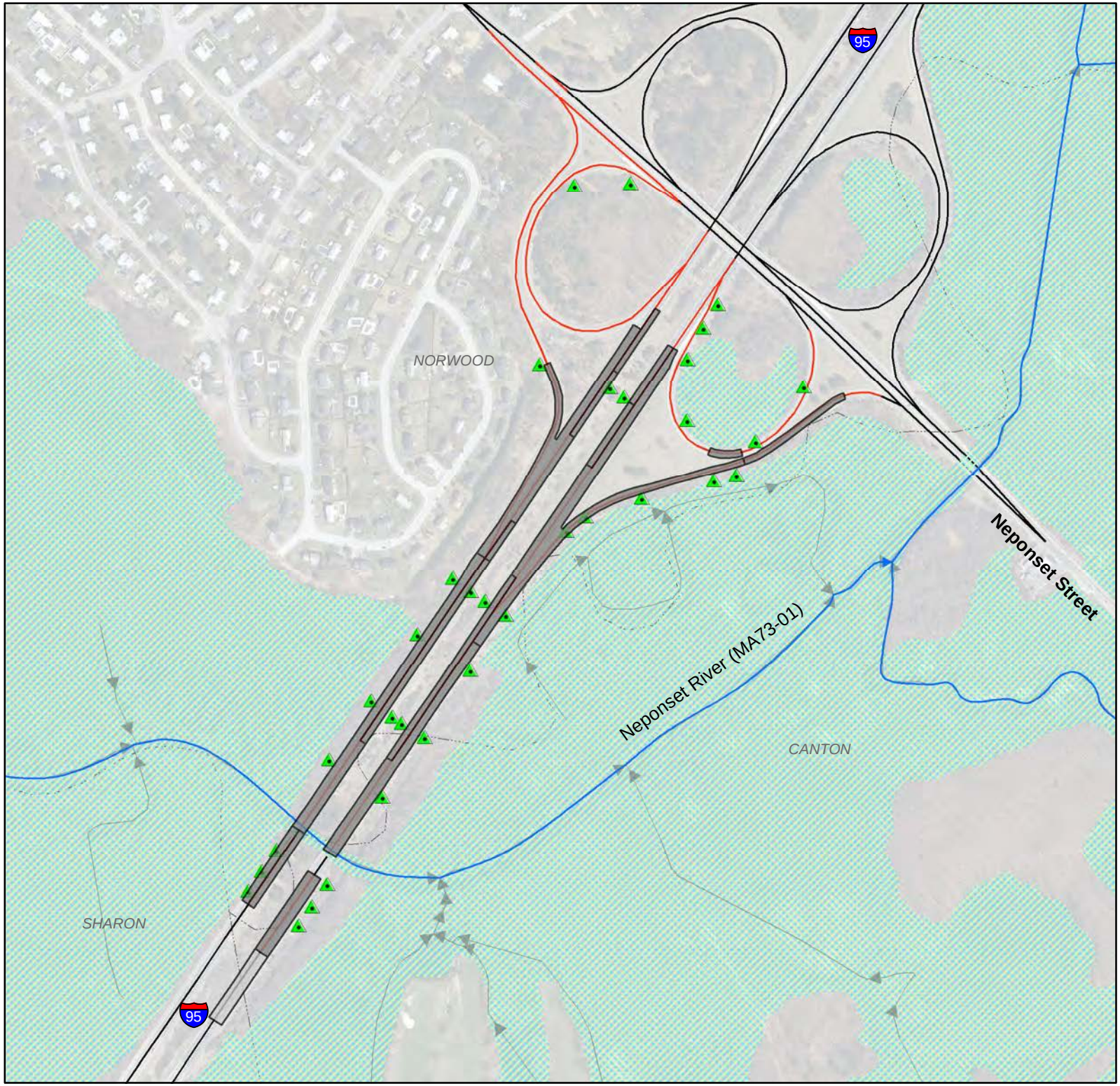

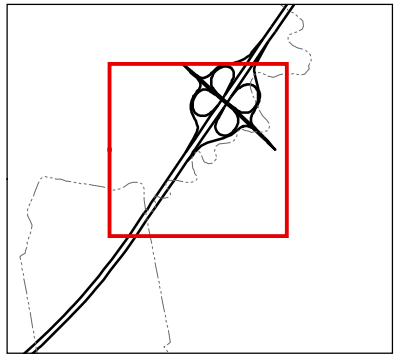

MassDOT Directly Contributing Non-Urban Watershed

MassDOT Directly Contributing Urban Watershed

Stormwater Outfalls

Impaired Stream Segment

Non-Impaired Stream Segment

NWI Wetland Areas

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

N

0 125 250 500 750 1,000 Feet

1 inch = 500 feet

Figure 4

Neponset River (MA73-01)
Directly Contributing
3 of 5

January 2012

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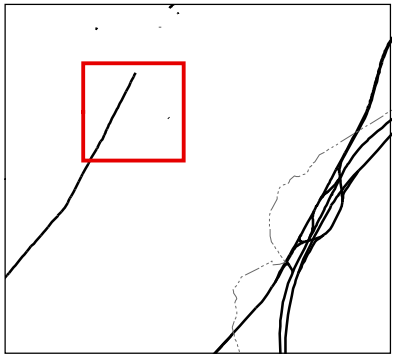

Stormwater Outfalls

MassDOT Directly Contributing Watersheds

Impaired Stream Segment

Non-Impaired Stream Segment

NWI Wetland Areas

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

N

0 125 250 500 750 1,000 Feet

1 inch = 500 feet

Figure 5

Neponset River (MA73-01) Directly Contributing 4 of 5

January 2012

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Stormwater Outfalls

MassDOT Directly Contributing Watersheds

Impaired Stream Segment

Non-Impaired Stream Segment

NWI Wetland Areas

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

N

0 125 250 500 750 1,000 Feet

1 inch = 500 feet

Figure 6

Neponset River (MA73-01)
Directly Contributing
5 of 5

January 2012

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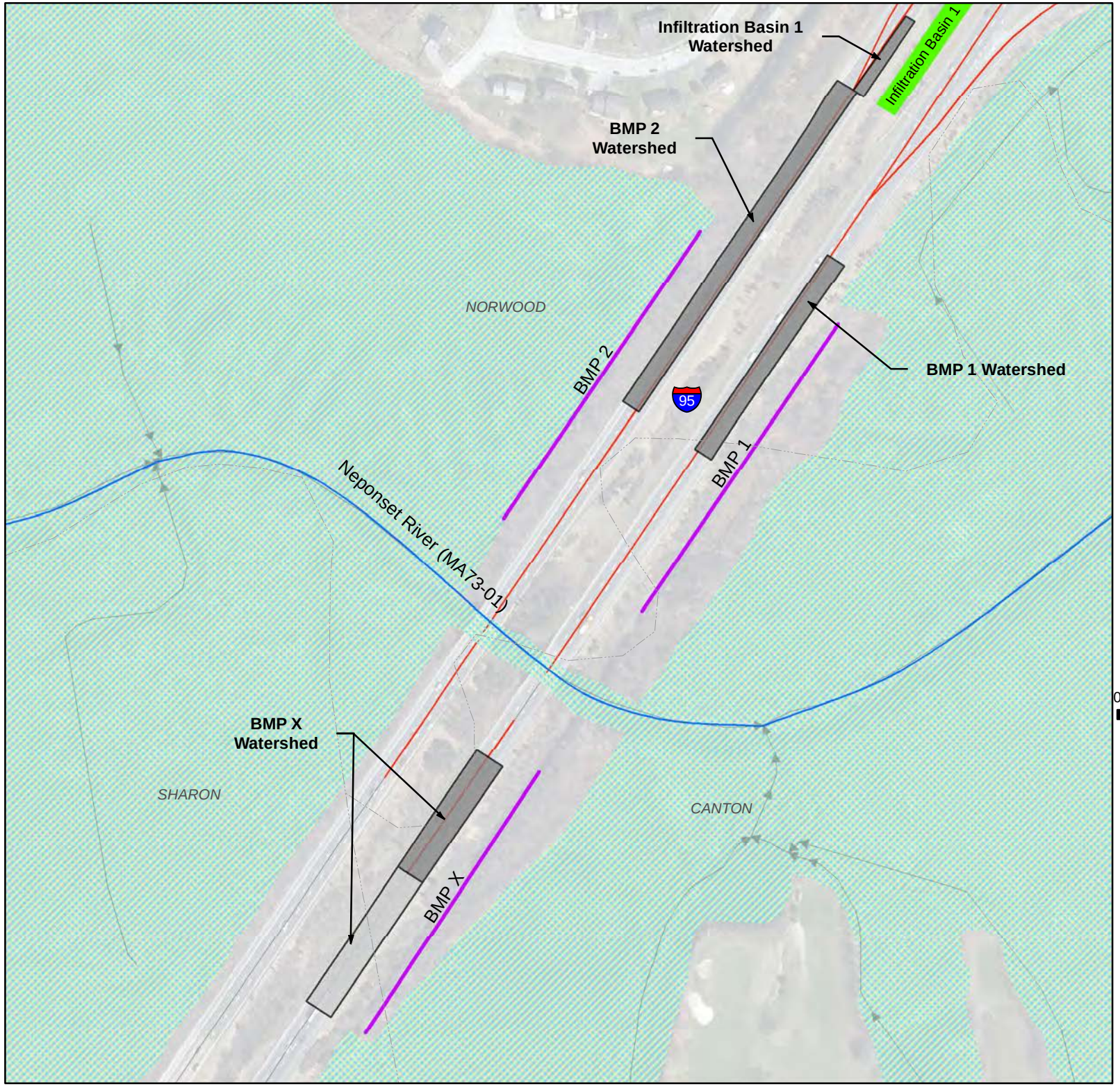

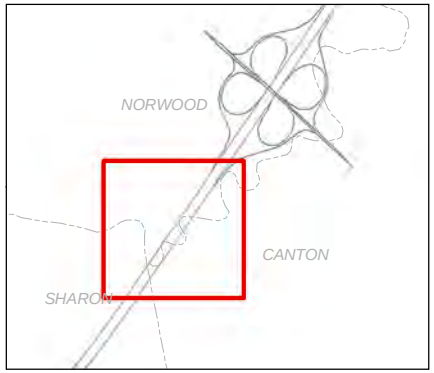

BMP Non-Urban Watershed Area
BMP Urban Watershed Area
Existing BMP - Basin
Proposed BMP - Swale
Impaired Stream Segment
Impaired Water Bodies
Non-Impaired Stream Segment
NWI Wetland Areas
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

N

0 62.5 125 250 375 500 Feet

1 in = 250 feet

Figure 7

Neponset River (MA73-01)
Existing and
Proposed BMPs
1 of 2

January 2012

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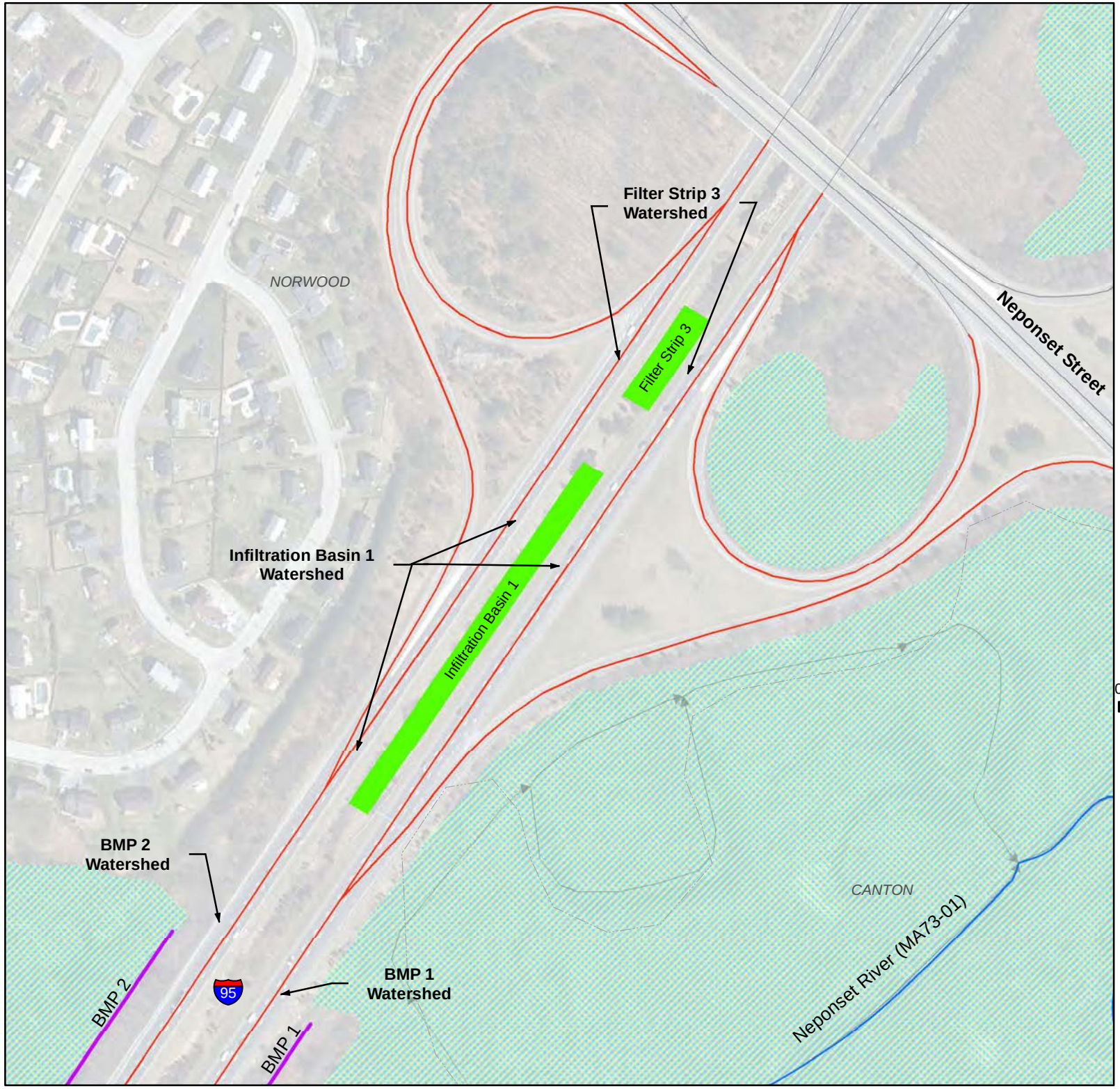

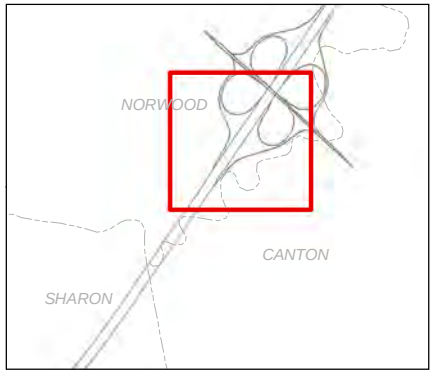

- Town Boundaries
- BMP Watershed
- Existing BMP - Basin
- Proposed BMP - Swale
- Impaired Stream Segment
- Impaired Water Bodies
- Non-Impaired Stream Segment
- NWI Wetland Areas
- MassDOT Roads in Urban Areas
- MassDOT Roads

N

0 62.5 125 250 375 500 Feet

1 in = 250 feet

Figure 8

Neponset River (MA73-01)
Existing and
Proposed BMPs
2 of 2

January 2012

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Impaired Waters Assessment for Neponset River (MA73-02) – Progress Report

Impaired Water Body

Name: Neponset River

Location: Confluence with East Branch in Canton to confluence with Mother Brook in Boston

Water Body ID: MA73-02

Impairments

The Neponset River (MA73-02) is listed under Category 5, "Waters Requiring a TMDL", on MassDEP's final *Massachusetts Year 2008*, final *Massachusetts Year 2010* and proposed *Massachusetts Year 2012 Integrated List of Waters*. Table 1 below shows the impairments to Segment MA73-02 included on each list.

Table 1. Impairments to Segment MA73-02 of the Neponset River Included on the Massachusetts Integrated List of Waters

Massachusetts Integrated List of Waters		
Final 2008 List	**Final 2010 List**	**Proposed 2012 List**
Organic enrichment/low DO	Dissolved Oxygen	Dissolved Oxygen
Pathogens	Fecal coliform	Fecal coliform
Turbidity	Turbidity	Turbidity
Oil and grease	Foam/flocs/scum/oil slicks	Foam/flocs/scum/oil slicks
Metals	PCB in fish tissue	PCB in fish tissue
Priority Organics	Other	Other
(Objectionable deposits*)	(Debris/floatables/trash*)	DDT
		Escherichia coli
		(Debris/floatables/trash*)

According to MassDEP's *Neponset River Watershed 2004 Water Quality Assessment Report* (MassDEP, 2010), 7.7 miles of the Neponset River are impaired due to low dissolved oxygen, PCB contamination in fish, and high levels of E. coli. The report suggests that PCB contamination is likely due to contaminated sediment. The causes of the other impairments are unknown.

As described below, MassDOT recommends the implementation of various Best Management Practices (BMPs) for Segment MA73-02 of the Neponset River to improve water quality based on an assessment using the Impervious Cover (IC) Method. While these recommendations for BMPs address impairments specific to Neponset River Segment MA73-02, all receiving water bodies downstream of the BMPs will ultimately benefit from the improvements.

Relevant Water Quality Standards

Water Body Classification: Class B\ Warm Water Fishery (WWF)

Applicable State Regulations:

- *314 CMR 4.05 (3)(b) 5 Solids*. These waters shall be free from floating, suspended and settleable solids in concentrations or combinations that would impair any use assigned to this class, that would cause aesthetically objectionable conditions, or that would impair the benthic biota or degrade the chemical composition of the bottom.
- *314 CMR 4.05 (3)(b) 6 Color and Turbidity*. These waters shall be free from color and turbidity in concentrations or combinations that are aesthetically objectionable or would impair any use assigned to this class.
- 314 CMR 4.05 (3)(b) 7 *Oil and Grease*. These waters shall be free from oil and grease, petrochemicals and other volatile or synthetic organic pollutants.
- *314 CMR 4.05 (5) (a) Aesthetics*. All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.
- *314 CMR 4.05 (5)(e) Toxic Pollutants*. All surface waters shall be free from pollutants in concentrations or combinations that are toxic to humans, aquatic life or wildlife. For pollutants not otherwise listed in 314 CMR 4.00, the National Recommended Water Quality Criteria: 2002, EPA 822R-02-047, November 2002 published by EPA pursuant to Section 304(a) of the Federal Water Pollution Control Act, are the allowable receiving water concentrations for the affected waters, unless the Department either establishes a site specific criterion or determines that naturally occurring background concentrations are higher. Where the Department determines that naturally occurring background concentrations are higher, those concentrations shall be the allowable receiving water concentrations. The Department shall use the water quality criteria for the protection of aquatic life expressed in terms of the dissolved fraction of metals when EPA's 304(a) recommended criteria provide for use of the dissolved fraction. The EPA recommended criteria based on total recoverable metals shall be converted to dissolved metals using EPA's published conversion factors. Permit limits will be written in terms of total recoverable metals. Translation from dissolved metals criteria to total recoverable metals permit limits will be based on EPA's conversion factors or other methods approved by the Department. The Department may establish site specific criteria for toxic pollutants based on site specific considerations.
- *314 CMR 4.05 (3)(b) 1 Dissolved Oxygen*. Shall not be less than 6.0 mg/l in cold water fisheries and not less than 5.0 mg/l in warm water fisheries. Where natural background conditions are lower, DO shall not be less than natural background conditions. Natural seasonal and daily variations that are necessary to protect existing and designated uses shall be maintained.
- *314 CMR 4.05 (3)(b) 4 Bacteria*.
    - a. At bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: where E. coli is the chosen indicator, the geometric

mean of the five most recent samples taken during the same bathing season shall not exceed 126 colonies per 100 ml and no single sample taken during the bathing season shall exceed 235 colonies per 100 ml; alternatively, where enterococci are the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 33 colonies per 100 ml and no single sample taken during the bathing season shall exceed 61 colonies per 100 ml;

- b.for other waters and, during the non bathing season, for waters at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: the geometric mean of all E. coli samples taken within the most recent six months shall not exceed 126 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 235 colonies per 100 ml; alternatively, the geometric mean of all enterococci samples taken within the most recent six months shall not exceed 33 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 61 colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

Site Description

The Neponset River is made up of four segments, MA73-01, MA73-02, MA73-03, and MA73-04. This assessment report focuses only on the second segment, Segment MA73-02, which begins at the confluence with East Branch in Canton and flows for approximately 7.7 miles to its confluence with Mother Brook in Boston (MassDEP, 2010). Refer to Figure 1 for a map identifying Segment MA73-02 of the Neponset River and its subwatershed.

Segment MA73-02 of the Neponset River has a subwatershed of approximately 7,668 acres. This subwatershed area was determined using USGS subbasin GIS shapefiles. Much of the land comprising the subwatershed is residential, commercial, or paved roadway. These areas contribute to a total impervious cover (IC) area of 1,487 acres (approximately 19.4%) within the subwatershed.

The Massachusetts Department of Transportation (MassDOT) owns and maintains several roadways within the Neponset River Segment MA73-02 subwatershed, including Interstate 95 (I-95), Route 128/I-95 (Rte 128) and Green Lodge Street, as well as small bridges on Dedham Street, Sprague Street, Dana Avenue and Milton Street.

An investigation performed in January 2011 as part of the I-95 Resurfacing project for the segment from the Sharon/Walpole town line to the junction of Interstate 93 and I-95 confirmed that stormwater from I-95 discharges directly to Segment MA73-02 via stormwater systems and conveyance ditches. During site visits performed as part of the investigation for this Impaired Waters Assessment on January 5th and 18th, 2012, it was determined that stormwater from a portion of Green Lodge Street discharges directly to Segment MA73-02 of the Neponset River via stormwater collection systems, in addition to stormwater from I-95. The bridges on Sprague Street, Dana Avenue and Milton Street are located in the middle of municipal portions of roadway and discharge to municipal MS4 systems. Combined, approximately 2 acres of urban MassDOT roadway contribute stormwater directly to Segment MA73-02 of the Neponset River. Some portions (8.1 acres) of non-urban MassDOT roadway are treated by BMPs which also treat urban MassDOT roadway. These non-urban areas are included in MassDOT's directly contributing IC watershed. MassDOT's total directly contributing IC watershed is shown in Figures 2 through 4.

Assessment under BMP 7U

None of the impairments for Segment MA73-02 of the Neponset River have been addressed by a Total Maximum Daily Load (TMDL). Therefore, MassDOT assessed the impairments using the approach described in BMP 7U, MassDOT Application of IC Method (MassDOT, 2011), of MassDOT's Storm Water Management Plan (*Water Quality Impaired Waters Assessment and Mitigation Plan*), which applies to impairments that have been assigned to a water body prior to completion of a TMDL. As described in MassDOT's Application of Impervious Cover Method in BMP 7U, impervious cover (IC) provides a measure of the potential impact of stormwater on many impairments. For this water body, MassDOT used the IC method to assess the following impairments:

- Foam/Flocs/Scum/Oil Slicks
- Dissolved Oxygen
- Turbidity
- Other

The impairment of PCBs in fish tissue is not related to stormwater runoff and is not addressed by the IC method herein. The USEPA National Urban Runoff Program found PCBs in only 1% of samples (EPA, 1983). In addition, the Water Quality Assessment Report indicates that the source of PCBs in this segment is likely contaminated sediments. Therefore, DOT did not consider this impairment to be potentially related to stormwater.

The impairment for pathogens is assessed separately in the section titled Assessment under BMP 7U for Pathogens. According to the final *Year 2010 Integrated List of Waters*, the impairment for debris/floatables/trash is considered a non-pollutant and unrelated to stormwater. Therefore, MassDOT has determined that further assessment of this impairment to the water body is not required.

MassDOT's Application of the Impervious Cover Method

MassDOT's Application of Impervious Cover Method in BMP 7U applies many aspects of USEPA Region I's Impervious Cover (IC) Method described in EPA's *Stormwater TMDL Implementation Support Manual* (ENSR, 2006) to MassDOT's program. This method assesses potential stormwater impacts on the impaired water and evaluates the impervious cover reduction required to ensure that stormwater is not the cause of the impairments. Consistent with findings of EPA and others, when a watershed had less than 9% IC, MassDOT concluded that stormwater was not the likely cause of the impairment. Additional information regarding this method is provided in MassDOT's Application of IC Method document.

First, MassDOT calculated the percent IC of the water body's entire contributing watershed (total watershed upstream of the downstream end of an impaired segment) and that of the local watershed contributing to the impaired segment (referred to as the subwatershed in this analysis) to determine whether stormwater has a potential to cause the impairments of the receiving water body. The total watershed and subwatershed to the impaired water body were delineated using the USGS Data Series 451. When USGS Data Series watersheds did not delineate the subwatershed of the water body under review, the GIS shapefiles were modified by delineating to the water body based on USGS topography to add specificity. Impervious cover data was available as part of the USGS data layers Data Series 451 and MassGIS's impervious surfaces data layer. In cases where it was determined that stormwater was a potential cause of the impairment, MassDOT calculated the degree to which impervious cover would need to be reduced in the subwatershed to meet the 9% IC target. This reduction was then applied proportionally to the area of MassDOT roadways/properties directly discharging to the water body segment to identify MassDOT's target IC reduction. The 9% IC reduction serves only as a recommended target and is not meant to imply

that failing to meet the target would cause an exceedance in water quality standards. As explained in BMP 7U, MassDOT will consider a variety of factors apart from numeric guidelines, including site constraints and the magnitude of any potential exceedances in water quality standards, to determine the precise nature and extent of additional BMPs recommended for particular locations. This approach is consistent with the iterative, adaptive management BMP approach set forth in EPA guidelines.

MassDOT calculated the effective impervious cover reduction afforded by the existing structural BMPs currently incorporated into the stormwater infrastructure of MassDOT's properties. This effective IC reduction was calculated by applying effective impervious cover reduction rates to existing BMPs based on their size, function and contributing watershed. BMP performances were derived from EPA Region 1's *Stormwater Best Management Practices (BMP) Performance Analysis* report (EPA, 2010) and engineering judgment. More information on the approach used to calculate the effective impervious cover reductions is described in BMP 7U. When the reduction in effective impervious cover achieved by the existing BMPs was equal to or greater than the target reduction, no further measures were proposed. When this was not the case, MassDOT considered additional BMPs in order to meet the targeted reduction.

Using this approach, MassDOT derived the following site parameters for the total contributing watershed of the impaired water (Neponset River (MA73-02)).

Table 2: Site Parameters for Neponset River (MA73-02)

Total Watershed		
Watershed Area	60,736	acres
Impervious Cover (IC) Area	10,851	acres
Percent Impervious	18	%
IC Area at 9% Goal	5,466	acres
Target Reduction % in IC	50	%
Subwatershed		
Subwatershed Area	7,668	acres
Impervious Cover (IC) Area	1,487	acres
Percent Impervious	19	%
IC Area at 9% Goal	690	acres
Target Reduction % in IC	54	%
Reductions Applied to DOT Direct Watershed		
MassDOT's IC Area **Directly** Contributing to Impaired Segment	10	acres
MassDOT's Target Reduction in Effective IC (53.6% of DOT Directly Contributing IC)	5.4	acres

The Segment MA73-02 subwatershed contains more than 9% IC, indicating that stormwater likely contributes to the water body's impairments. In order to reach the 9% threshold, effective IC within the subwatershed should be reduced by 54%. Therefore, MassDOT's target is to reduce its own effective IC within the directly contributing watershed by the same percentage by removing 5.4 acres of effective IC.

Existing BMPs

The memorandum prepared for the I-95 resurfacing project in January 2011, "I-95 Canton – Stormwater Improvement Recommendations," states that there are four existing BMPs, two of which receive urban stormwater runoff. However, neither of the BMPs receiving urban stormwater runoff are documented to be effective at reducing impervious cover; therefore, they are not included in this assessment. No additional BMPs were identified in the Segment MA73-02 subwatershed during the site visits performed to review additional roads draining to the receiving water on January 5th and 18th, 2012.

Next Steps

Based on recommendations documented in the memorandum prepared for the I-95 resurfacing project, MassDOT has initiated the design of six stormwater BMPs to address its direct and indirect stormwater discharges to the Neponset River. Conceptual designs for these BMPs are documented in a series of typicals entitled "I-95 Canton-Norwood-Sharon-Walpole Typical – Water Quality Check Dams" for Project Number 605590. Two of these BMPs will provide treatment for stormwater runoff from I-95 which discharges directly to Segment MA73-02 and are listed in Table 3. Three BMPs will provide treatment for I-95 urban stormwater runoff which discharges directly to Segment MA73-01 (discussed further in the "Impaired Waters Assessment for Neponset River (MA73-01)), and the sixth BMP will treat stormwater from only non-urban I-95 roadway, and therefore, is not included in either assessment because it does not treat any runoff from urban DOT roadway.

The table below summarizes the percent reductions in effective IC provided by the BMPs drawn up in MassDOT's conceptual designs which will treat stormwater which discharges directly to Segment MA73-02. As shown in the table, Grass Swale 3 and Grass Swale 4 will treat urban and non-urban roadway. The estimated reduction of effective non-urban IC does not receive credit towards the target IC reduction in this assessment.

Table 3: IC Resurfacing Project #605590 Recommendations

BMP Identifier	BMP Type	Contributing Watershed Urban IC Area (ac)	Contributing Watershed Non-Urban IC Area (ac)	Resulting Effective Urban IC area Reduction (ac)	Resulting Effective Non-Urban IC Area Reduction (ac)
Grass Swale 3*	Infiltration Swale	0.1	5.7	0.1	4.0
Grass Swale 4*	Infiltration Swale	0.5	2.5	0.4	2.1
Total		0.6	8.2	0.5	6.0**

*Grass Swale 3 and Grass Sale 4 treat both urban and non-urban roadway.

** Rounding accounts for difference in summation

The following paragraphs briefly describe each of the conceptual designs for BMPs included in the memorandum for Resurfacing Project Number 605590. Refer to the actual memorandum for additional details. Figure 5 shows the locations of the conceptual BMPs.

Grass Swale 1

A check dam will be installed at Norwood Station 92+00 in the existing ditch alongside the northbound shoulder. This check dam will be 30 inches high and 6 feet wide. The ditch behind the check dam is approximately 1,680 feet long.

Grass Swale 2
A check dam will be installed at Norwood Station 93+00 in the existing ditch alongside the southbound shoulder. This check dam will be 30 inches high and 3 feet wide. The ditch behind the check dam is approximately 1,820 feet long.

Assessment under BMP 7U for Pathogens

Pathogen concentrations in stormwater vary widely temporally and spatially; concentrations can vary by an order of magnitude within a given storm event at a single location (MassDEP, 2009b). Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites will be assessed collectively based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to stormwater management.

In addition, while there is a positive relationship between impervious cover and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely solely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

Pathogens in MassDOT Discharge

A study conducted on MassDOT's South East Expressway measured bacterial concentrations in stormwater runoff (Smith, 2002). This study found a geometric mean of 186 fecal coliform organisms/100 ml. Concentrations of pathogens in stormwater runoff from roadways can vary widely and pathogen concentrations in runoff across the state likely deviate significantly from this stretch of roadway's specific estimate. Event mean concentrations of fecal coliform bacteria in urban stormwater from other sources ranging between 14,000 and 17,000 fecal coliform organisms/100 ml have been reported (MassDEP, 2009b). This data suggests that pathogen loading from highways may be lower than other urban areas.

Consideration of the potential sources of pathogens supports the idea that pathogens are present in lower concentrations in highway runoff since potential pathogen sources are likely to be less prevalent in the highway environment than other urban roadways:

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other stormwater systems. This has been confirmed by MassDOT's illicit discharge detection on many miles of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles, and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.
- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the stormwater system.

- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally cross them.

The dearth of pathogen sources on highways and the relatively low concentrations of pathogens measured in the South East Expressway study together suggest that pathogen loading from stormwater runoff from highways is lower than other urban sources.

Furthermore, in almost all cases the contribution of pathogens from MassDOT to a specific water body is likely to be very small relative to other sources of pathogens in the watershed. Since MassDOT urban roadways are linear and usually cross watersheds, they represent a small fraction of the receiving water body's watershed. The water quality within these water bodies is dependent on discharge from various sources, including discharges from other stormwater systems and a large number of other factors.

Assessment and Mitigation Plan

Pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations.

TMDLs for pathogen impairments in Massachusetts recognize that pathogens are highly variable and difficult to address and emphasize the need for an iterative adaptive management approach to address pathogens. Examples of relevant language from these TMDLs are included below:

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (MassDEP, 2009a)
- "The NPDES permit does not, however, establish numeric effluent limitations for stormwater discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals."(MassDEP, 2009b)
- "Although the TMDL presents quantified WLAs for stormwater that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs." (MassDEP, no date).

This language clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters. The recommendations in pathogen TMDLs for waters in Massachusetts generally require development and implementation of stormwater management programs, illicit discharge detection and elimination efforts, and in some cases installing BMPs to the maximum extent practicable

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contains specific requirements for compliance with pathogen TMDLs (in Appendix G). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing stormwater discharges to pathogen-impaired waters. Section 2.2.1(c) of the permit states "For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA." Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

- Residential educational program
- Illicit connection identification, tracking and removal
- Pet waste management

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Storm Water Management Plan (SWMP) including educational programs, illicit connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure
- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
- BMP 5H-2: Post Construction Runoff Enforcement – Drainage Tie-In
- BMP 5H-3: Post Construction Runoff Enforcement – Offsite Pollution to MassHighway Drainage System
- BMP 6A-1: Source Control – 511 Program
- BMP 6A-2: Source Control – Adopt-A-Highway Program
- BMP 6C-1: Maintenance Program

In addition, the structural BMPs that will be considered to reduce the IC will also have the effect of reducing pathogen loads.

MassDOT believes the existing and proposed efforts are consistent with the current and draft MS4 permit's requirements and TMDL recommendations. MassDOT's existing stormwater management plan outlines BMPs that include education and illicit discharge detection and elimination. Although not included in this permit term, MassDOT will be implementing a pet waste management program at its rest stops that have discharges to pathogen impaired waters. In addition, MassDOT has requested coverage under an individual stormwater permit for the next permit term. This permit may contain additional programmatic BMPs to address pathogens.

Conclusions

MassDOT used the IC Method to assess Segment MA73-02 of the Neponset River for the impairments identified in MassDEP's Final *Year 2010 Integrated List of Waters*. Results indicate that MassDOT should reduce its effective IC within its directly contributing watershed to Segment MA73-02 by 5.4 acres to achieve the targeted reduction in effective IC.

There are no existing BMPs to provide a reduction in effective urban IC within MassDOT's directly contributing watershed to Segment MA73-02. MassDOT has initiated the design of additional stormwater BMPs under Project # 605590. These proposed BMPs provide a combined reduction of approximately 0.5 acres of effective urban IC. MassDOT's remaining retrofit target after subtracting the reduction in effective IC provided by the existing and proposed BMPs is 4.9 acres. The following table summarizes IC reductions within MassDOT's directly contributing watershed under existing and proposed conditions.

Table 4: Effective IC Reductions under Existing & Proposed Conditions

Effective IC Reductions	
MassDOT Target Reduction in Effective IC	5.4 acres
Effective IC Reduction under Existing Conditions	0 acres
Effective IC Reduction under Proposed Conditions for Programmed Project # 605590	0.5 acres
Remaining Target	**4.9 acres**

MassDOT will now work with its design consultants to identify opportunities for additional BMPs to meet the remaining target of 4.9 acres of effective IC. Note that this remaining target may change depending on the final designs for the conceptual BMPs included in the memorandum for Programmed Project # 605590. The design consultants should strive to meet the remaining target plus any difference in effective IC reduction resulting from final BMP designs. The final BMP designs will provide treatment to the maximum extent practicable given site constraints that are identified as the design process moves forward. Once the designs are finalized, MassDOT will perform a final assessment of this water body under the Impaired Waters program.

MassDOT will continue to identify opportunities to implement additional structural BMPs to address pollutant loading when road work is conducted under MassDOT's Programmed Projects Initiative, such as with Programmed Project # 605590. Work on Programmed Projects often includes broader scale road layout changes that may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to addressing impairments. MassDOT will include an update in annual reports and biannual submittals to EPA regarding progress made towards meeting target IC reductions, plans for construction of proposed BMPs, and finalized assessments including reductions achieved by finalized BMP designs. Furthermore, MassDOT will continue to implement non-structural BMPs that reduce the impacts of stormwater.

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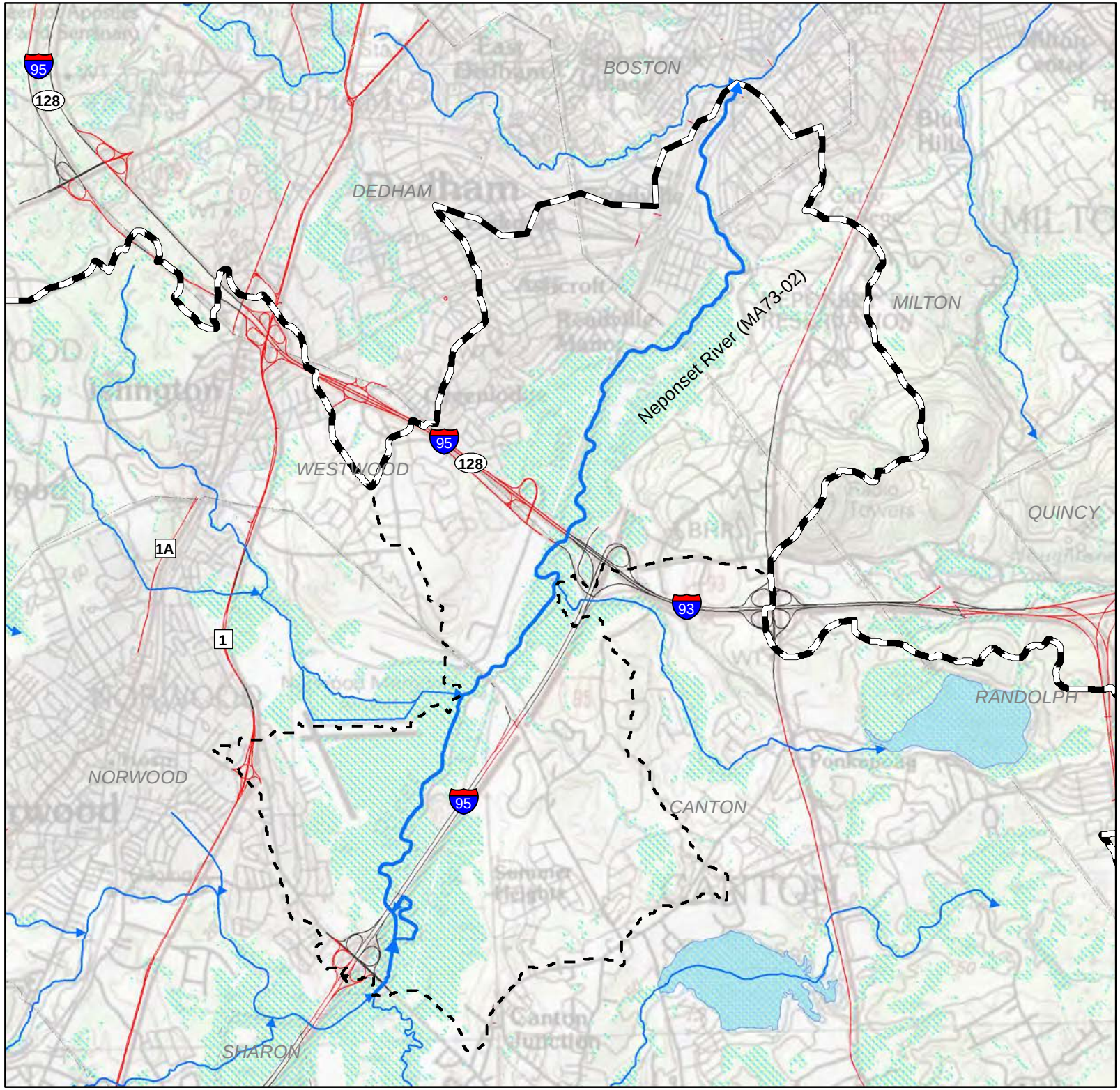

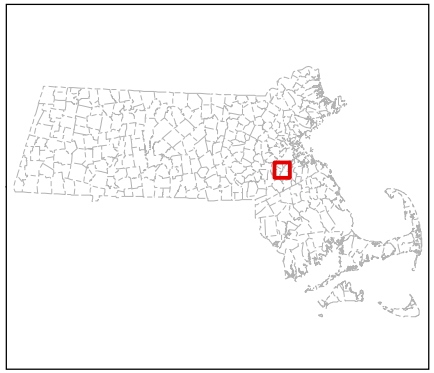

Neponset River Total Watershed
Neponset River Subwatershed
MA73-02
Impaired Stream Segments
Impaired Water Bodies
NWI Wetland Areas
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

N

0 0.2 0.4 0.8 1.2 1.6
Miles

1 in = 1 miles

Figure 1

Neponset River (MA73-02) Subwatershed

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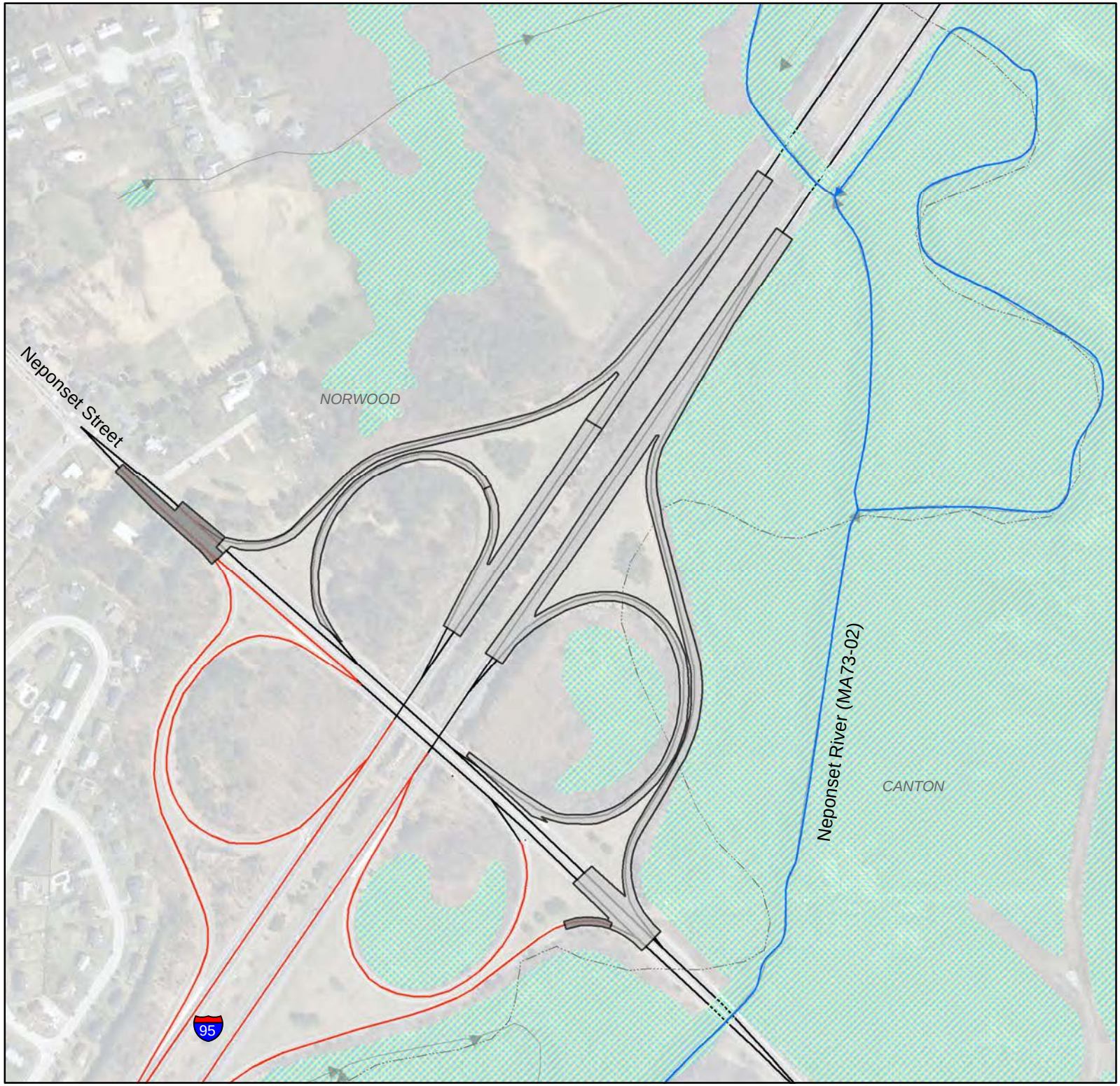

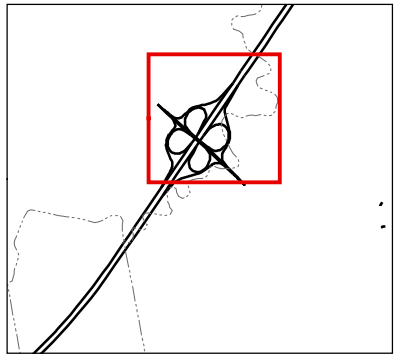

MassDOT Directly Contributing Non-Urban Watershed

MassDOT Directly Contributing Urban Watershed

Stormwater Outfalls

Impaired Stream Segment

Non-Impaired Stream Segment

NWI Wetland Areas

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

N

0 100 200 400 600 800 Feet

1 inch = 400 feet

Figure 2

Neponset River (MA73-02) Directly Contributing MassDOT Watershed 1 of 3

January 2012

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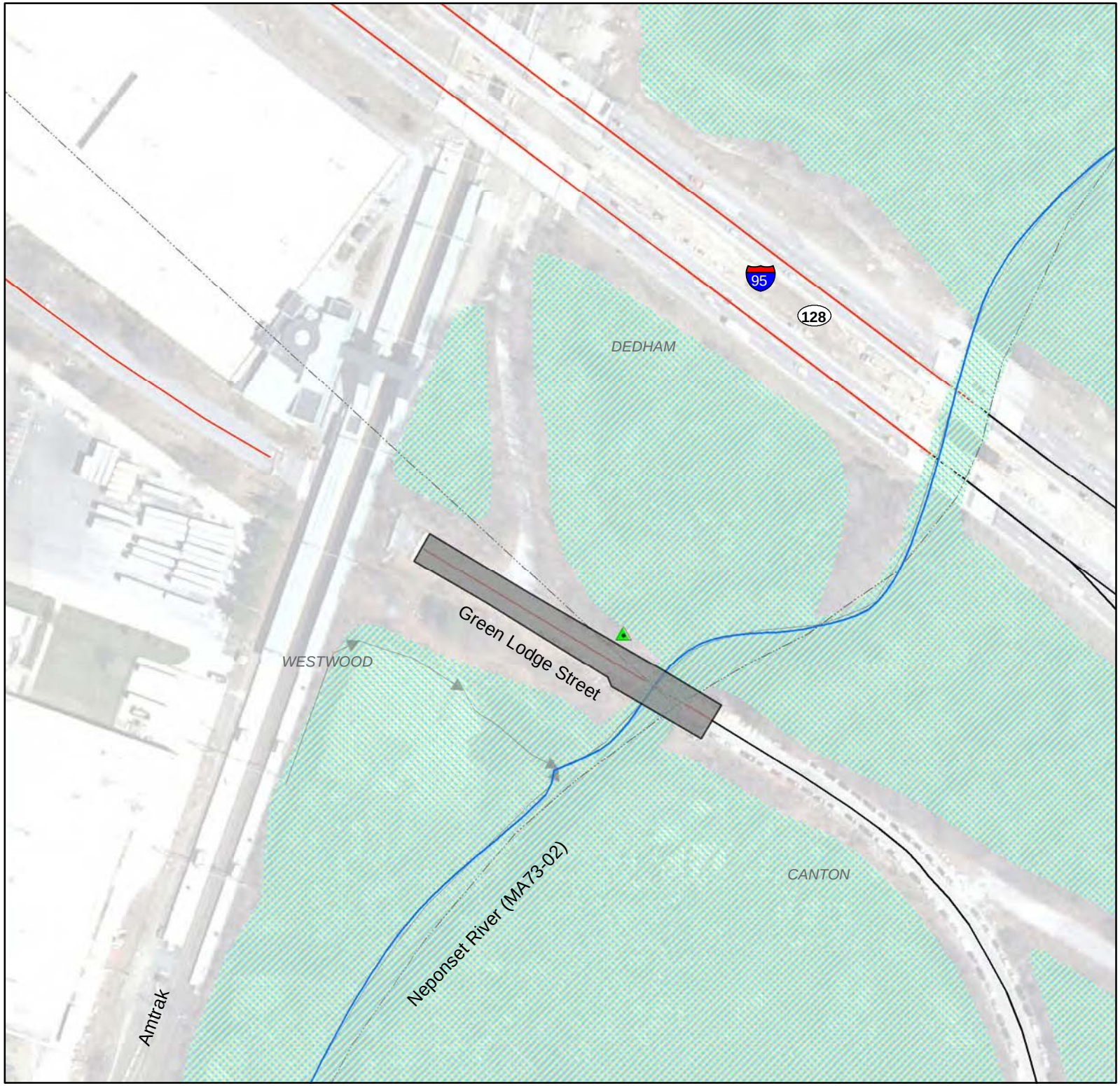

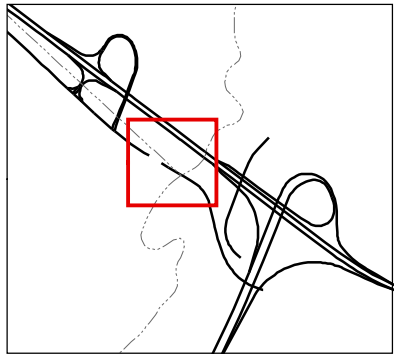

Stormwater Outfalls

MassDOT Directly Contributing Watersheds

Impaired Stream Segment

Non-Impaired Stream Segment

NWI Wetland Areas

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

N

0 40 80 160 240 320 Feet

1 inch = 167 feet

Figure 3

Neponset River (MA73-02) Directly Contributing MassDOT Watershed 2 of 3

January 2012

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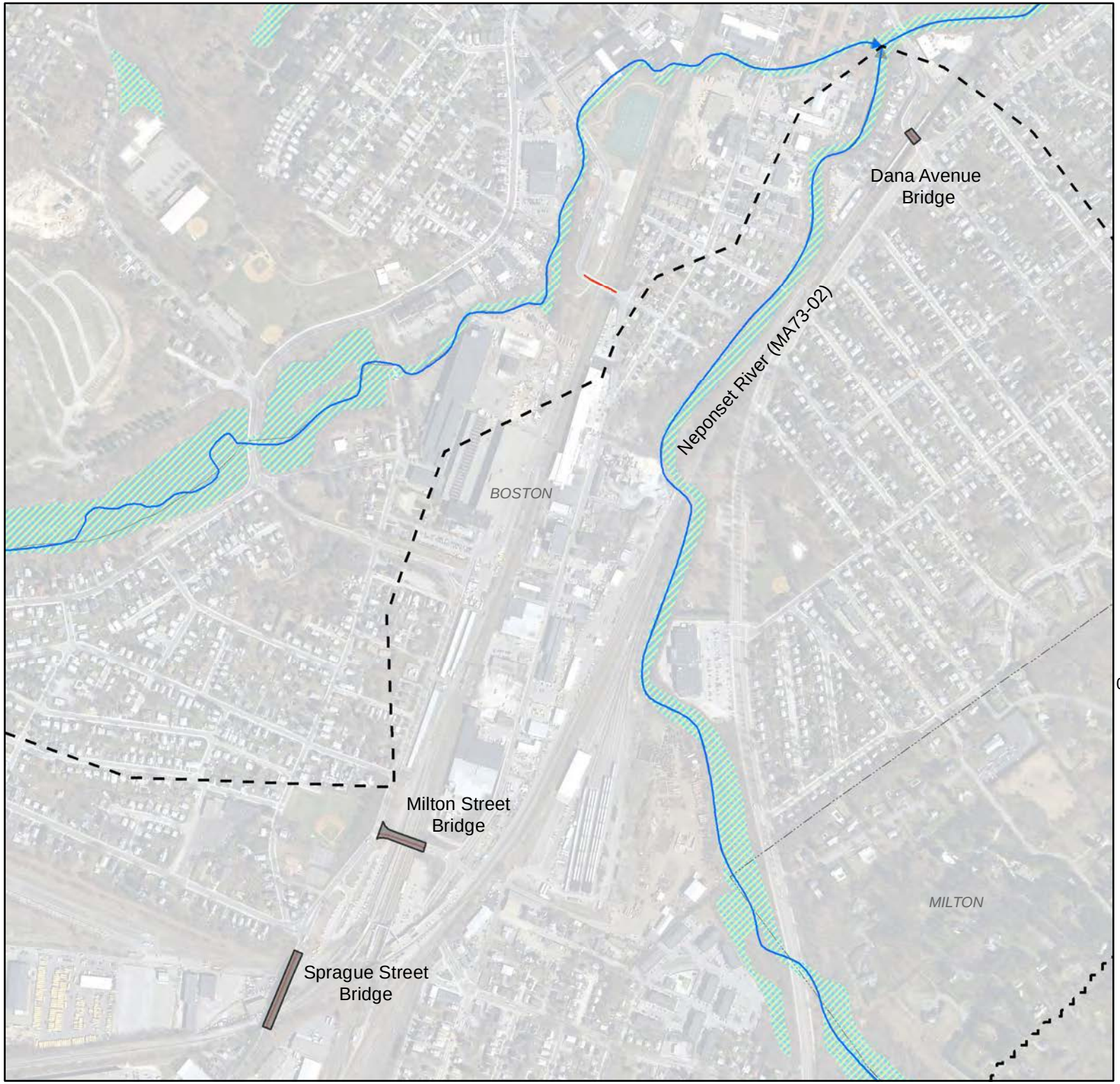

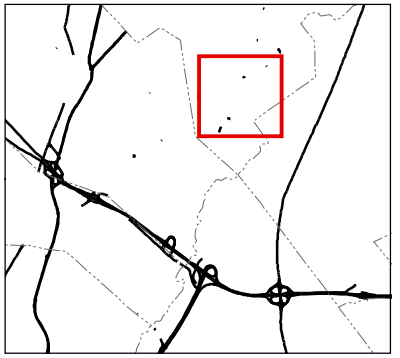

Stormwater Outfalls
MassDOT Directly Contributing Watersheds
Neponset River (MA73-02) Subwatershed
Impaired Stream Segment
Non-Impaired Stream Segment
NWI Wetland Areas
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

N

0 187.5375 750 1,125 1,500 Feet

1 inch = 750 feet

Figure 4

Neponset River (MA73-02)
Directly Contributing
MassDOT Watershed
3 of 3

January 2012

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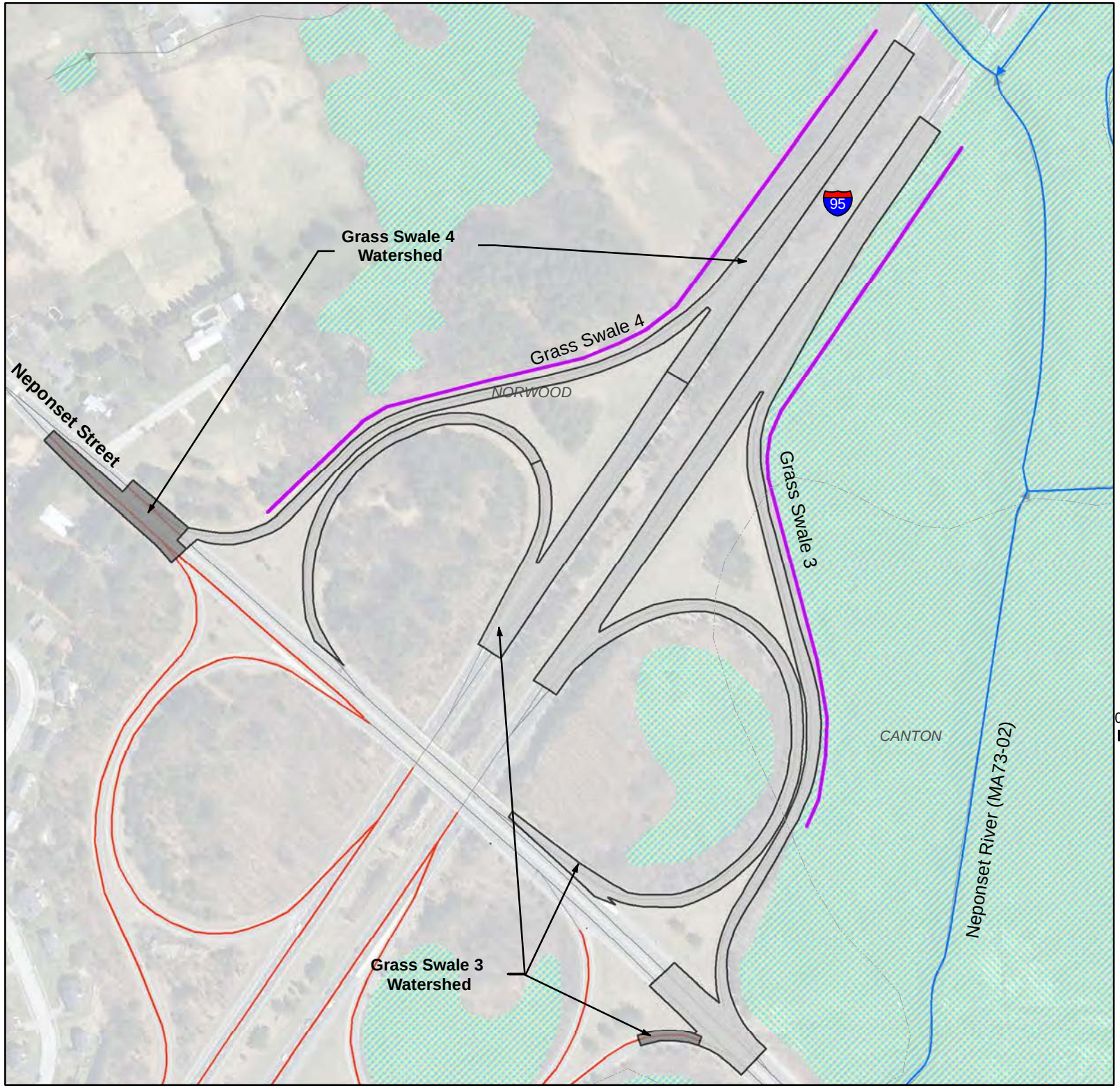

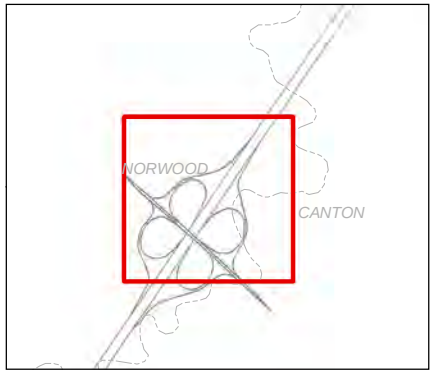

- BMP Non-Urban Watershed Area
- BMP Urban Watershed Area
- Proposed BMP - Swale
- Impaired Stream Segment
- Impaired Water Bodies
- Non-Impaired Stream Segment
- NWI Wetland Areas
- MassDOT Roads in Urban Areas
- MassDOT Roads
- Town Boundaries

N

0 75 150 300 450 600 Feet

1 in = 300 feet

Figure 5

Neponset River (MA73-02)
Existing and
Proposed BMPs

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