MassDOT Quarter 4 Submittal

(March 8, 2011 – June 7, 2011)

NPDES MS4 General Permit Compliance
Water Quality Impaired Waters Assessment and Mitigation Plan

June 8, 2011

Deval L. Patrick, Governor
Timothy P. Murray, Lt. Governor
Jeffrey B. Mullan, Secretary & CEO
Luisa Paiewonsky, Administrator

massDOT
Massachusetts Department of Transportation
Highway Division

June 8, 2011

David Gray
U.S. Environmental Protection Agency, Region 1
5 Post Office Square - Suite 100, Mail Code #OEP06-1
Boston, MA 02110

Subject: Quarter 4 Submittal under MassDOT's Impaired Waters Program

Dear Mr. Gray,

The attached report documents MassDOT's fourth quarter of the Impaired Waters Program, specifically the status of commitments made in MassDOT's June 9, 2010 and July 23, 2010 submittals to EPA. The submittals committed to assessing, for possible mitigation, 684 impaired water bodies using the processes outlined in BMP 7U: Impaired Waters Assessment and Mitigation Plan and BMP 7R: TMDL Watershed Review (collectively, the "Impaired Waters Program").

During the fourth quarter, MassDOT completed assessments on 34 water bodies from Appendix L-1 (dated July 22, 2010, included in MassDOT's July 23 submittal). This submittal includes the following two attachments:

1. **Impaired Waters Assessments:** Attachment 1 includes eight assessments for impaired waterbodies including:
    - Mill Pond (MA84083) under BMP 7U (IC Method). The assessment includes one recommended BMP to meet the impervious cover target. Design and permitting of these BMPs will now progress under MassDOT's design contract.
    - Beaver Brook (MA84B-02) under BMP 7U (IC Method). The assessment includes 10 recommended BMPs to meet the impervious cover target. Design and permitting of these BMPs will now progress under MassDOT's design contract.
    - Pleasant Bay (MA96-77) under BMP 7R (Nitrogen TMDL). The assessment determines that structural BMPs are not necessary to meet the TMDL.
    - Frost Fish Creek (MA96-49) under BMP 7R (Nitrogen and Pathogen TMDL). The assessment determines that structural BMPs are not necessary to meet the TMDL.
    - Muddy Creek (MA96-51) under BMP 7R (Nitrogen and Pathogen TMDL). The assessment determines that structural BMPs are not necessary to meet the TMDL.
    - Ryder Cove (MA96-50) under BMP 7R (Nitrogen and Pathogen TMDL). The assessment determines that structural BMPs are not necessary to meet the TMDL.
2. **No Discharge from MassDOT Outfalls Assessments:** Attachment 2 includes assessments where desktop review of the subbasin indicates that MassDOT urban roads do not drain to the receiving water in question. These assessments include a desktop

review of several receiving waters which determined that MassDOT does not directly discharge to the impaired waterbody. The section also includes a summary of the site conditions reviewed for discharges to Mill Pond (MA84081), Long Pond (MA82072), Round Cove (MA 96-75) and Crows Pond (MA96-47) which determined that MassDOT does not directly discharge to the impaired waterbody.

MassDOT's two design contractors (VHB and Tetratech) are developing design and construction documents for BMPs proposed in previously submitted assessments. The following is a summary of the progress to date:

- **Lowes Pond**: Design has been finalized. Construction of this additional ~$930k of BMPs have been included in the resurfacing contract that will advertise in the summer of 2011.
- **Blackstone River:** 25% Design is complete. Construction of the BMPs will be included in MassDOT's FFY 2011 BMP Retrofit Construction contract to be advertised in the summer of 2011. Construction of retrofit BMPs could begin as early as 6 months from the date of contract advertising.
- **Burncoat Park Pond:** 75% Design is complete. Construction of the BMPs will be included in MassDOT's FFY 2011 BMP Retrofit Construction contract to be advertised in the summer of 2011. Construction of retrofit BMPs could begin as early as 6 months from the date of contract advertising.

This submittal brings the total number of impaired waters assessments to 148. Of these impaired waters assessments, 73 have included waters with TMDLs. These 73 waterbodies with TMDLs represent 35% of the 209 waterbodies with TMDLs included in the waterbody assessment list (Appendix L-1) submitted to EPA. This exceeds our commitment of reviewing 20% of TMDL waterbodies each year.

MassDOT welcomes any input or feedback from the EPA on the assessments included in this and all future progress reports. If you have any questions or concerns, or would like to meet to discuss this submittal, please feel free to contact me at (617) 973-7419.

Yours sincerely,

Henry Barbaro

Henry Barbaro
Supervisor of Wetlands & Water Resources
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cc: Kathleen Woodward, Esq., EPA Region I
Al Caldarelli, Esq., MassDOT

Attachment 1:
Impaired Waters Assessment

Impaired Waters Assessment for Mill Pond (MA84038)

Impaired Waterbody

Name: Mill Pond (North Basin)

Location: Littleton, MA

Water Body ID: MA84038

Impairments

Mass DEP 2008 303d List: Noxious aquatic plants

Mass DEP 2010 Draft 303d List Changes: no changes

Relevant Water Quality Standards: Water Body Class: B

- 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

The north basin of Mill Pond (MA84038) is located in the Town of Littleton, Massachusetts. This basin has a surface area of 30.2 acres and a watershed area of 5,437 acres. There are two tributaries that discharge into the western side of Mill Pond, the upstream segment of Beaver Brook and an unnamed stream (Figure 1). A separate water body also named Mill Pond (MA84081), referred to as the south basin of Mill Pond, is connected to the north basin of Mill Pond at the crossing on Harwood Avenue. The north basin of Mill Pond discharges over a spillway into Beaver Brook at its eastern boundary with Interstate 495.

The Mill Pond subwatershed, delineated as the portion of the watershed draining directly to Mill Pond, versus one of the upstream tributaries, is approximately 260 acres, of which approximately 43 acres are impervious surface. MassDOT property in the Mill Pond subwatershed includes portions of Interstate 495 at Interchange 30 and a portion of Route 2A/110 west of Interstate 495 (Figure 1).

The southbound lane of Interstate 495 from the Harwood Ave overpass to the Beaver Brook crossing drains to the western shoulder via overland flow and point discharges from catch basins. The drainage swale along the western shoulder includes grass and some wetland vegetation in the southern section. The swale has an approximately 350 foot concrete channel along a steeper sloped section that ends near the Mill Pond outlet spillway. This drainage is considered an input to Beaver Brook (MA84B-02) and is included in the Impaired Waters Assessment for that water body segment.

Likewise, drainage from the southbound lane of Interstate 495 from approximately 750 feet north of the bridge over Beaver Brook to Beaver Brook is conveyed though storm drains directly into Beaver Brook, and thus does not discharge to Mill Pond.

Along the western side of the Interstate 495 southbound on ramp from Route 2A/110 there are five stormwater outfalls. The northernmost outfall drains the southwestern portion of the cloverleaf of the southbound ramp. This outfall discharges directly to a wetland with open water in the northern portion of Mill Pond. Adjacent to this outfall is an outfall that drains the triangle section of the interchange and a small portion of Interstate 495. The other three outfalls are from catch basins along the on ramp to Interstate 495. These outfalls are situated in an area that appears to function as an infiltration basin since there is no evidence that water has flowed over the low point of the topographic depression.

Route 2A/110 (King Street) in Littleton from the interchange with Interstate 495 to the topographic drainage divide is primarily drained by sheet flow to the roadway shoulder. Drainage from King Street is considered indirect drainage to Mill Pond because there is no evidence of channelized flow in this area. According to NRCS soil data this section of King Street is situated on soils characterized as hydrologic soil group A, well-drained to excessively well-drained sands or gravels. Catch basins on this portion of King Street drain to outfalls along the shoulder of the road that abut private property where space is too limited to employ structural BMPs. It appears that due to the soil type in this area much of the runoff from King Street in this area infiltrates naturally.

Assessment under BMP 7U for Nutrients and Other Habitat Alterations Impairments

The impairment for the north basin of Mill Pond (noxious aquatic plants) has not been addressed by a 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.

Impairments for noxious aquatic plants may be related to the input of nutrients. The input of nutrients has been documented to be directly related to the amount of impervious cover in the watershed (Schueler, 2003).

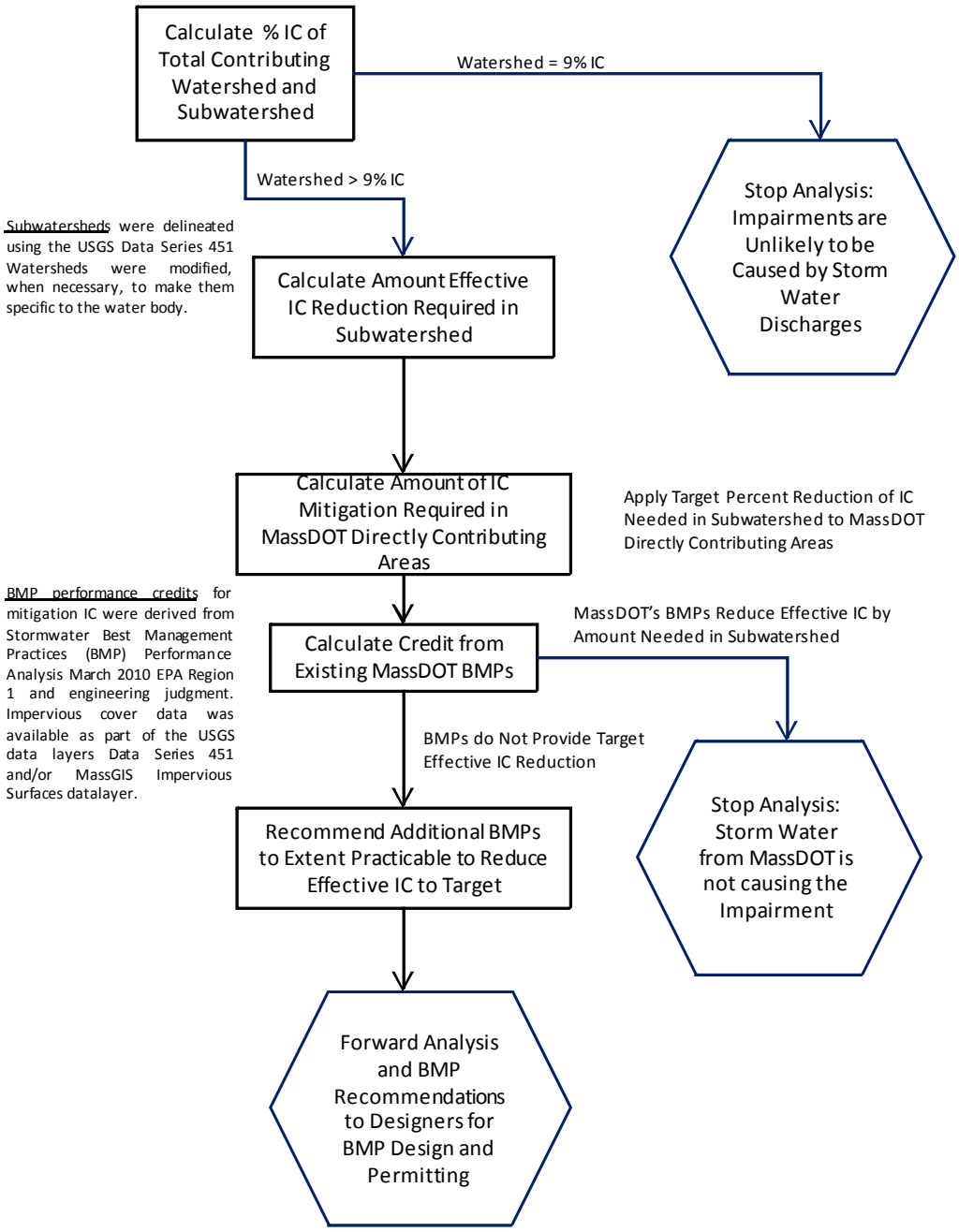
For this water body, MassDOT used our Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method) which applies many aspects of USEPA Region I's Impervious Cover (IC) Method described in EPA's Stormwater TMDL Implementation Support Manual (ENSR 2006) to MassDOT's program to assess potential storm water impacts on the impaired water and evaluate the level of 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% impervious cover, 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.

MassDOT's Application of the Impervious Cover Method

First, MassDOT calculated the percent IC of the water body's entire contributing watershed (total watershed upstream of downstream end of impaired segment) and that of the local watershed contributing directly 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. The USGS Data Series watersheds were modified, when necessary, to make them specific to the water body. Impervious cover data was available as part of the USGS

data layers Data Series 451 and MassGIS's impervious surfaces datalayer. 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.

MassDOT then 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 2010b) and engineering judgment. 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 to the total contributing watershed of the impaired water (Mill Pond (MA84038)):

Watershed		
Watershed Area	5,437	acres
Impervious Cover (IC) Area	580	acres
Percent Impervious	10.7%	
IC Area at 9% Goal	489	acres
Necessary Reduction % in IC	46%	

Reductions Applied to DOT Direct Watershed		
MassDOT's IC Area **Directly** Contributing to Impaired Segment	2.2	acres
MassDOT's Required Reduction in Effective IC (46% of DOT Directly Contributing IC)	1.0	acres

The watershed is greater than 9% impervious which indicates that the storm water is likely contributing to the impairment. The watershed needs to reduce its effective IC by 46% to reach the 9% goal. Therefore, MassDOT should reduce its effective IC by the same percentage. MassDOT needs to remove the effect of 1.0 acre of effective IC.

Existing BMPs

MassDOT has one existing BMP in the Mill Pond subwatershed that is mitigating potential storm water quality impacts prior to discharge to Mill Pond. 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 BMP is characterized as hydrologic group A (sand and gravel).

Ex-BMP-1

Three outlets from catch basin on the Interstate 495 southbound on ramp discharge into a topographic depression on the western side of the ramp. The vegetation in this depression indicates storm water is retained in this area, and there are no signs that the water discharges from this area. This area is characterized as an infiltration basin with an effective IC removal efficiency of 100%. Since this area provides treatment for 0.68 acres of impervious cover, the infiltration basin equates to the treatment and removal of 0.68 acres of IC from the MassDOT direct drainage to Mill Pond.

Existing BMP

BMP Name	BMP Type	Soil Type	Storage Volume (in.)	IC Area Treated (acres)	Percent Reduction of Effective IC*	Reduction of Effective IC (acres)
Ex-BMP-1	Infiltration Basin	A - Loamy Sand 2.41 in/hr	1.9	0.68	100%	0.68
Total				**0.68**		**0.68**

* The percent reduction of effective IC is dependent on BMP type, size relative to the IC that they process, and local soil conditions. BMP performances are discussed further in MassDOT Application of IC Method document. The spreadsheet used to calculate IC reductions is available by request.

Recommendations

Since the total mitigation of impervious surface achieved by Mass DOT's BMPs is less than the target of 1.0 acres, Mass DOT considered locations for additional BMPs.

A small wetland area located in the western side of the Interstate 495 southbound interchange currently retains storm water from a portion of the intersection with Route 2A/110 (King Street) (Figure 2); however, due to its small size and lack of outlet control it cannot be credited for IC removal. It appears the outlet from this wetland area is somewhat controlled by a topographic low point on the south side, where it drains through a swale and culvert to Mill Pond. This wetland is located adjacent to the drainage divide between Mill Pond and Beaver Brook. The northern and eastern portion of this cloverleaf drain to the northeast to a pipe that ultimately discharges into Beaver Brook, so the BMP recommendation at this location is also in the Beaver Brook Assessment.

If subsurface conditions permit, the construction of an infiltration basin within the existing swale area is proposed by installing check dams and/or outlet controls for the swale to the Mill Pond and Beaver Brook drains. Assuming hydrologic soil group C, approximately 17,000 feet of area potentially available for infiltration, a total drainage area of 1.4 acres (including Beaver Brook subwatershed), and 0.63 acres of impervious surface in the drainage area, approximately 95% reduction in IC could potentially be achieved.

Proposed BMPs

BMP Name	BMP Type	Soil Type	Storage Volume (in.)	IC Area Treated (acres)	Percent Reduction of Effective IC*	Reduction of Effective IC (acres)
Pr-BMP-1	Infiltration Basin	C - Silt Loam - 0.27 in/hr	2.0	0.35	95%	0.33
Proposed BMPs				**0.35**		**0.33**
Existing BMP				0.68		0.68
Total				**1.03**		**1.01**

* The percent reduction of effective IC is described in MassDOT's Application of IC Method manual. The spreadsheet used to calculate IC reductions is available by request.

Conclusions

This assessment for the north basin of Mill Pond (MA84038) has shown that the existing BMPs treating MassDOT's roadways/ properties provide 68% of the recommended reduction in IC. In order to further reduce MassDOT's contribution to the effective impervious cover within the Mill Pond watershed, MassDOT is proposing modifications to an existing swale in the cloverleaf to reduce the total effective impervious cover contribution from MassDOT by more than 46% (1.0 acres). The proposed modifications consist of the installation of outlet control structures in the existing swale in the cloverleaf in order to achieve higher storm water infiltration volume.

The following table summarizes the effective IC removal of the existing and proposed BMPs.

Impervious Cover Reduction

IC in Directly Contributing Watershed	2.2	acres
Required Reduction in Effective IC	1.0	acres
IC Effectively Reduced by Existing BMPs	0.68	acres
IC Remaining to Mitigate with Proposed BMPs	0.32	acres
IC Reduction Provided by Proposed BMPs	0.33	acres

MassDOT will continue to implement non-structural BMPs that reduce potential nutrient and sediment loading. MassDOT will re-evaluate the potential need for structural BMPs to address pollutant loading when road work is conducted as programmed projects for this area. This is consistent with an iterative adaptive management approach to addressing impairments.

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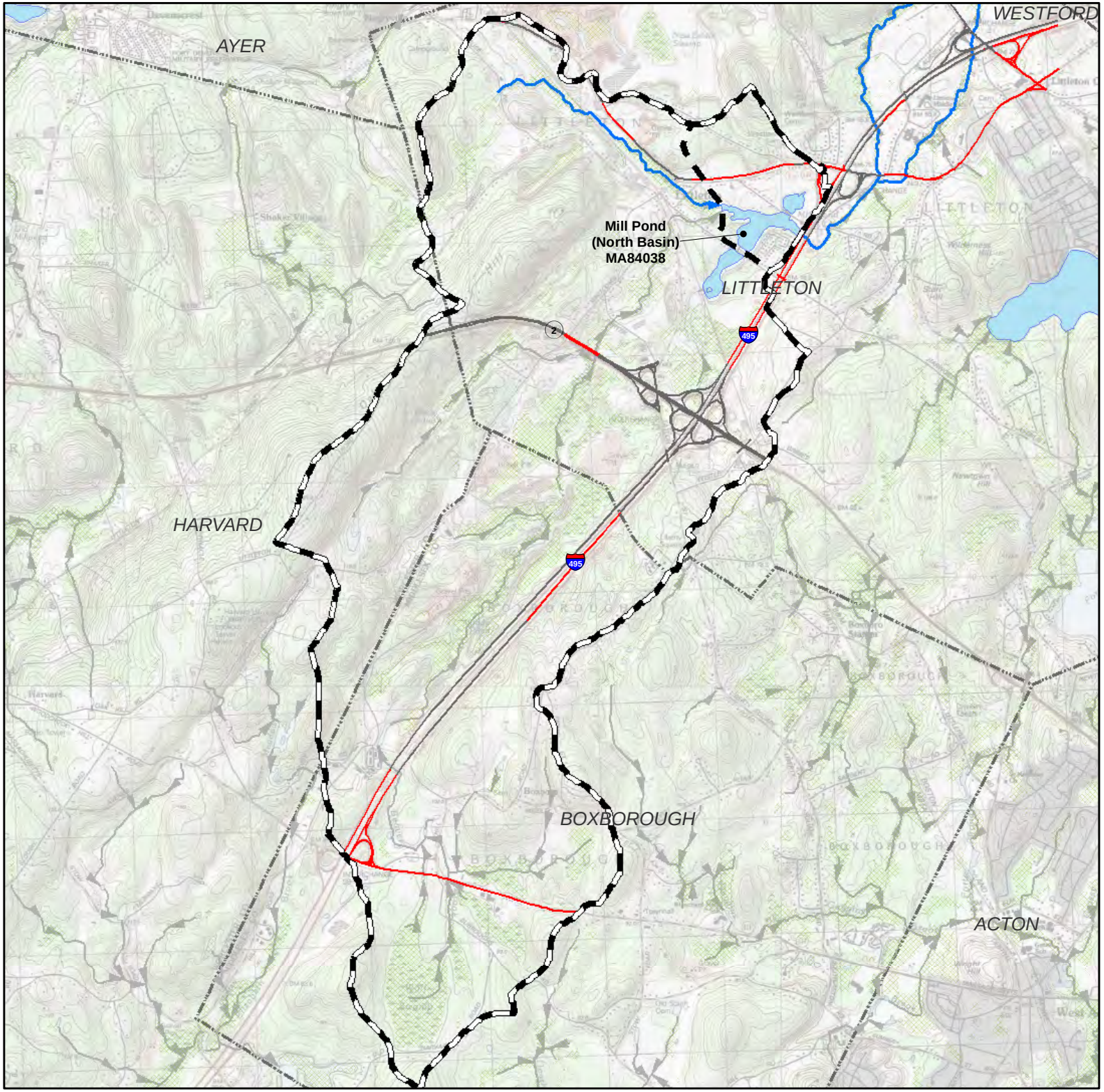

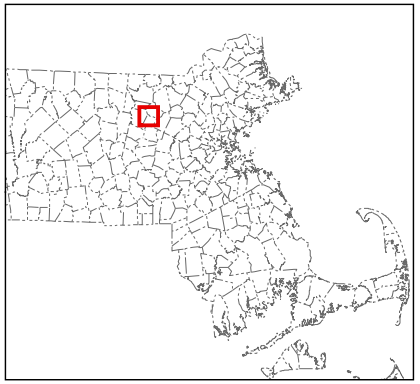

MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries
Upstream Mill Pond Watershed
Mill Pond (MA84038) Subwatershed
NWI Wetland Areas
Impaired Water Bodies
Impaired Stream Segments
Non-Impaired Stream Segments

N

0 0.5 1 Miles

Figure 1
Mill Pond
North Basin
Watershed
MA84038

June 2011

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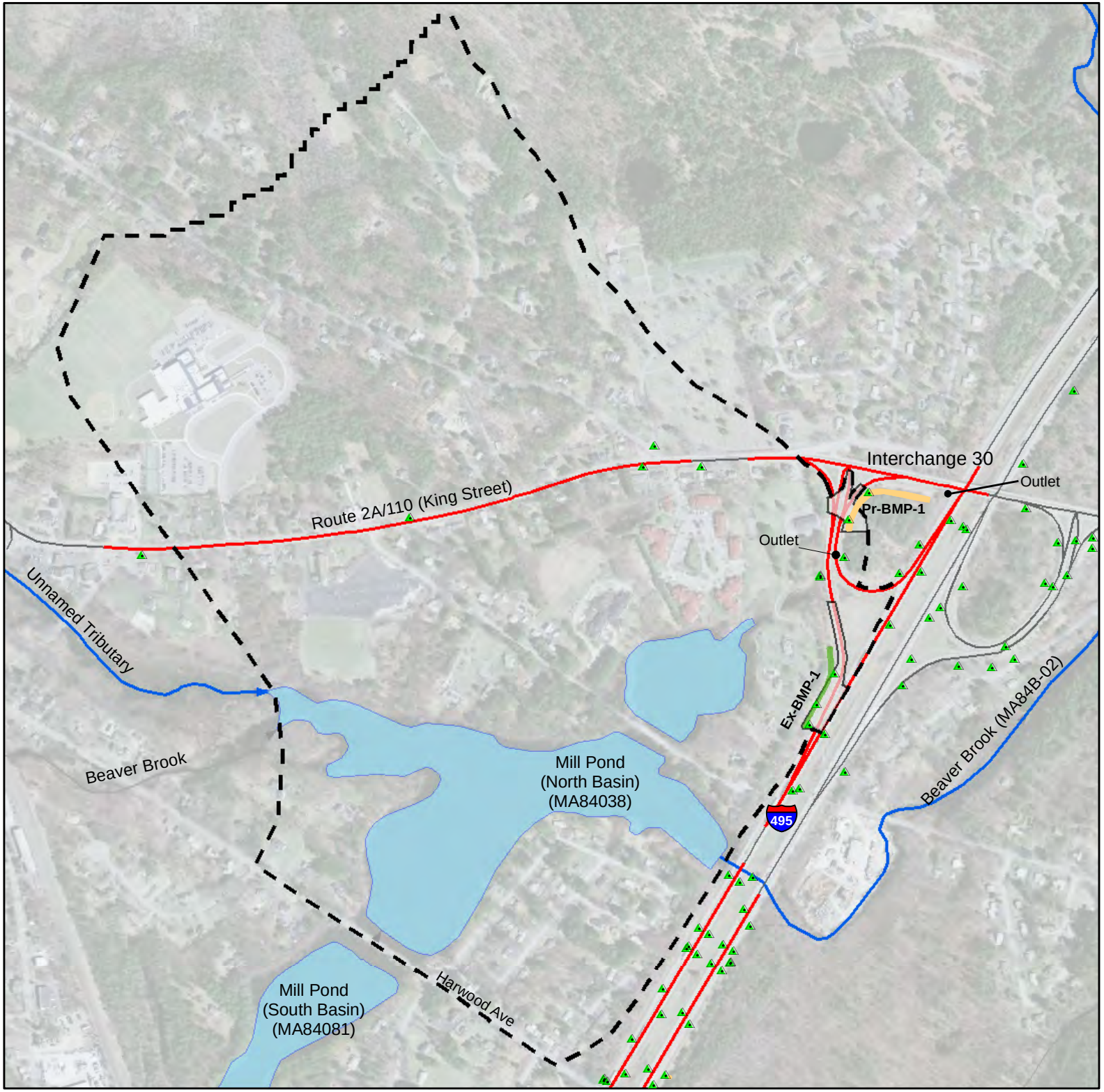

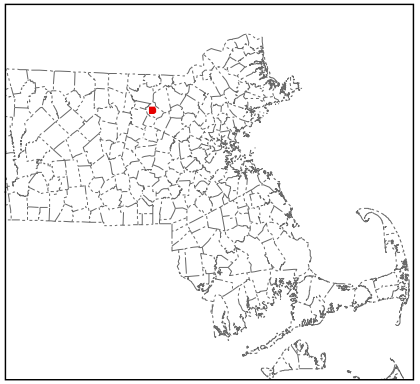

Stormwater Outfalls
Existing BMP Location
Proposed BMP Location
BMP Watersheds
Mill Pond Subwatershed
MassDOT Roads in Urban Areas
MassDOT Roads
Impaired Water Bodies
Impaired Stream Segments
Non-Impaired Stream Segments

N

0 500 1,000 Feet

Figure 2
Mill Pond
North Basin
Directly Contributing
Watershed
MA84038

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Impaired Waters Assessment for Beaver Brook (MA84B-02)

Impaired Waterbody

Name: Beaver Brook

Location: Littleton and Westford, MA

Water Body Segment ID: MA84B-02

Impairments

Mass DEP 2008 303d List: nutrients, pH, organic enrichment/low DO, pathogens, suspended solids

Mass DEP 2010 Draft 303d List Changes: nutrients removed from list

Relevant Water Quality Standards: Water Body Class: B

- *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)3 pH.* Shall be in the range of 6.5 through 8.3 standard units but not more than 0.5 units outside of the natural background range. There shall be no change from natural background conditions that would impair any use assigned to this Class.
- *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)(c)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)5 Floating or suspended 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.

Site Description

Beaver Brook segment MA84B-02 is an approximately 4.8 mile stream that is located in the Towns of Littleton and Westford, MA between the outlet of Mill Pond (MA84038) in Littleton and the inlet to Forge Pond in Westford. Beaver Brook passes beneath Interstate 495 (I-495) and flows north along the eastern side of the I-495 and Route 2A/110 (King Street) interchange (Figure 1). The main Beaver Brook channel flows north and again passes beneath I-495 approximately 1,500 feet north of this interchange. The eastern branch of Beaver Brook flows south at the culvert on King Street, and north through the I-495 and Great Road interchange. The main channel passes under Great Road to the west of this interchange where it drains through an extensive wetland complex.

The Beaver Brook total contributing watershed is approximately 8,414 acres and includes the Mill Ponds (MA84038 and MA84081) and extensive wetland areas. The subwatershed that contributes directly to the impaired segment of Beaver Brook, and not to upstream tributaries, is approximately 1,878 acres (Figure 1). Within this subwatershed, Mass DOT property includes approximately 124 acres, of which approximately 50 acres of impervious surface drain to Beaver Brook through systems of piping, swales, and overland flow.

MassDOT roads that are designated as being located within an urban area in the Beaver Brook watershed are highly segmented in this area due to the inconsistency in the urban boundary definition. This impaired waters assessment has considered all MassDOT property in this watershed to ensure the inadvertent segmentation did not influence the comprehensive approach of the methods used.

The drainage from MassDOT property is described in the following sections from the southern upstream watershed area to the northern downstream area.

I-495 South of Mill Pond

The southbound lane of Interstate 495 from the Harwood Avenue overpass to the Beaver Brook crossing drains to the western shoulder via overland flow and point discharges from catch basins. The drainage swale along the western shoulder is grass lined and includes some wetland and natural forest vegetation at its high elevation in the southern section. The swale has an approximately 350 foot concrete channel along a steeper sloped section that ends near the Mill Pond outlet spillway. Because this MassDOT property discharges at the outlet from Mill Pond and as such does not contribute to the in-lake water quality, this is considered a discharge to Beaver Brook for our assessments.

An area that extends approximately 500 feet south of the Harwood Avenue overpass along the southbound land of I-495 drains through a 40-inch concrete pipe to the median where it

connects to a 48-inch concrete pipe that conveys storm water runoff from the median north approximately 550 feet (20 feet north of the Harwood Avenue overpass) to a manhole. This storm drain discharges through a 54-inch concrete pipe to a small wetland area that is approximately 50 feet east of the northbound lane. This small wetland drains north through a swale that is between approximately 10 and 15 feet wide and has a low slope (<0.5%). This swale discharges directly into Beaver Brook approximately 200 feet downstream from the I-495 bridge (Figure 2b). Also discharging to this swale is the drainage from the northbound lane of I-495, the median, and the shoulder in the drainage area that extends from approximately 1,000 feet north to approximately 500 feet south of the Harwood Avenue overpass.

I-495 North of Mill Pond to Interchange 30 (I-495 and King Street)

The southbound lane of I-495 north of Mill Pond primarily drains through a piped storm water system that discharges to Beaver Brook from the median. Runoff from the northbound lane is conveyed by a swale that slopes south to Beaver Brook. The off ramp and a portion of the on ramp of the northbound cloverleaf at Interchange 30 drain to areas outside of the clover leaf where infiltration areas are situated. The upper and lower portion of the cloverleaf drain to the areas inside the cloverleaf where storm water infiltrates or flows to the outlet located on the northern side. The southbound cloverleaf receives runoff from the upper portion of the intersection with King Street, and from an area on I-495 near the entrance to the off ramp (Figure 2c). Storm water that drains to the inside of the cloverleaf infiltrates or flows into the storm water inlet pipe located in the northeastern corner.

I-495 between Interchange 30 and 31

Storm water runoff from the I-495 median and the southbound lane between Interchange 30 and Beaver Brook is conveyed through a system of swales, catch basins, and pipes to Beaver Brook at an outfall located near the western side of the I-495 bridge (Figure 2d). Some overland storm water flow to Beaver Brook occurs in the median and along the northeastern side of the northbound lane. The northbound lane in this area drains to a pipe in the median with an outfall to Beaver Brook.

Storm water runoff from the southbound lane between the I-495 bridge over Beaver Brook and the Russell Street overpass drains to a swale that slopes south to a channel that discharges into Beaver Brook. The median and the northbound lane in this area drain through a system of catch basins, swales and pipes to an outfall that discharges to Beaver Brook in the median.

Storm water runoff from I-495 between the Russell Street overpass and Interchange 31 drains overland in the median and the shoulders over low-sloped grass covered areas.

Interchange 31 (I-495 and Great Road)

The eastern branch of Beaver Brook passes through the southbound cloverleaf at Interchange 31. A portion of the southbound cloverleaf discharges to a tributary to Beaver Brook, thus is not associated with the Beaver Brook subwatershed. Runoff from a portion of Grant Road and I-495 along the northeastern portion of the cloverleaf drains to the eastern branch of Beaver Brook through a structural conveyance system.

The northbound cloverleaf at Interchange 31 receives storm water runoff from the northbound lane and median of I-495 over an area that extends approximately 2,000 feet north of the interchange. The swale on the eastern side of the northbound lane in this area has catch basins that convey storm water to a concrete storm drain in the median. The median and the triangle in at this interchange are drained by this storm drain which discharges to the inside of

the cloverleaf into a wetland area. The wetland in the cloverleaf drains to a stream channel that passes under I-495 to the west where it flows through a large wetland to Beaver Brook.

Grant Road on the east side of I-495 and the Littleton Common area drain through a structural conveyance system to a headwall outfall at the entrance to the northbound on ramp. Storm water discharge from this outfall flows west along a stream channel across the cloverleaf to the culvert under I-495.

Assessment under BMP 7U for Nutrients and Other Habitat Alterations Impairments

The impairments listed for Beaver Brook (pH, organic enrichment/low DO, pathogens, and suspended solids) have not been addressed by a 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.

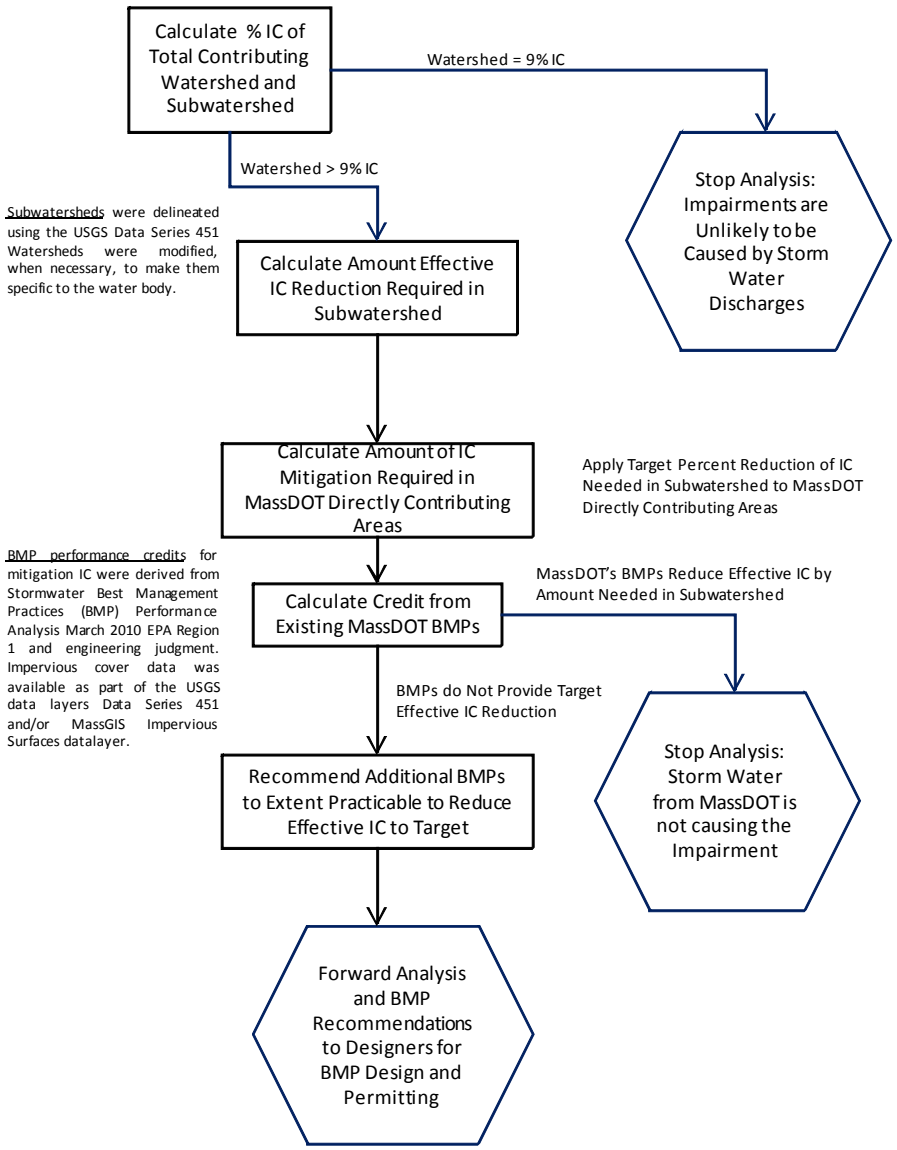
Excessive suspended solids in Beaver Brook may be caused by storm water runoff or episodic re-suspension of stream bed deposits. Impairments for organic enrichment/low DO may be related to the input of nutrients. The input of nutrients has been documented to be directly related to the amount of impervious cover in the watershed (Schueler, 2003).

For this water body, MassDOT used our Description of MassDOT's Application of Impervious Cover Method in BMP 7U (MassDOT Application of IC Method) which 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 to assess potential storm water impacts on the impaired water and evaluate the level of 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% impervious cover, 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.

MassDOT's Application of the Impervious Cover Method

First, MassDOT calculated the percent IC of the water body's entire contributing watershed (total watershed upstream of downstream end of impaired segment) and that of the local watershed contributing directly 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. The USGS Data Series watersheds were modified, when necessary, to make them specific to the water body. Impervious cover data was available as part of the USGS data layers Data Series 451 and MassGIS's impervious surfaces datalayer. 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.

MassDOT then 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


Calculate % IC of Total Contributing Watershed and Subwatershed
Watershed = 9% IC
Stop Analysis: Impairments are Unlikely to be Caused by Storm Water Discharges
Watershed > 9% IC
Subwatersheds were delineated using the USGS Data Series 451 Watersheds were modified, when necessary, to make them specific to the water body.
Calculate Amount Effective IC Reduction Required in Subwatershed
Calculate Amount of IC Mitigation Required in MassDOT Directly Contributing Areas
Apply Target Percent Reduction of IC Needed in Subwatershed to MassDOT Directly Contributing Areas
BMP performance credits for mitigation IC were derived from Stormwater Best Management Practices (BMP) Performance Analysis March 2010 EPA Region 1 and engineering judgment. Impervious cover data was available as part of the USGS data layers Data Series 451 and/or MassGIS Impervious Surfaces datalayer.
Calculate Credit from Existing MassDOT BMPs
MassDOT's BMPs Reduce Effective IC by Amount Needed in Subwatershed
BMPs do Not Provide Target Effective IC Reduction
Stop Analysis: Storm Water from MassDOT is not causing the Impairment
Recommend Additional BMPs to Extent Practicable to Reduce Effective IC to Target
Forward Analysis and BMP Recommendations to Designers for BMP Design and Permitting

Analysis report (EPA 2010b) and engineering judgment. 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 to the total contributing watershed of the impaired water (Beaver Brook (MA84B-02)):

Watershed		
Watershed Area	1,878	acres
Impervious Cover (IC) Area	246	acres
Percent Impervious	13%	
IC Area at 9% Goal	169	acres
Necessary Reduction % in IC	31%	

Reductions Applied to DOT Direct Watershed		
MassDOT's IC Area **Directly** Contributing to Impaired Segment	49.4	acres
MassDOT's Required Reduction in Effective IC (31% of DOT Directly Contributing IC)	15.5	acres

The watershed is greater than 9% impervious which indicates that the storm water is likely contributing to the impairment. The watershed needs to reduce its effective IC by 31% to reach the 9% goal. Therefore, MassDOT should reduce its effective IC by the same percentage. MassDOT needs to remove the effect of 15.5 acres of effective IC.

Existing BMPs

MassDOT has several existing BMPs that mitigate potential storm water quality impacts prior to discharge to Beaver Brook including infiltration basins and vegetated filter strips. 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 are characterized as hydrologic group A (sand and gravel), group B (sand and loam), and group C (silt, loam and clay) soils, and urban fill. Urban fill was conservatively assumed to have drainage properties similar to those of a group C soil.

The following table summarizes the existing BMPs, the respective area of IC they treat, their calculated IC reduction credit percentage, and the resulting IC area reduction. The locations of the existing BMPs are identified on Figures 2a through 2f. The existing BMPs process storm water runoff from a total of 5.5 acres of impervious cover and are calculated to remove the effect of 5.3 acres of impervious cover.

Existing BMPs

BMP Name	BMP Type	Soil Type	Storage Volume (in.)	IC Area Treated (acres)	Percent Reduction of Effective IC*	Reduction of Effective IC (acres)
Ex-BMP-1	Infiltration Basin	C - Silt Loam - 0.27 in/hr	1.9	0.26	94%	0.24
Ex-BMP-2	Infiltration Basin	B - Loam 0.52 in/hr	1.3	0.54	91%	0.49
Ex-BMP-3	Infiltration Basin	B - Loam 0.52 in/hr	1.9	0.34	97%	0.33
Ex-BMP-4	Infiltration Basin	A - Loamy Sand 2.41 in/hr	2.0	0.65	100%	0.65
Ex-BMP-5	Vegetated Filter Strip	C - Silt Loam - 0.27 in/hr	2.0	1.38	95%	1.31
Ex-BMP-6	Vegetated Filter Strip	C - Silt Loam - 0.27 in/hr	2.0	1.48	95%	1.41
Ex-BMP-7	Vegetated Filter Strip	A - Loamy Sand 2.41 in/hr	1.8	0.73	100%	0.73
Ex-BMP-8	Infiltration Swale	B - Loam 0.52 in/hr	1.6	0.16	95%	0.15
Total				**5.54**		**5.31**

* The percent reduction of effective IC is dependent on BMP type, size relative to the IC that they process, and local soil conditions. BMP performances are discussed further in MassDOT Application of IC Method document. The spreadsheet used to calculate IC reductions is available upon request.

Recommendations

Since the total mitigation of impervious surface achieved by existing Mass DOT's BMPs is less than the target of 15.5 acres, Mass DOT reviewed possible areas to locate additional BMPs that are potentially capable of removing approximately10.8 acres of effective IC (Figures 2a – 2f). Upon further site-specific investigations and the BMP design process, the most feasible of these proposed BMP locations will be selected to meet the IC goal to the greatest extent possible.

Pr-BMP-1: Infiltration Swale

The proposed BMP location *Pr-BMP-1* is an existing swale on the western shoulder of I-495 immediately south of the Harwood Avenue overpass (Figure 2a). By converting this swale to an infiltration swale, approximately 0.44 acres of effective IC could potentially be removed from the MassDOT direct drainage area. The soils in this area are classified by the NRCS as hydrologic group A (sand and gravel).

Pr-BMP-2: Infiltration Swale

The location of proposed BMP *Pr-BMP-2* is an existing swale on the eastern shoulder of I-495 immediately north of the Harwood Avenue overpass (Figure 2a). This swale receives runoff from the median and the I-495 northbound lane. Runoff is discharged into this swale from the median through a 54-inch pipe and from the area south of this pipe from a swale with drop-inlet drains. This swale discharges directly to Beaver Brook approximately 200 feet downstream from the I-495 bridge. Infiltration and storage capacity in the Pr-BMP-2 swale could be improved by installing

check dams or similar means of outlet control. This could potentially reduce the effective IC of the MassDOT direct drainage area by 84%, which equates to approximately 2.83 acres.

Pr-BMP-3: Infiltration Swale

The location of proposed BMP *Pr-BMP-3* is an existing concrete lined channel on the western shoulder of I-495 immediately south of the Mill Pond outlet to Beaver Brook (Figure 2b). By replacing the concrete channel with an infiltration swale approximately 0.47 acres of effective IC could be removed from the MassDOT direct drainage area. The soil in this area is categorizes as hydrologic soil group A.

Pr-BMP-4: Infiltration Swale

The proposed BMP location *Pr-BMP-4* is an existing swale along the western shoulder of the I-495 southbound lane that is drained by a 30-inch concrete drain with drop inlets (Figures 2d). Runoff that is conveyed through this drainage system discharges directly into Beaver Brook. This swale can be improved by installing check dams or otherwise increasing the storage volume between the drop inlets to allow for increased infiltration. This improvement could reduce the effective IC from associated MassDOT direct drainage by approximately 1.13 acres.

Pr-BMP-5: Infiltration Swale

The location of proposed BMP *Pr-BMP-5* is an existing swale in the median that has drop inlets that convey runoff to the pipe that drains the swale along the *Pr-BMP-4* location (Figures 2d). By installing check dams between the catch basins along this swale, runoff storage and infiltration could be increased. This improvement could reduce the effective IC from associated MassDOT direct drainage by approximately 0.47 acres.

Pr-BMP-6: Infiltration Swale

Proposed BMP *Pr-BMP-6* is located on the western side of the I-495 southbound lane immediately north of Interchange 31 (Figure 2f). Runoff from the southbound lane drains to a swale with drop inlets to a concrete pipe. The lower portion of this swale has a concrete-lined channel. By modifying this swale to an infiltration swale, the effective IC from associated MassDOT direct drainage could potentially be reduced by approximately 1.69 acres.

Pr-BMP-7: Infiltration Swale

Proposed BMP *Pr-BMP-7* is located along the eastern side of I-495 immediately south of Harwood Avenue (Figure 2a). This swale conveys runoff from the I-495 northbound lane north to the location of *Pr-BMP-2*. Drop inlets along this swale convey storm water into a concrete pipe that discharges on the north side of the Harwood Avenue abutment. By modifying this swale to improve infiltration between the drop inlets, the effective IC from associated MassDOT direct drainage could potentially be reduced by approximately 1.06 acres.

Pr-BMP-8: Infiltration Swale

Proposed BMP *Pr-BMP-8* is located on the western side of the southbound lane of I-495 immediately north of the bridge over Beaver Brook (Figure 2d). The existing swale in this area conveys runoff from I-495 south to channel that discharges to Beaver Brook. Infiltration could be enhanced along this swale with the installation of check dams. This improvement is calculated to remove approximately 0.84 acres of IC from the associated MassDOT direct drainage area.

Pr-BMP-9: Infiltration Basin

The location of proposed *Pr-BMP-9* is within the southbound cloverleaf at Interchange 30 (Figure 2c). Runoff from a portion of the interchange at the intersection with King Street drains to an area on the northern side of the cloverleaf. There is currently a swale that conveys storm water from the outfall location east to a pipe that drains to a stream and wetland immediately north of the interchange. By installing an outlet control in this swale, this area could function as an infiltration basin. This improvement is calculated to remove approximately 1.24 acres of IC from the associated MassDOT direct drainage area.

Pr-BMP-10: Infiltration Swale

Proposed BMP *Pr-BMP-10* is located along the eastern side of the I-495 northbound lane immediately north of the bridge over Beaver Brook (Figure 2b). The existing swale slopes south and discharges to Beaver Brook. This swale receives storm water runoff from approximately 750 feet of I-495. By converting this existing swale into an infiltration swale approximately 0.60 acres of effective IC may be reduced from the associated MassDOT direct drainage area.

Proposed BMPs

BMP Name	BMP Type	Soil Type	Storage Volume (in.)	IC Area Treated (acres)	Percent Reduction of Effective IC*	Reduction of Effective IC (acres)
Pr-BMP-1	Infiltration Swale	A - Loamy Sand 2.41 in/hr	1.7	0.44	99%	0.44
Pr-BMP-2	Infiltration Swale	C - Silt Loam - 0.27 in/hr	1.1	3.36	84%	2.82
Pr-BMP-3	Infiltration Swale	A - Loamy Sand 2.41 in/hr	0.6	0.53	89%	0.47
Pr-BMP-4	Infiltration Swale	C - Silt Loam - 0.27 in/hr	1.0	1.37	83%	1.14
Pr-BMP-5	Infiltration Swale	C - Silt Loam - 0.27 in/hr	2.0	0.50	95%	0.48
Pr-BMP-6	Infiltration Swale	C - Sandy Clay Loam - 0.17 in/hr	0.8	2.45	69%	1.69
Pr-BMP-7	Infiltration Swale	C - Silt Loam - 0.27 in/hr	1.1	1.26	85%	1.07
Pr-BMP-8	Infiltration Swale	C - Silt Loam - 0.27 in/hr	1.4	0.95	89%	0.85
Pr-BMP-9	Infiltration Basin	C - Silt Loam - 0.27 in/hr	2.0	1.31	95%	1.24
Pr-BMP-10	Infiltration Swale	C - Silt Loam - 0.27 in/hr	0.8	0.81	74%	0.60
Proposed BMPs				12.98		10.80
Existing BMP				5.54		5.31
Total				**18.52**		**16.11**

Conclusions

This assessment for segment MA84B-02 of Beaver Brook has shown that the existing BMPs treating MassDOT's roadways/ properties provide approximately 34% of the reduction in IC recommended to achieve the subwatershed goal of 9% IC. In order to further reduce MassDOT's contribution to the effective impervious cover within the Beaver Brook watershed, MassDOT proposes modifications to ten existing swales to further reduce the total effective impervious cover contribution from MassDOT by approximately 70% (16.1 acres). This equates to a total reduction in effective impervious cover by MassDOT that is equal to 33%, which is greater than the calculated requirement of 31% needed for the subwatershed. Since the proposed BMPs are only conceptual at this time, the next stage of design will allow for gathering site specific soil information, site constraints and other information which will allow the designer to further refine which of the proposed BMPs is most applicable to meet the mitigation target.

The following table summarizes the effective IC removal of the existing and proposed BMPs.

Impervious Cover Reduction

IC in Directly Contributing Watershed	49.4	acres
Required Reduction in Effective IC	15.5	acres
IC Effectively Reduced by Existing BMPs	5.3	acres
IC Remaining to Mitigate with Proposed BMPs	10.2	acres
IC Reduction Provided by Proposed BMPs	16.1	acres

MassDOT will continue to implement non-structural BMPs that reduce potential nutrient and sediment loading. MassDOT will re-evaluate the potential need for structural BMPs to address pollutant loading when road work is conducted as programmed projects for this area. This is consistent with an iterative adaptive management approach to addressing impairments.

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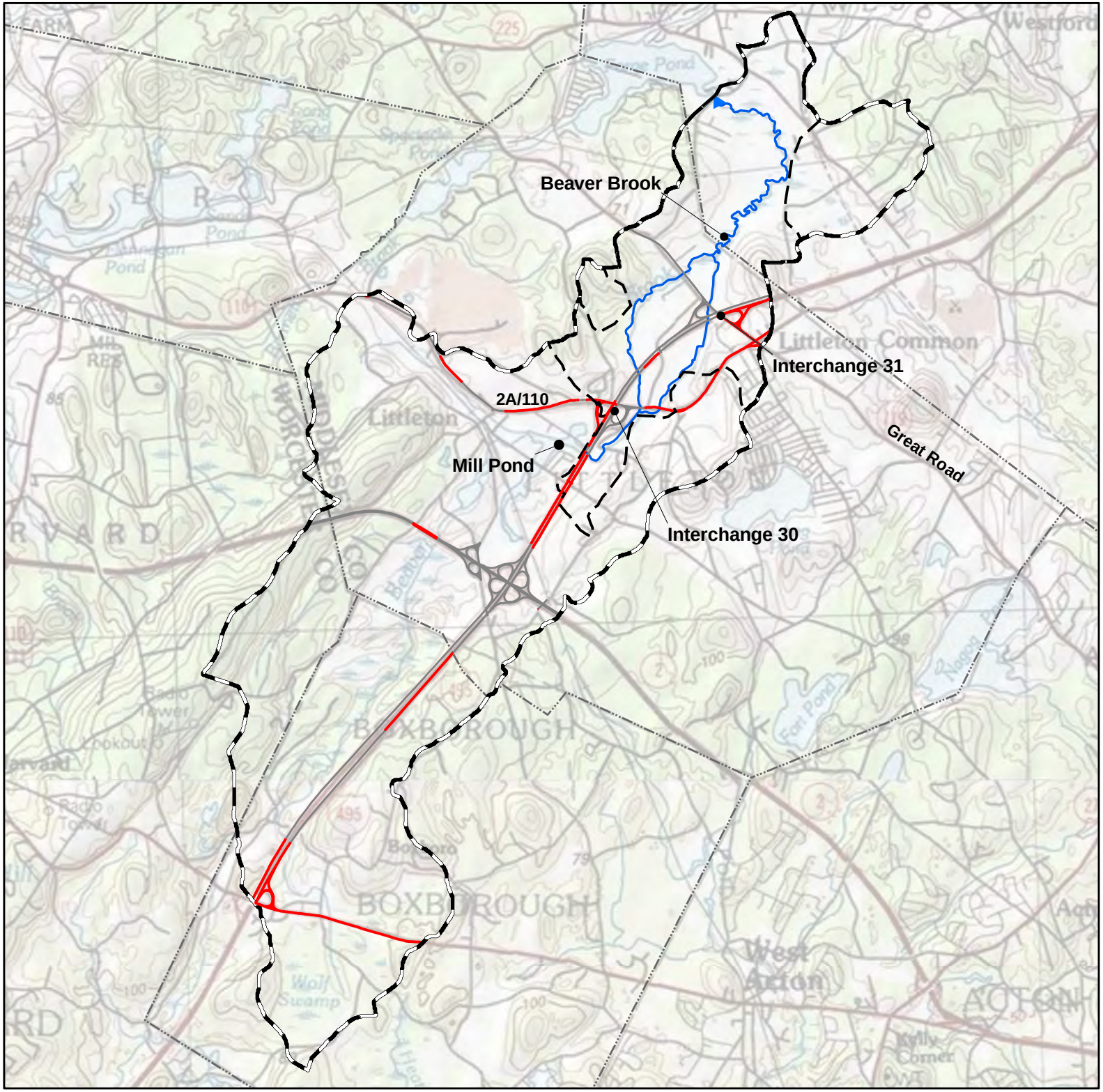

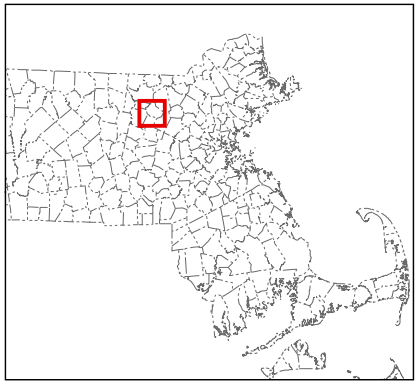

MA84B-02
MassDOT Roads in Urban Areas
MassDOT Road
Town Boundary
Upstream Beaver Brook Watershed
Segment MA84B-02 Subwatershed

N

0 0.5 1 Miles

Figure 1
Beaver Brook Watershed MA84B-02

June 2011

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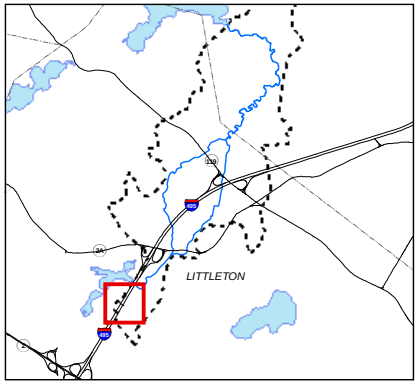

- Stormwater Outfalls
- Existing BMP-Vegetated Filter Strip
- Existing BMP-Infiltration Basin
- Proposed BMP-Infiltration Swale
- Proposed BMP-Infiltration Basin
- BMP Watershed
- MassDOT Roads in Urban Areas
- MassDOT Roads
- NWI Wetland Area
- Impaired Water Bodis
- Beaver Brook (MA84B-02)
- Non-Impaired Stream Segments

N

0 200 400 Feet

Figure 2a
BMP Locations
Beaver Brook
MA84B-02

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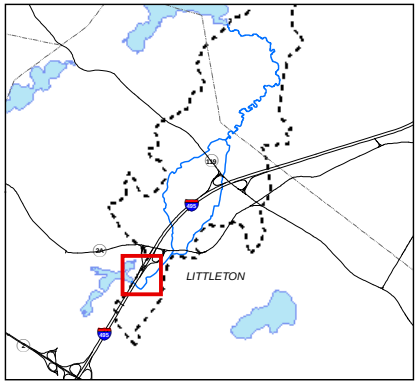

- Stormwater Outfalls
- Existing BMP-Vegetated Filter Strip
- Existing BMP-Infiltration Basin
- Proposed BMP-Infiltration Swale
- Proposed BMP-Infiltration Basin
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- MassDOT Roads
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N

0 200 400 Feet

Figure 2b
BMP Locations
Beaver Brook
MA84B-02

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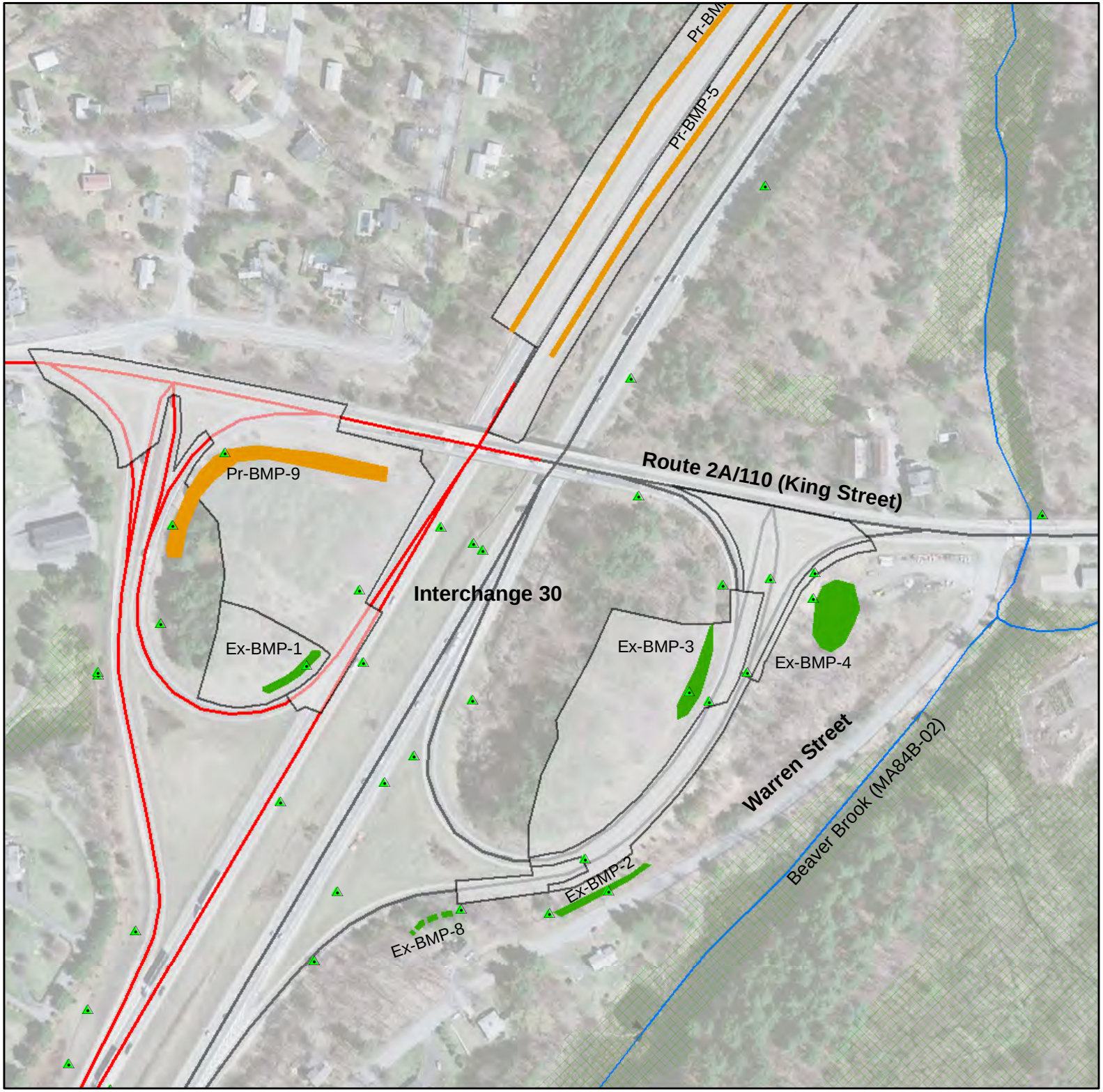

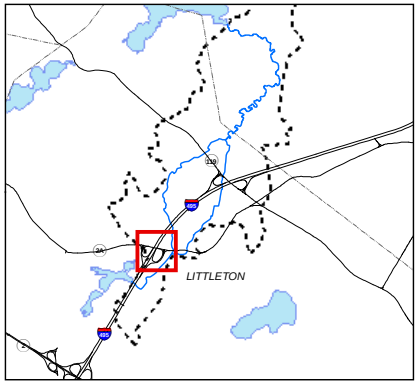

- Stormwater Outfalls
- Existing BMP-Vegetated Filter Strip
- Existing BMP-Infiltration Basin
- Proposed BMP-Infiltration Swale
- Proposed BMP-Infiltration Basin
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- MassDOT Roads
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- Impaired Water Bodis
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- Non-Impaired Stream Segments

N

0 200 400 Feet

Figure 2c
BMP Locations
Beaver Brook
MA84B-02

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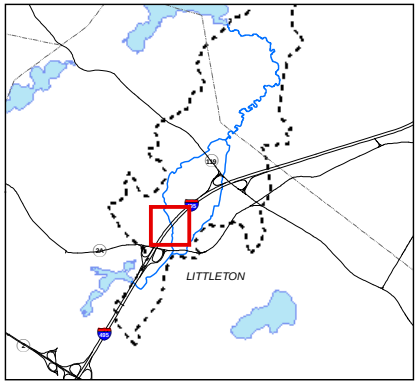

- Stormwater Outfalls
- Existing BMP-Vegetated Filter Strip
- Existing BMP-Infiltration Basin
- Proposed BMP-Infiltration Swale
- Proposed BMP-Infiltration Basin
- BMP Watershed
- MassDOT Roads in Urban Areas
- MassDOT Roads
- NWI Wetland Area
- Impaired Water Bodis
- Beaver Brook (MA84B-02)
- Non-Impaired Stream Segments

N

0 200 400 Feet

Figure 2d
BMP Locations
Beaver Brook
MA84B-02

June 2011

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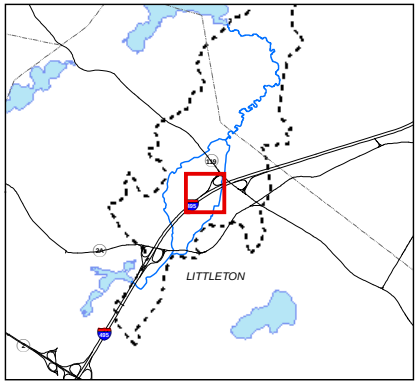

- Stormwater Outfalls
- Existing BMP-Vegetated Filter Strip
- Existing BMP-Infiltration Basin
- Proposed BMP-Infiltration Swale
- Proposed BMP-Infiltration Basin
- BMP Watershed
- MassDOT Roads in Urban Areas
- MassDOT Roads
- NWI Wetland Area
- Impaired Water Bodis
- Beaver Brook (MA84B-02)
- Non-Impaired Stream Segments

N

0 200 400 Feet

Figure 2e
BMP Locations
Beaver Brook
MA84B-02

June 2011

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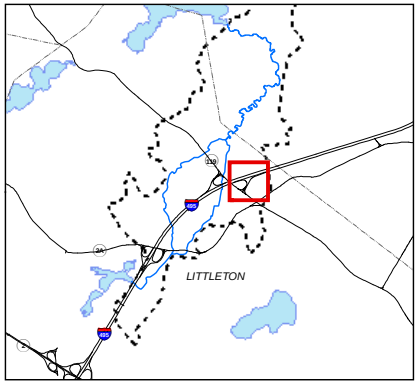

- Stormwater Outfalls
- Existing BMP-Vegetated Filter Strip
- Existing BMP-Infiltration Basin
- Proposed BMP-Infiltration Swale
- Proposed BMP-Infiltration Basin
- BMP Watershed
- MassDOT Roads in Urban Areas
- MassDOT Roads
- NWI Wetland Area
- Impaired Water Bodis
- Beaver Brook (MA84B-02)
- Non-Impaired Stream Segments

N

0 200 400 Feet

Figure 2f
BMP Locations
Beaver Brook
MA84B-02

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Impaired Waters Assessment for Pleasant Bay (MA 96-77)

Impaired Water Body

Name: Pleasant Bay

Water Body ID: MA 96-77

Impairments

Pleasant Bay (MA96-77) is impaired for Nutrients according to both the Final Year 2008 and the Proposed Year 2010 List of Integrated Waters. Pleasant Bay is also listed in both documents as a Category 4a water body and is covered by a Total Maximum Daily Load (TMDL) for Total Nitrogen.

Relevant Water Quality Standards

Pleasant Bay has been classified by the Massachusetts Surface Water Quality Standards as a Class SA water. Water quality standards of particular interest to the issues of cultural eutrophication are aesthetics, dissolved oxygen, and nutrients. The Massachusetts water quality standards (314 CMR 4.0) contain numeric criteria for dissolved oxygen, but have only narrative standards that relate to the other variables, as described below:

- 314 CMR 4.05(5)(a) “Aesthetics. All surface waters shall be free from pollutants in concentrations 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 (4)(a) 1 “Dissolved Oxygen. Shall not be less than 6.0 mg/l. Where natural background conditions are lower, DO shall not be less than natural background. 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.”

Site Description

Pleasant Bay is defined as the waters between the mouth of Muddy Creek, Harwich and imaginary lines drawn from the northeastern edge of Orleans (near The Horseshoe), southeasterly to the northeastern tip of Sipson Island, then continuing to and around the northeastern border of Sipson Meadow, Orleans then south to the northern tip of Strong Island, Chatham and from the southeastern tip of Strong Island to Allen Point, Chatham (excluding the delineated segments; Bassing Harbor, Round Cove and Quanset Pond).

The bay is a large waterbody which outlets to Chatham Harbor and eventually the Atlantic Ocean and has a surface area of approximately 1840 acres. According to the Cape Cod Coastal Drainage Areas Water Quality Assessment Report, all of Pleasant Bay is approved for shellfish harvesting. Pleasant Bay is heavily used for water-based recreation and has six public/ semi public beaches. Most of the freshwater flow to Pleasant Bay is through groundwater, although there are some small freshwater streams which discharge to Pleasant Bay.

According to both the Final Year 2008 and Proposed Year 2010 List of Integrated Waters, Pleasant Bay is impaired for Nutrients and falls under the TMDL for nitrogen titled, “Pleasant Bay System Total Maximum Daily Loads For Total Nitrogen” [10/24/2007-CN244.0].

MassDOT owns Route 28 which runs north-south on the western edge of Pleasant Bay from approximately Muddy Creek just past Tar Kiln Marsh. Route 28 is a two lane roadway with impervious width of approximately 20-feet to 24-feet with a section near Tar Kiln Marsh that is approximately 36-ft wide. A tidal stream from Tarn Kiln Marsh crosses beneath a Route 28 bridge to the northeast of Pleasant Bay. MassDOT property also includes ROW of approximately 10-feet on either side of the roadway. The edges of pavement are not curbed and stormwater runoff sheds to the sides of the road and much of it infiltrates. The section of road was reviewed during a site visit on May 23, 2011. Based on the assumption in the Pleasant Bay System TMDL for Total Nitrogen that runoff within a 200-ft buffer of a waterbody is considered a direct discharge, approximately 2.4 acres of impervious MassDOT property directly discharges to Pleasant Bay. The limits of the watershed are shown in Figure 1.

Precipitation that falls on the pervious MassDOT right of way near Pleasant Bay infiltrates and flows to the Bay through groundwater. As stated in the Pleasant Bay System TMDL for Total Nitrogen, it is unlikely that runoff would be channeled as a point source from areas more than 200-ft away. Additionally, the total pathogen TMDL for Cape Cod titled, “Final Pathogen TMDL for the Cape Cod Watershed” [08/28/2009-CN252.0] states that rates of natural surface runoff on Cape Cod are generally very low to zero due to soils characteristics. During the development of the WLA for pathogens it was assumed that no runoff occurs from the pervious areas. Due to the soils and geology of Cape Cod this assessment assumed that runoff on pervious surfaces percolates into the ground. This was further verified during the site visit.

It should be noted that there are two golf courses within close proximity to Pleasant Bay (Eastward Ho Country Club and Cape Cod National Golf Club). The entirety of both courses are within 4,000-ft of Pleasant Bay and much of Eastward Ho Country Club is within 200-ft of Pleasant Bay. According to turf managers at the golf courses turf area application rates ranged from 87 (lb/acre/yr) to 131 (lb/acre/yr) at Eastward Ho and 76 (lb/acre/yr) to 196 (lb/acre/yr) at Cape Cod National (Mass DEP, 2006)

Assessment under BMP 7R for Total Nitrogen

As stated in the Pleasant Bay System TMDL for Total Nitrogen, most of the nitrogen affecting the Pleasant Bay Embayment system originates from the sediments, with on-site subsurface wastewater disposal systems (septic systems) and atmospheric deposition providing the next largest sources. Considerably less nitrogen originates from fertilizers, runoff and natural background sources.

The TMDL for Total Nitrogen for the Pleasant Bay System addresses the impairment for Nutrients for Pleasant Bay. Therefore, MassDOT assessed the contribution of Nitrogen from MassDOT urban areas to this water body to address the impairment. 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 "Pleasant Bay System Total Maximum Daily Loads For Total Nitrogen" states that loading of nitrogen from stormwater from impervious areas is "…obviously negligible when compared to other sources." Based on this conclusion, it is clear that discharge from the 2.4 acres of MassDOT urban roadway that drains to Pleasant Bay is de minimus and therefore no further measures are necessary.

This conclusion is confirmed by the requirements in EPA's draft permit for stormwater discharges from MS4s that covers this area (the IMS Small MS4 General Permit). This permit contains draft requirements for implementing BMPs to be consistent with applicable TMDLs. The requirements in this permit for consistency with the Pleasant Bay System TMDL are below:

> "2.2.1(g) Appendix G, Table G-4, lists the names of municipalities that have small MS4s located in the Cape Cod Watershed and Buzzards Bay Watershed that are subject to approved TMDLs for nitrogen.
>
> > i. Within two (2) years of the effective date of the permit, the permittee shall identify the sources of nitrogen which discharge to the waters listed in Appendix G, Table G-4 as having impairments due to nitrogen.
> >
> > ii. The permittee shall implement practices such that the total existing levels of nitrogen are maintained or decreased to the waters listed in Appendix G, Table G-4 as having impairments due to nitrogen."
>
> "2.4.2.1(c)(i) Public Outreach and Education "Residential program: maintenance of septic systems; effects of outdoor activities such as lawn care (use of pesticides, herbicides, and fertilizers) on water quality; benefits of appropriate onsite infiltration of stormwater; effects of automotive work and car washing on water quality; proper disposal of swimming pool water; and proper management of pet waste. If the small MS4 has greater than 50 percent of its residents serviced by septic systems or is subject to an approved TMDL for nitrogen, the municipality shall include maintenance of septic systems as part of its education program.
>
> > For MS4s located in areas listed in Appendix G, Tables G-1, G-2 and G-4 subject to an approved TMDL for either phosphorus or nitrogen, the residential education program must address the proper use of fertilizer, alternatives to traditional fertilizers containing nutrients (phosphorus and nitrogen), and septic system maintenance. The education material shall describe methods of recycling lawn clipping and yard waste as fertilizer and mulch, or its proper collection and disposal. The educational materials

shall include information encouraging the use of alternative forms of fertilizers containing lower nutrient concentrations, or slower releasing or less available forms of nutrients.

For MS4s located in areas listed in Appendix G, Table G-1, the permittee shall provide information on alternatives to detergents containing phosphates."

"2.4.2.1(c)(ii) Public Outreach and Education "Business/Commercial/Institution program: proper lawn maintenance (use of pesticides, herbicides and fertilizer); benefits of appropriate on-site infiltration of stormwater; building maintenance (use of detergents); use of salt or other de-icing and anti-icing materials (minimize their use); proper storage of salt or other de-icing/anti-icing materials (cover/prevent runoff to pollution prevention); proper management of waste materials and dumpsters (cover and pollution prevention); proper management of parking lot surfaces (sweeping); proper car care activities (washing of vehicles and maintenance); and proper disposal of swimming pool water (except dechlorinated swimming pool water) by entities such as motels, hotels, and health clubs (discharges should be free from pollutants).

For MS4s located in areas listed in Appendix G, Tables G-1, G-2 and G-4, subject to an approved TMDL for either phosphorus or nitrogen, the education program for this audience shall include information on the proper use of fertilizer, alternatives to fertilizers containing nutrients (phosphorus and nitrogen), and the benefits of street/parking lot sweeping for control of nutrients. The education material shall describe methods of recycling lawn clipping and yard waste as fertilizer and mulch, or its proper collection and disposal. The educational materials shall include information encouraging the use of alternative forms of fertilizers containing lower nutrient compositions, or slower releasing or less available forms of nutrients."

"2.4.2.1(c)(iv) Industrial program: equipment inspection to ensure timely maintenance; proper storage of industrial materials (emphasize pollution prevention); proper management and disposal of wastes; proper management of dumpsters; minimization of use of salt or other de-icing/anti-icing materials; proper storage of salt or other de-icing/anti-icing materials (cover/prevent runoff to storm system and ground water contamination); benefits of appropriate on-site infiltration of stormwater runoff from areas with low exposure to industrial materials such as roofs or employee parking; and proper maintenance of parking lot surfaces (sweeping).

For MS4s located in areas listed in Appendix G, Tables G-1, G-2 and G-4, subject to an approved TMDL for either phosphorus or nitrogen, the education program for this audience shall include information on the proper use of fertilizer, alternatives to fertilizers containing nutrients (phosphorus and nitrogen), and the benefits of street/parking lot sweeping for control of nutrients. The education material shall describe methods of recycling lawn clipping and yard waste as fertilizer and mulch, or its proper collection and disposal. The educational materials shall include information encouraging the use of alternative forms of fertilizers containing lower nutrient compositions, or slower releasing or less available forms of nutrients."

"2.4.7.1(a)(1) For MS4s located in the areas listed in Appendix G, Table G-1, G-2 and G-4, subject to an approved TMDL for either phosphorus or nitrogen, the permittee shall evaluate alternatives to traditional fertilizers and incorporate, to the extent practicable, their use on permittee owned spaces. The permittee shall also address public green space care and municipal leaf litter collection and disposal."

Appendix G of the Draft Permit also indicates that the approved TMDL waste load allocation (WLA) for total nitrogen for storm water discharges to this water body is "negligible."

MassDOT programs included in the Storm Water Management Plan (SWMP) related to nitrogen include:

1. **Vegetation Management Program (BMP 6A-5):** The VMP program establishes the criteria whereby MassDOT controls vegetation along state roads and highways in compliance with the Rights of Way Management Regulations (333 CMR 11.00). Under this regulatory program, MassDOT has prepared both a 5-Year Vegetation Management Plan (VMP) and a Yearly Operational Plan (YOP) for Vegetation Management. The provisions of MassDOT's VMP are summarized below.

   Integrated Roadside Vegetation Management

   MassDOT's VMP incorporates Integrated Roadside Vegetation Management (IRVM) methods which include roadside development (active planting to encourage appropriate competing vegetation, non-organic barriers), mechanical (mowing, hand cutting, selective trimming), and chemical (low volume foliar herbicide treatments).

   One goal of the VMP is to minimize the use of chemical controls, through minimizing areas of application, quantity of chemicals, and frequency of application. Chemical control techniques shall be limited to use on high traffic volume, high speed interstate and primary roadways in the Commonwealth where safety of motorists, MassDOT employees, and contractors precludes the use of mechanical methods. Using IRVM methods, MassDOT will employ only two types of herbicide application: Foliar treatment and cut stump surface treatment.

   - *Foliar Treatments* involve the selective application of approved herbicides and adjuvants diluted in water, to the foliage and stems of the target vegetation. The foliar treatment used shall be low pressure, below 60 psi at the nozzle, with a normal working pressure of 40 psi for application at volumes of less than 50 gallons/acre.
   - *Cut Stump Surface Treatment* is the application of an herbicide to the cut surface of a stump immediately following or during a cutting operation, to prevent re-sprouting.

   Identifying and Protecting Sensitive Areas

   Sensitive areas are defined as areas within rights-of-way in which public health, environmental or agricultural concerns warrant special protection to further minimize risks of unreasonable adverse effects (of herbicides) and include public groundwater supplies, public surface water supplies, private drinking water supplies, surface waters, wetlands, rivers, inhabited areas and agricultural areas.

   All herbicides used by MassDOT have been researched, tested and approved by the Department of Food & Agriculture for use in Sensitive Areas. The MassDOT VMP provides descriptions and procedures for how Sensitive Areas will be identified for required protection, summarizes the restrictions and no-spray zones associated with application of herbicides within the right of way, and describes how no-spray zones will be identified and flagged.

   In addition, MassDOT prepares its Yearly Operational Plan which includes the provisions of the VMP and proposed spray locations by route and municipality. A copy of the YOP are sent to the Conservation Commission, Board of Health (or designated health agent), and to the head of government (Mayor, City Manager, Chair of the Board

of Selectmen) of each municipality where herbicides are to be applied along the rights of way during the calendar year.

Source Control and Operational Guidelines for Herbicide Applicators

The MassDOT VMP provides operational guidelines for applicators to properly manage herbicides. Source Control measures provided in the VMP include:

- Mixing and loading of herbicides at the maintenance facility in limited amounts of herbicide necessary to carry out only that day's work.
- Spray vehicles will be equipped with a clipboard log of the herbicides on board, a bag of adsorbent, activated charcoal, plastic bats, a broom and a shovel in case of a minor spill.
- Applicators to roadside rights of way must hold a valid pesticide certification from the Department of Food and Agriculture.
- Herbicide application will be restricted during certain adverse weather conditions, such as rain or wind.
- Low-pressure foliar application equipment will be calibrated to maintain pressure not exceeding 60 pounds per square inch at the nozzle.
- Monitoring will include project record keeping to maintain timely information on the nature, timing, and location of actions taken, including project location, weather conditions, miles completed, amount of material used, worker and equipment hours devoted to the project, and persons responsible for activity and follow-up evaluation.
- Chemically treated areas shall be monitored after the necessary translocation period of the herbicide to determine the effectiveness of the applications and to monitor any off target injury and migration of the spray solution.
- MassDOT will conduct training for District staff in methods of vegetation management, employee safety and record keeping.
- The VMP includes a Remedial Plan to address potential spills and related accidents.

Alternatives to Chemical Herbicide Study

MassDOT, in collaboration with the Federal Highway Administration, funds a research project at the University of Massachusetts to seek alternatives to chemical herbicides for roadside weed control. With the assistance of the UMass Department of Soil Sciences, MassDOT is experimenting and testing alternative research, chemicals, and non-conventional control methods.

MassDOT is committed to actively pursue testing and evaluation of alternative methods of vegetation control. Other methods for investigation of management of roadside vegetation under guardrails include hand mowing, steaming, flaming, mulching with organic materials, and mulching with sheeting made from recycled products such as tires or plastic bottles. MassDOT continues to monitor the progress, provide updated information, notification, and assist the University of Massachusetts with the study. MassDOT will constantly monitor and evaluate the success of the vegetation management program and integrate appropriate new methods into the VMP and Yearly Operational Plans (YOP). YOPs are prepared by April of each year and posted on MassDOT's website within 30 days.

2. **BMP 1A: MassDOT Training Assistance Program (MTAP) and BMP 1B: Baystate Roads Program**: MassDOT provides significant training of highway personnel and municipal employees through BMP 1A: MassDOT Training Assistance Program (MTAP) and BMP 1B: Baystate Roads Program which focus on subjects such as stormwater BMPs and the use of the MassDOT Stormwater Handbook to identify the appropriate BMPs for a site, including those that will reduce nitrogen loading.

3. **MassDOT's 511 Traveler Information System (BMP 6A-1)**: The 511 program provides signage within the highway right-of-way that support litter law enforcement and encourages roadway users to notify MassDOT of litter and debris along the roadway. When calls are received, MassDOT crews are dispatched to clean up the litter or take other necessary actions.

Public education and outreach related to residential, commercials and industrial programs related to lawn care and fertilizer use is not applicable to MassDOT.

MassDOT has reviewed the measures it conducts under is Storm Water Management Program and has concluded that they are consistent with the intent of the applicable BMP requirements of the draft permit.

In combination, the TMDL's conclusion that storm water loading of TN is negligible and the consistency of MassDOT's SWMP with the Draft IMS permit's requirements indicate that no further measures are necessary at this location for compliance with the TMDL WLA.

Applicable Recommendations for Nitrogen Reduction

However, MassDOT has conducted a site visit to this location and identified a number of potential locations for installing BMPs. These opportunities are described in the following section. Although installation of these BMPs is not required, MassDOT will consider implementing them in the future as part of programmed projects or potentially as retrofits.

Assessment and Mitigation Plan

A site visit on May 23rd, 2011 indicated that there are no existing BMPs in place to treat MassDOT runoff before it discharges to Pleasant Bay and the right-of-way (ROW) owned by MassDOT is extremely limited in this area with less than ten feet on either side and residential homes and wetlands adjacent to the right-of-way. These space constraints limit the options for installation of BMPs that provide nitrogen removal. Nitrogen removal is dependent upon vegetative uptake or infiltration and requires BMPs such as bioretention and retention basins or infiltration measures. There is limited space, and therefore, the only feasible BMP alternatives for retrofit are installing leaching catch basins on Route 28 and water quality swales.

Infiltration BMPs rely upon the infiltration ability of underlying soils for proper function. Additionally, by adding infiltration BMPs, MassDOT would limit the volume of direct discharge to Pleasant Bay. MassDOT performed a desktop analysis of soils within the areas where it recommends infiltration BMPs to determine soil type and associated Hydrologic Soil Group (HSG) using the United States Department of Agriculture's Natural Resources Conservation Service (NRCS) SSURGO-Certified soils data, obtained from MassGIS. MassDOT assigned infiltration rates to each HSG as shown in Table 1 below.

Table 1. Infiltration Rates Assigned to NRCS Hydrologic Soil Groups

NRCS Hydrologic Soil Group (HSG)	Infiltration Rate (inches/hour)
A	2.41
B	0.52
C	0.17
D	N/A

The NRCS soils data shows that in the areas where infiltration BMPs are recommended, soils consist entirely of HSG A. The corresponding infiltration rates for this HSG are relatively high and thus suitable for the installation of infiltration BMPs. MassDOT will conduct site-specific soil testing before designing and installing infiltration BMPs.

The following sections describe the potential BMPs in further detail. Refer to Figure 2 for exact locations of storm water outfalls and potential BMPs.

Leaching Catch Basins

Leaching catch basins would allow infiltration of stormwater runoff. MassDOT will consider installing 7 leaching catch basins in the directly contributing watershed closest to Muddy Creek, install 2 leaching catch basins near the cranberry bog near Tar Kiln Marsh and installation of 4 leaching catch basins near the Tar Kiln Stream. Currently, MassDOT contributes 2.4 acres of stormwater runoff to Pleasant Bay. The 7 leaching catch basins within the directly contributing area near Muddy Creek would collect and infiltrate approximately 0.5 acres of runoff, the two catch basins near the cranberry bog would collect approximately 0.1 acres and the 4 leaching catch basins near Tar Kiln Stream would collect and infiltrate approximately 0.5 acres of runoff. The location and drainage area received of the leaching catch basins is approximate and further analysis should be taken during design of these BMPs.

Water Quality Swales

There is potentially space to install water quality swales on two shoulders. These swales would collect and infiltrate approximately 0.1 acres of runoff. These swales would provide vegetative uptake as well as infiltration.

During future programmed project work for this section of roadway, MassDOT would review the possibility of installing additional BMPs if additional right-of-way could be obtained and other site constraints were appropriate.

Conclusions

Pleasant Bay is subject to one TMDL: TMDL for Total Nitrogen for the Pleasant Bay System. The nitrogen TMDL for the Pleasant Bay System, which includes Pleasant Bay, indicates that that storm water loading of TN is negligible and the IMS Small MS4 General Permit again indicates that if MassDOT's SWMP is consistent with the Draft IMS permit's requirements no further measures are necessary at this location for compliance with the TMDL WLA. MassDOT has reviewed the measures it conducts under is Storm Water Management Program and has concluded that they are consistent with the intent of the applicable BMP requirements of the draft permit for the total nitrogen TMDL. Therefore, no further measures are necessary or proposed at this time.

However, MassDOT has conducted a site visit to this location and identified a number of potential locations for installing BMPs; including thirteen leaching catch basins and two water quality swales. Although installation of these BMPs is not required, MassDOT will consider implementing them in the future as part of programmed projects or potentially as retrofits.

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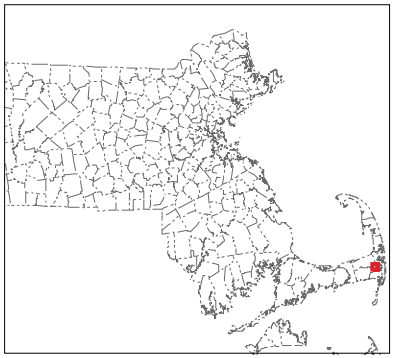

MA96-77

MassDOT Directly Contributing Watersheds

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

1,000 500 0 1,000 Feet

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Figure 1
Pleasant Bay
MA96-77

June 2011

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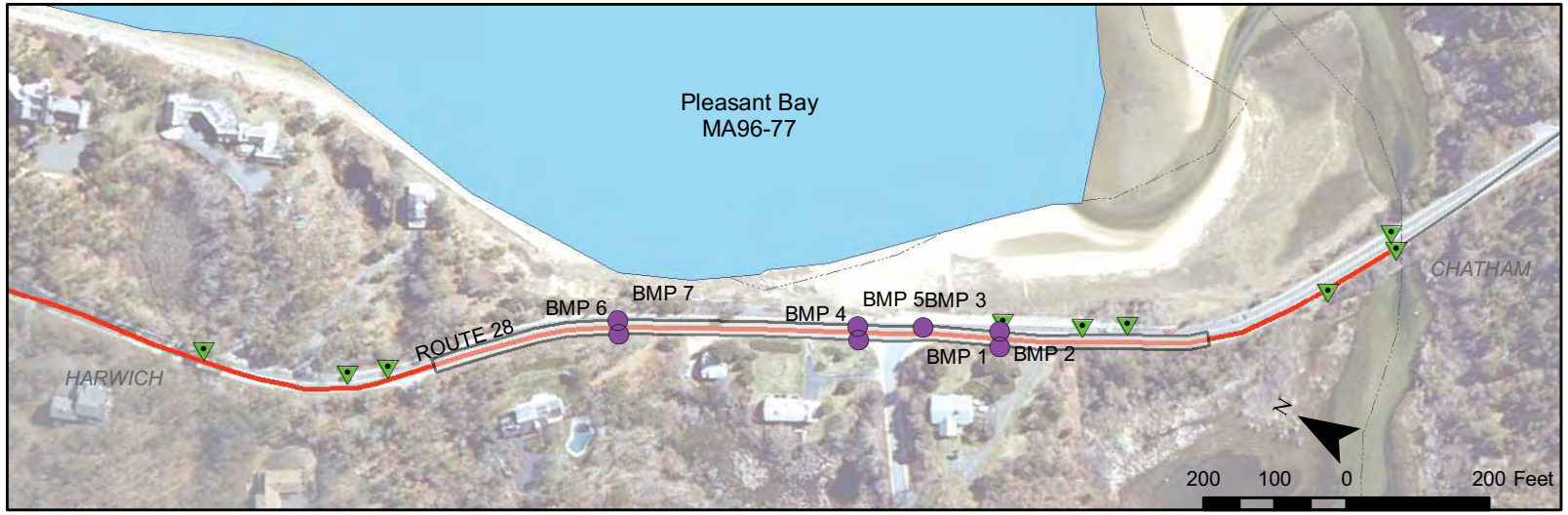

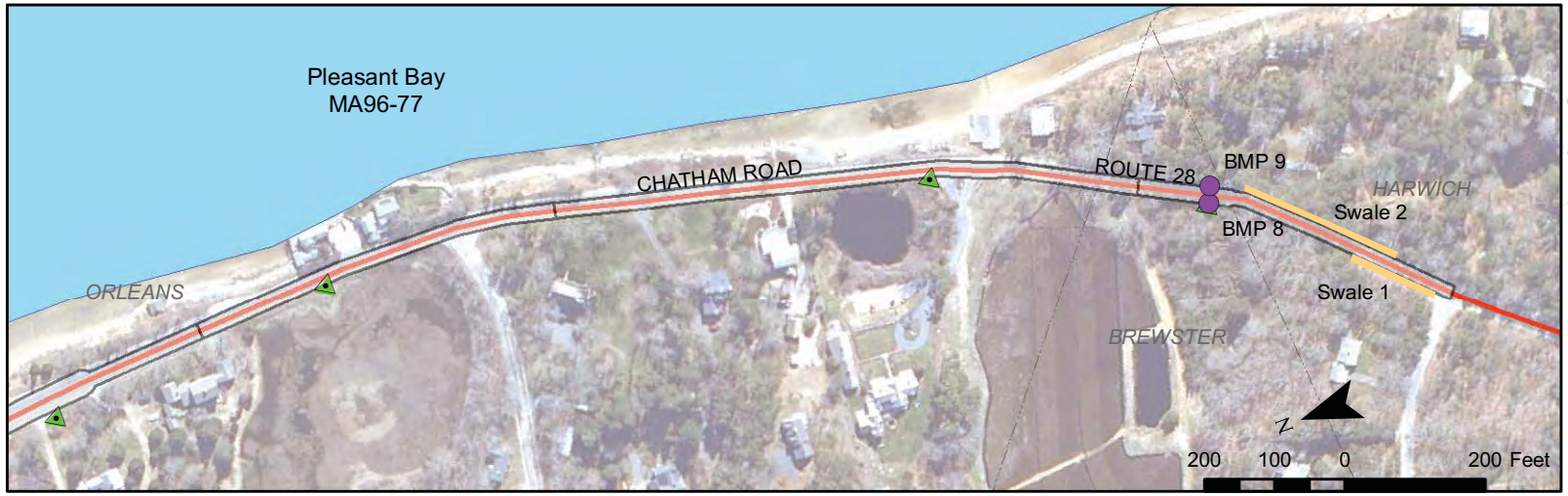

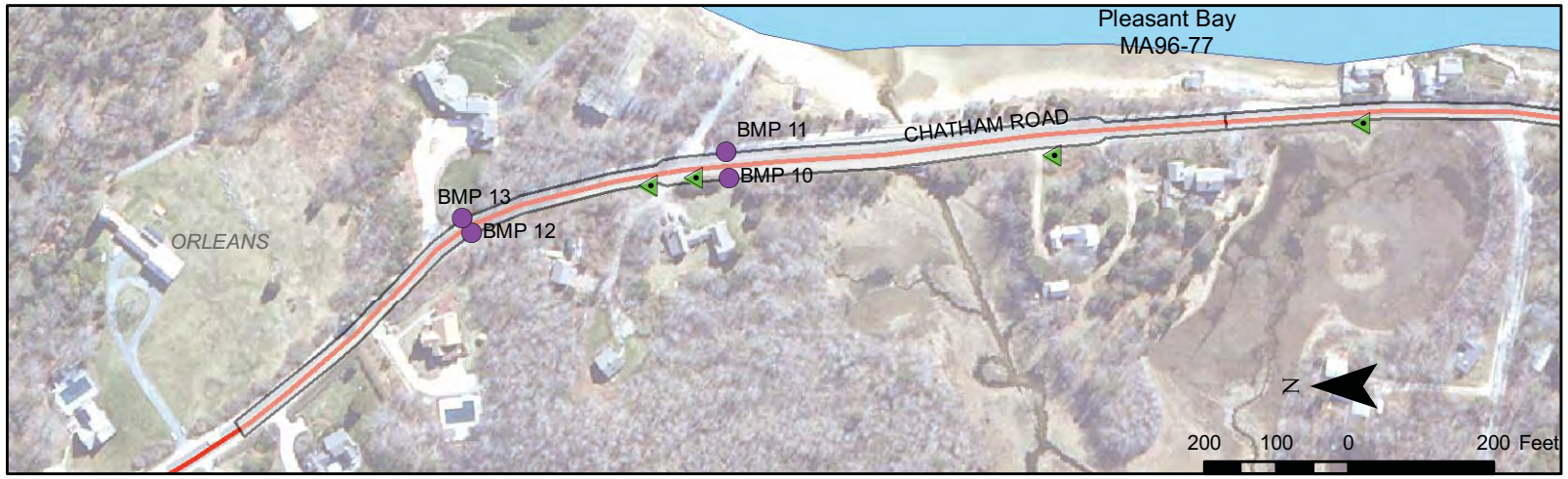

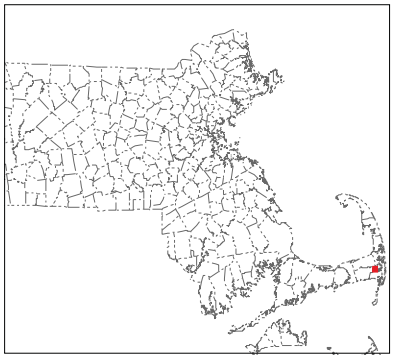

MA96-77

MassDOT Directly Contributing Watersheds

Stormwater Outfalls

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

Proposed BMPs

ProposedBMPs

Figure 2
Pleasant Bay
MA96-77

June 2011

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Impaired Waters Assessment for Frost Fish Creek (MA 96-49)

Impaired Water Body

Name: Frost Fish Creek

Water Body ID: MA 96-49

Impairments

Frost Fish Creek (MA96-49) is impaired for Nutrients and Pathogens according to both the Final Year 2008 and the Proposed Year 2010 List of Integrated Waters. Frost Fish Creek is also listed in both documents as a Category 4a water body and is covered by a Total Maximum Daily Load (TMDL) for Total Nitrogen and a TMDL for Bacteria.

Relevant Water Quality Standards

Frost Fish Creek has been classified by the Massachusetts Surface Water Quality Standards as a Class SA water. Water quality standards of particular interest to the issues of cultural eutrophication are aesthetics, bacteria, dissolved oxygen, and nutrients. The Massachusetts water quality standards (314 CMR 4.0) contain numeric criteria for dissolved oxygen, but have only narrative standards that relate to the other variables, as described below:

- 314 CMR 4.05(5)(a) “Aesthetics. All surface waters shall be free from pollutants in concentrations 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.”
- 301 CMR 4.05 (4)(a) 4 “Bacteria.
    a) Waters designated for shellfishing: fecal coliform shall not exceed a geometric mean Most Probable Number (MPN) of 14 organisms per 100 ml, nor shall more than 10% of the samples exceed an MPN of 28 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 a geometric mean of 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 samples taken within 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.”

- 314 CMR 4.05 (4)(a) 1 “Dissolved Oxygen. Shall not be less than 6.0 mg/l. Where natural background conditions are lower, DO shall not be less than natural background. 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.”

Site Description

Frost Fish Creek is a small tributary in Chatham, Massachusetts which outlets from a cranberry bog northwest of Stony Hill Road to the confluence with Ryder Cove. The Creek is approximately ¾ of a mile long and has a surface area of about 12.8 acres. There are two culverts at Route 28 and a dike and weir system immediately up gradient which split Frost Fish Creek into a lower and upper portion. The weir and culvert maintain approximately three feet of water at low tide within the upper portion of the Creek. The ponding of estuarine waters and limited tide range supports fringing saltwater wetland. Upper Frost Fish Creek has a significant amount of groundwater entry from its watershed (Mass DEP 2007).

The lower Frost Fish Creek is tidally influenced between the Rt. 28 culverts and Ryder Cove. This lower portion is nearly completely drained at ebb slack tide and as a result supports extensive tidal flats. Tidal waters from Pleasant Bay enter through Bassing Harbor and Ryder Cove before influencing the lower portion of Frost Fish Creek.

According to both the Final Year 2008 and Proposed Year 2010 List of Integrated Waters, Frost Fish Creek is impaired for Nutrients and Pathogens and falls under the TMDL for pathogens titled, “Bacteria Total Maximum Daily Load For Frost Fish Creek Chatham, Massachusetts” [4/28/2005-CN207.0] and the TMDL for nitrogen titled, “Pleasant Bay System Total Maximum Daily Loads For Total Nitrogen” [10/24/2007-CN244.0]. The total drainage basin to the upper portion of Frost Fish Creek is approximately 210 acres and the total drainage basin for both portions is approximately 231 acres. These sub-watersheds were delineated by the United States Geological Survey for the Massachusetts Estuaries Project based upon MODFLOW/MODPATH and utilize the most current physical information and modeling.

MassDOT owns Route 28 which bisects the lower portion and upper portions of Frost Fish Creek. Route 28 is a two lane roadway with impervious width of approximately 21-feet. MassDOT property also includes ROW of approximately 10-feet on either side of the roadway. The edges of pavement are not curbed and stormwater runoff sheds to the sides of the road and much of it infiltrates. The section of road was reviewed during a site visit on May 23, 2011. Based on the assumption in the Pleasant Bay System TMDL for Total Nitrogen that runoff within a 200-ft buffer of a waterbody is considered a direct discharge, approximately 0.5 acres of impervious MassDOT property directly discharges to Frost Fish Creek. This watershed is shown in Figure 1.

Precipitation that falls on the pervious MassDOT right of way near Frost Fish Creek infiltrates and flows to the Creek through groundwater. As stated in the Pleasant Bay System TMDL for Total Nitrogen, it is unlikely that runoff would be channeled as a point source from areas more than 200-ft away. Additionally, the total pathogen TMDL for Cape Cod titled, "Final Pathogen TMDL for the Cape Cod Watershed" [08/28/2009-CN252.0] states that rates of natural surface runoff on Cape Cod are generally very low to zero due to soils characteristics. During the development of the WLA for pathogens it was assumed that no runoff occurs from the pervious areas. Due to the soils and geology of Cape Cod this assessment assumed that runoff on pervious surfaces percolates into the ground. This was further verified during the site visit.

Assessment under BMP 7R for Pathogens

The Bacteria Total Maximum Daily Load For Frost Fish Creek states that the most likely sources of fecal coliform bacteria are waterfowl and other wildlife throughout the upper basin and stormwater runoff from roads and paved surfaces near the tidal inlet at Rt. 28. The culverts associated with roadways and a separate dike and weir just up gradient from the roadway create standing water and decreased flushing which can lead to increased concentrations of contaminants.

Pathogen[1] concentrations in storm water vary widely temporally and spatially; concentrations can vary by an orders of magnitude within a given storm event (Mass DEP, 2009). Therefore, it is difficult to predict storm water pathogen concentrations with accuracy. Due to this difficulty, MassDOT is not conducting site specific assessments of loading at each location impaired for pathogens as part of this Retrofit Program. Instead these sites will be assessed collectively based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA. MassDOT believes this approach is consistent with an iterative adaptive management approach to storm water and is consistent with pathogen TMDLs for waters within Massachusetts.

To look for guidance on how to address the pathogen sources from storm water discharges, MassDOT referred to the measures specified in EPA's Draft Massachusetts Interstate, Merrimack and South Coastal (IMS) Small MS4 General Permit (IMS Small MS4 General Permit) . Although this permit is in draft form it provides the best available guidance on EPA's expectations from permittees to achieve compliance with the Pathogen TMDL.

Assessment and Mitigation Plan

The existing NPDES MS4 permit that covers MassDOT stormwater discharges does not provide guidance on what measures are necessary to comply with the Bacteria Total Maximum Daily Load for Frost Fish Creek, However, the draft permit for MS4 stormwater discharges that covers this area (the IMS Small MS4 General Permit) does contains guidance on what measures EPA has determined are necessary to be consistent with this and other TMDLs that are applicable to storm water discharges. Although this permit is still in draft form, it provides the best available guidance on what measures to implement to achieve consistency with the TMDL.

Section 2.2.1 of the draft IMS Small MS4 General permit states:

> "b. Appendix G of the permit identifies areas for which there are approved TMDLs applicable to small MS4s. It also identifies, by section, the provisions in this permit that contain TMDL-based requirements that the permittee shall implement to be consistent with the approved TMDL. In

[1] The term "pathogens" is used in this write up to refer to impairments in the 303(d) list including pathogens, e. coli, enterococcus, and other terms describing impairments related to bacteria.

addition to those specific requirements, EPA may notify the permittee of the need to comply with additional requirements to satisfy the requirements of the waste load allocation (WLA). If EPA determines more stringent requirements are necessary to satisfy the requirements of the WLA, EPA will impose such requirements through a modification to this permit pursuant to 40 CFR §122.62 or by their inclusion into this permit upon reissuance. Alternatively, EPA may notify the permittee that an individual permit application is necessary in accordance with Part 1.8."

"c. For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Paragraph 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. Permittees may be subject to requirements of more than one TMDL."

Appendix G of the IMS Small MS4 General Permit indicates that stormwater discharges to Frost Fish Creek are required to implement the following measures):

- Part 2.4.2.1.1(c)(i) Public Outreach and Education: "Residential program: maintenance of septic systems; effects of outdoor activities such as lawn care (use of pesticides, herbicides, and fertilizers) on water quality; benefits of appropriate onsite infiltration of stormwater; effects of automotive work and car washing on water quality; proper disposal of swimming pool water; and proper management of pet waste. ….
    - o …For MS4s located in areas listed in Appendix G, Tables G-3 and Table G-4, subject to an approved TMDL for bacteria or pathogens, the permittee shall disseminate educational materials to dog owners at the time of issuance or renewal of a dog license, or other appropriate time. Education materials shall describe the detrimental impacts of improper management of pet waste, requirements for waste collection and disposal, and penalties for non-compliance. The permittee shall address proper maintenance of septic systems."
- Part 2.4.4: Illicit Discharge Detection and Elimination Program
- Part 2.4.7.1(a)(ii): "For MS4s located in the areas listed in Appendix G, Table G-3 and Table G-4, subject to an approved TMDL for either bacteria or pathogens, within 1 year of the effective date of this permit, the permittee shall undertake the following:
    - o Identify locations within its community where inappropriate pet waste management practices are immediately apparent and pose a threat to receiving water quality due to proximity and potential for direct conveyance of waste to its MS4. Within 2 years of the effective date of this permit, the permittee shall implement targeted management efforts in the identified areas. In neighborhood areas, management efforts shall include additional public education (e.g., door hangers) and enforcement (e.g., increased patrol for violators). In municipally-owned recreational areas where dog walking is allowed, the permittee shall install educational signage, pet waste baggies, and disposal receptacles (or require carry-out).
    - o In order to measure the effectiveness of its pet waste management practices, the permittee shall document in its annual reports information regarding the scope and extent of its education, compliance, and enforcement efforts (including the number of violations pursued and fines levied).
    - o Identify public lands where waterfowl congregate and feeding by the public occurs. Within 2 years of the effective date of this permit, the permittee shall begin dissemination of educational materials to users of identified areas that pose a significant threat to receiving water quality due to proximity and potential for direct conveyance of waste to its MS4. The permittee shall accomplish this through the installation of signage or use other targeted techniques to educate the public about the detrimental impacts of feeding waterfowl (including the resulting feces

deposition) and discourage such feeding practices. Within 3 years of the effective date of this permit, the permittee shall also implement practices that discourage the undesirable congregation of waterfowl in these areas, or otherwise isolate the direct drainage from these areas away from its MS4.

MassDOT has assessed its existing Storm Water Management Program (SWMP) for consistency with these requirements. They are discussed in detail below:

Public Outreach and Education: MassDOT public education programs related to pathogens include:

- MassDOT provides significant training of highway personnel and municipal employees through BMP 1A: MassHighway Training Assistance Program (MTAP) and BMP 1B: Baystate Roads Program which focus on subjects such as stormwater BMPs and the use of the MassDOT Stormwater Handbook to identify the appropriate (including infiltration) BMP for a site.
- MassDOT provides Environmental Awareness Training annual for maintenance facility personnel regarding good housekeeping and spill prevention (BMP 6B-2).
- MassDOT maintenance and material storage yards have strict compliance programs for hazardous waste, wetlands, hazardous materials, underground storage tanks, water quality, sold waste and asbestos controls. These are described in each facility's Environmental Handbook and tracked in the Environmental Management System. (BMP 6C-2)
- The MassDOT 511 Traveler Information System provides signage within the highway right-of-way that support litter law enforcement and encourages roadway users to notify MassDOT of litter and debris along the roadway. When calls are received, MassDOT crews are dispatched to clean up the litter or take other necessary actions. (BMP 6A-1)

Finally, many MassDOT rest areas include dog walking areas where appropriate signage and trash receptacles let pet owners know that they must properly dispose of pet waste. Public education and outreach related to residential programs related to lawn care and septic system upkeep is not applicable to MassDOT. While this pet waste program is not specifically discussed in MassDOT's SWMP, the program is in place and will be added to future SWMP revisions.

Illicit Discharge Detection and Elimination: As described in BMP 3D (Illicit Connection Review Program), MassDOT has implemented a robust IDDE program that commits to reviewing ten percent of roads covered under the MS4 permit each year and the program has focused on waterbodies that are pathogen impaired. MassDOT is committed to conducting illicit discharge detection on urban outfalls to the receiving water under assessment by the end of fall of 2011. Any detected illicit connections will be removed as soon as practicable. Due to the nature of MassDOT roads, linear with limited right of way, minimal illicit connections have been identified and identification through MassDOT employees during construction projects and maintenance work has been a more efficient method of identification.

Pet Waste Management: Many MassDOT rest areas include dog walking areas where appropriate signage and trash receptacles let pet owners know that they must properly dispose of pet waste. MassDOT does not own other facilities that encourage dog walking and there are no rest areas within this stretch of Route 28.

Waterfowl: Since MassDOT owns and operates roadway systems versus parks where waterfowl congregate, the waterfowl requirements do not appear to be applicable. Much of the highway runoff infiltrates into the ground which removes a significant amount of the bacteria load associated with the waterfowl from the surface runoff.

In combination, MassDOT believes that the measures outlined above are consistent with the applicable requirements and intent of the draft permit. Therefore, no further measures are proposed for compliance with the pathogen TMDL.

Assessment under BMP 7R for Total Nitrogen

As stated in the Pleasant Bay System TMDL for Total Nitrogen, most of the nitrogen affecting the Pleasant Bay Embayment system originates from the sediments with on-site subsurface wastewater disposal systems (septic systems) and atmospheric deposition providing the next largest sources. Considerably less nitrogen originates from fertilizers, runoff and natural background sources.

The TMDL for Total Nitrogen for the Pleasant Bay System addresses the impairment for Nutrients for Frost Fish Creek. Therefore, MassDOT assessed the contribution of Nitrogen from MassDOT urban areas to this water body to address the impairment. 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 "Pleasant Bay System Total Maximum Daily Loads For Total Nitrogen" states that loading of nitrogen from stormwater from impervious areas is "…obviously negligible when compared to other sources." Based on this conclusion, it is clear that discharge from the 0.5 acres of MassDOT urban roadway that drains to Frost Fish creek is de minimus and therefore no further measures are necessary.

This conclusion is confirmed by the requirements in EPA's draft permit for stormwater discharges from MS4s that covers this area (the IMS Small MS4 General Permit). This permit contains draft requirements for implementing BMPs to be consistent with applicable TMDLs. The requirements in this permit for consistency with the Pleasant Bay System TMDL are below:

> "2.2.1(g) Appendix G, Table G-4, lists the names of municipalities that have small MS4s located in the Cape Cod Watershed and Buzzards Bay Watershed that are subject to an approved TMDLs for nitrogen and in some instances, pathogens.
>
> > i. Within two (2) years of the effective date of the permit, the permittee shall identify the sources of nitrogen which discharge to the waters listed in Appendix G, Table G-4 as having impairments due to nitrogen.
> >
> > ii. The permittee shall implement practices such that the total existing levels of nitrogen are maintained or decreased to the waters listed in Appendix G, Table G-4 as having impairments due to nitrogen."
>
> "2.4.2.1(c)(i) Public Outreach and Education "Residential program: maintenance of septic systems; effects of outdoor activities such as lawn care (use of pesticides, herbicides, and fertilizers) on water quality; benefits of appropriate onsite infiltration of stormwater; effects of automotive work and car washing on water quality; proper disposal of swimming pool water; and proper management of pet waste. If the small MS4 has greater than 50 percent of its residents serviced by septic systems or is subject to an approved TMDL for nitrogen, the municipality shall include maintenance of septic systems as part of its education program.
>
> > For MS4s located in areas listed in Appendix G, Tables G-1, G-2 and G-4 subject to an approved TMDL for either phosphorus or nitrogen, the residential education

program must address the proper use of fertilizer, alternatives to traditional fertilizers containing nutrients (phosphorus and nitrogen), and septic system maintenance. The education material shall describe methods of recycling lawn clipping and yard waste as fertilizer and mulch, or its proper collection and disposal. The educational materials shall include information encouraging the use of alternative forms of fertilizers containing lower nutrient concentrations, or slower releasing or less available forms of nutrients.

For MS4s located in areas listed in Appendix G, Table G-1, the permittee shall provide information on alternatives to detergents containing phosphates."

"2.4.2.1(c)(ii) Public Outreach and Education "Business/Commercial/Institution program: proper lawn maintenance (use of pesticides, herbicides and fertilizer); benefits of appropriate on-site infiltration of stormwater; building maintenance (use of detergents); use of salt or other de-icing and anti-icing materials (minimize their use); proper storage of salt or other de-icing/anti-icing materials (cover/prevent runoff to pollution prevention); proper management of waste materials and dumpsters (cover and pollution prevention); proper management of parking lot surfaces (sweeping); proper car care activities (washing of vehicles and maintenance); and proper disposal of swimming pool water (except dechlorinated swimming pool water) by entities such as motels, hotels, and health clubs (discharges should be free from pollutants).

For MS4s located in areas listed in Appendix G, Tables G-1, G-2 and G-4, subject to an approved TMDL for either phosphorus or nitrogen, the education program for this audience shall include information on the proper use of fertilizer, alternatives to fertilizers containing nutrients (phosphorus and nitrogen), and the benefits of street/parking lot sweeping for control of nutrients. The education material shall describe methods of recycling lawn clipping and yard waste as fertilizer and mulch, or its proper collection and disposal. The educational materials shall include information encouraging the use of alternative forms of fertilizers containing lower nutrient compositions, or slower releasing or less available forms of nutrients."

"2.4.2.1(c)(iv) Industrial program: equipment inspection to ensure timely maintenance; proper storage of industrial materials (emphasize pollution prevention); proper management and disposal of wastes; proper management of dumpsters; minimization of use of salt or other de-icing/anti-icing materials; proper storage of salt or other de-icing/anti-icing materials (cover/prevent runoff to storm system and ground water contamination); benefits of appropriate on-site infiltration of stormwater runoff from areas with low exposure to industrial materials such as roofs or employee parking; and proper maintenance of parking lot surfaces (sweeping).

For MS4s located in areas listed in Appendix G, Tables G-1, G-2 and G-4, subject to an approved TMDL for either phosphorus or nitrogen, the education program for this audience shall include information on the proper use of fertilizer, alternatives to fertilizers containing nutrients (phosphorus and nitrogen), and the benefits of street/parking lot sweeping for control of nutrients. The education material shall describe methods of recycling lawn clipping and yard waste as fertilizer and mulch, or its proper collection and disposal. The educational materials shall include information encouraging the use of alternative forms of fertilizers containing lower nutrient compositions, or slower releasing or less available forms of nutrients."

"2.4.7.1(a)(1) For MS4s located in the areas listed in Appendix G, Table G-1, G-2 and G-4, subject to an approved TMDL for either phosphorus or nitrogen, the permittee shall evaluate alternatives to traditional fertilizers and incorporate, to the extent practicable, their use on permittee owned spaces. The permittee shall also address public green space care and municipal leaf litter collection and disposal."

Appendix G of the Draft Permit also indicates that the approved TMDL waste load allocation (WLA) for total nitrogen for storm water discharges to this water body is “negligible.”

MassDOT programs included in the Storm Water Management Plan (SWMP) related to nitrogen include:

1. **Vegetation Management Program (BMP 6A-5):** The VMP program establishes the criteria whereby MassDOT controls vegetation along state roads and highways in compliance with the Rights of Way Management Regulations (333 CMR 11.00). Under this regulatory program, MassDOT has prepared both a 5-Year Vegetation Management Plan (VMP) and a Yearly Operational Plan (YOP) for Vegetation Management. The provisions of MassDOT’s VMP are summarized below.

   Integrated Roadside Vegetation Management

   MassDOT's VMP incorporates Integrated Roadside Vegetation Management (IRVM) methods which include roadside development (active planting to encourage appropriate competing vegetation, non-organic barriers), mechanical (mowing, hand cutting, selective trimming), and chemical (low volume foliar herbicide treatments).

   One goal of the VMP is to minimize the use of chemical controls, through minimizing areas of application, quantity of chemicals, and frequency of application. Chemical control techniques shall be limited to use on high traffic volume, high speed interstate and primary roadways in the Commonwealth where safety of motorists, MassDOT employees, and contractors precludes the use of mechanical methods. Using IRVM methods, MassDOT will employ only two types of herbicide application: Foliar treatment and cut stump surface treatment.

   - *Foliar Treatments* involve the selective application of approved herbicides and adjuvants diluted in water, to the foliage and stems of the target vegetation. The foliar treatment used shall be low pressure, below 60 psi at the nozzle, with a normal working pressure of 40 psi for application at volumes of less than 50 gallons/acre.
   - *Cut Stump Surface Treatment* is the application of an herbicide to the cut surface of a stump immediately following or during a cutting operation, to prevent re-sprouting.

   Identifying and Protecting Sensitive Areas

   Sensitive areas are defined as areas within rights-of-way in which public health, environmental or agricultural concerns warrant special protection to further minimize risks of unreasonable adverse effects (of herbicides) and include public groundwater supplies, public surface water supplies, private drinking water supplies, surface waters, wetlands, rivers, inhabited areas and agricultural areas.

   All herbicides used by MassDOT have been researched, tested and approved by the Department of Food & Agriculture for use in Sensitive Areas. The MassDOT VMP provides descriptions and procedures for how Sensitive Areas will be identified for required protection, summarizes the restrictions and no-spray zones associated with application of herbicides within the right of way, and describes how no-spray zones will be identified and flagged.

   In addition, MassDOT prepares its Yearly Operational Plan which includes the provisions of the VMP and proposed spray locations by route and municipality. A copy

of the YOP are sent to the Conservation Commission, Board of Health (or designated health agent), and to the head of government (Mayor, City Manager, Chair of the Board of Selectmen) of each municipality where herbicides are to be applied along the rights of way during the calendar year.

Source Control and Operational Guidelines for Herbicide Applicators

The MassDOT VMP provides operational guidelines for applicators to properly manage herbicides. Source Control measures provided in the VMP include:

- Mixing and loading of herbicides at the maintenance facility in limited amounts of herbicide necessary to carry out only that day's work.
- Spray vehicles will be equipped with a clipboard log of the herbicides on board, a bag of adsorbent, activated charcoal, plastic bats, a broom and a shovel in case of a minor spill.
- Applicators to roadside rights of way must hold a valid pesticide certification from the Department of Food and Agriculture.
- Herbicide application will be restricted during certain adverse weather conditions, such as rain or wind.
- Low-pressure foliar application equipment will be calibrated to maintain pressure not exceeding 60 pounds per square inch at the nozzle.
- Monitoring will include project record keeping to maintain timely information on the nature, timing, and location of actions taken, including project location, weather conditions, miles completed, amount of material used, worker and equipment hours devoted to the project, and persons responsible for activity and follow-up evaluation.
- Chemically treated areas shall be monitored after the necessary translocation period of the herbicide to determine the effectiveness of the applications and to monitor any off target injury and migration of the spray solution.
- MassDOT will conduct training for District staff in methods of vegetation management, employee safety and record keeping.
- The VMP includes a Remedial Plan to address potential spills and related accidents.

Alternatives to Chemical Herbicide Study

MassDOT, in collaboration with the Federal Highway Administration, funds a research project at the University of Massachusetts to seek alternatives to chemical herbicides for roadside weed control. With the assistance of the UMass Department of Soil Sciences, MassDOT is experimenting and testing alternative research, chemicals, and non-conventional control methods.

MassDOT is committed to actively pursue testing and evaluation of alternative methods of vegetation control. Other methods for investigation of management of roadside vegetation under guardrails include hand mowing, steaming, flaming, mulching with organic materials, and mulching with sheeting made from recycled products such as tires or plastic bottles. MassDOT continues to monitor the progress, provide updated information, notification, and assist the University of Massachusetts with the study. MassDOT will constantly monitor and evaluate the success of the vegetation management program and integrate appropriate new methods into the VMP and Yearly

Operational Plans (YOP). YOPs are prepared by April of each year and posted on MassDOT's website within 30 days.

2. **BMP 1A: MassDOT Training Assistance Program (MTAP) and BMP 1B: Baystate Roads Program**: MassDOT provides significant training of highway personnel and municipal employees through BMP 1A: MassDOT Training Assistance Program (MTAP) and BMP 1B: Baystate Roads Program which focus on subjects such as stormwater BMPs and the use of the MassDOT Stormwater Handbook to identify the appropriate BMPs for a site, including those that will reduce nitrogen loading.

3. **MassDOT's 511 Traveler Information System (BMP 6A-1)**: The 511 program provides signage within the highway right-of-way that support litter law enforcement and encourages roadway users to notify MassDOT of litter and debris along the roadway. When calls are received, MassDOT crews are dispatched to clean up the litter or take other necessary actions.

Public education and outreach related to residential, commercials and industrial programs related to lawn care and fertilizer use is not applicable to MassDOT.

MassDOT has reviewed the measures it conducts under is Storm Water Management Program and has concluded that they are consistent with the intent of the applicable BMP requirements of the draft permit.

In combination, the TMDL's conclusion that storm water loading of TN is negligible and the consistency of MassDOT's SWMP with the Draft IMS permit's requirements indicate that no further measures are necessary at this location for compliance with the TMDL WLA.

Applicable Recommendations for Nitrogen Reduction

However, MassDOT has conducted a site visit to this location and identified a number of potential locations for installing BMPs. These opportunities are described in the following section. Although installation of these BMPs is not required, MassDOT will consider implementing them in the future as part of programmed projects or potentially as retrofits.

Assessment and Mitigation Plan

A site visit on May 23rd, 2011 indicated that there are no existing BMPs in place to treat MassDOT runoff before it discharges to Frost Fish Creek and the right-of-way (ROW) owned by MassDOT is extremely limited in this area with less than ten feet on either side and residential homes and wetlands adjacent to the right-of-way. These space constraints limit the options for installation of BMPs that provide nitrogen removal. Nitrogen removal is dependent upon vegetative uptake or infiltration and requires BMPs such as bioretention and retention basins or infiltration measures. There is limited space, and therefore the only feasible BMP alternative for retrofit is installing leaching catch basins on Route 28 south of Frost Fish Creek.

Infiltration BMPs rely upon the infiltration ability of underlying soils for proper function. Additionally, by adding infiltration BMPs, MassDOT would limit the volume of direct discharge to Frost Fish Creek. MassDOT performed a desktop analysis of soils within the areas where it recommends infiltration BMPs to determine soil type and associated Hydrologic Soil Group (HSG) using the United States Department of Agriculture's Natural Resources Conservation Service (NRCS) SSURGO-Certified soils data, obtained from MassGIS. MassDOT assigned infiltration rates to each HSG as shown in Table 1 below.

Table 1. Infiltration Rates Assigned to NRCS Hydrologic Soil Groups

NRCS Hydrologic Soil Group (HSG)	Infiltration Rate (inches/hour)
A	2.41
B	0.52
C	0.17
D	N/A

The NRCS soils data shows that in the areas where infiltration BMPs are recommended, soils consist entirely of HSG A. The corresponding infiltration rates for this HSG are relatively high and thus suitable for the installation of infiltration BMPs. MassDOT will conduct site-specific soil testing before designing and installing infiltration BMPs.

The following sections describe the potential BMPs in further detail. Refer to Figure 1 for exact location of storm water outfalls and potential BMPs.

Leaching Catch Basins

Leaching catch basins would allow infiltration of stormwater runoff. MassDOT will consider installing six leaching catch basins within the directly contributing area. Currently, MassDOT contributes 0.5 acres of stormwater runoff to Frost Fish Creek. The six leaching catch basins within the directly contributing area would collect and infiltrate approximately 0.4 acres of runoff. The location and drainage area received of the leaching catch basins is approximate and further analysis should be taken during design of these BMPs.

During future programmed project work for this section of roadway, MassDOT would review the possibility of installing additional BMPs if additional right-of-way could be obtained. The TMDL also indicates that modifications to the culvert and weir structures under Route 28 would allow increased tidal flushing of the upstream portion of Frost Fish Creek, which would help reduce the nitrogen load. The possibility of including such changes could be explored as part of the programmed projects although there may be difficult permitting issues with this recommendation and the hydraulic impact would need to be explored.

Conclusions

Frost Fish Creek is subject to two TMDLs: TMDL for Total Nitrogen for the Pleasant Bay System and Final Pathogen TMDL for the Cape Cod Watershed. As stated in the Bacteria TMDL for Frost Fish Creek, the most likely sources of fecal coliform bacteria are waterfowl and other wildlife throughout the upper basin and stormwater runoff from roads and paved surfaces near the tidal inlet at Rt. 28. Review of EPA's draft Small MS4 General Permit for Interstate, Merrimack and South Coastal Watersheds indicates that if MassDOT's SWMP is consistent with certain pathogen related requirements of the permit (as defined in Appendix G) then no further measures are necessary for compliance with the pathogen TMDL. Similarly, the nitrogen TMDL for the Pleasant Bay System, which includes Frost Fish Creek, indicates that that storm water loading of TN is negligible and the IMS Small MS4 General Permit again indicates that if MassDOT's SWMP is consistent with the Draft IMS permit's requirements no further measures are necessary at this location for compliance with the TMDL WLA. MassDOT has reviewed the measures it conducts under is Storm Water Management Program and has concluded that they are consistent with the intent of the applicable BMP requirements of the draft permit for both the pathogen and the total nitrogen TMDL. Therefore, no further measures are necessary or proposed at this time.

However, MassDOT has conducted a site visit to this location and identified a number of potential locations for installing BMPs; including six leaching catchbasins. Although installation of these BMPs is not required, MassDOT will consider implementing them in the future as part of programmed projects or potentially as retrofits.

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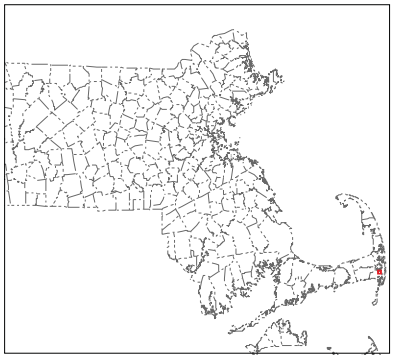

MA96-49

MA96-49

MassDOT Directly Contributing Watersheds

Stormwater Outfalls

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

Proposed BMPs

200 100 0 200 Feet

N

Figure 1
Frost Fish Creek
MA96-49

June 2011

Moving Massachusetts Forward. massDOT

Impaired Waters Assessment for Muddy Creek (MA 96-51)

Impaired Water Body

Name: Muddy Creek

Water Body ID: MA 96-51

Impairments

Muddy Creek (MA96-51) is impaired for Nutrients and Pathogens according to both the Final Year 2008 and the Proposed Year 2010 List of Integrated Waters. Muddy Creek is also listed in both documents as a Category 4a water body and is covered by a Total Maximum Daily Load (TMDL) for Total Nitrogen and a TMDL for Bacteria.

Relevant Water Quality Standards

Muddy Creek has been classified by the Massachusetts Surface Water Quality Standards as a Class SA water. Water quality standards of particular interest to the issues of cultural eutrophication are aesthetics, bacteria, dissolved oxygen, and nutrients. The Massachusetts water quality standards (314 CMR 4.0) contain numeric criteria for dissolved oxygen, but have only narrative standards that relate to the other variables, as described below:

- 314 CMR 4.05(5)(a) “Aesthetics. All surface waters shall be free from pollutants in concentrations 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.”
- 301 CMR 4.05 (4)(a) 4 “Bacteria.
    a) Waters designated for shellfishing: fecal coliform shall not exceed a geometric mean Most Probable Number (MPN) of 14 organisms per 100 ml, nor shall more than 10% of the samples exceed an MPN of 28 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 a geometric mean of 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 samples taken within 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.”

- 314 CMR 4.05 (4)(a) 1 “Dissolved Oxygen. Shall not be less than 6.0 mg/l. Where natural background conditions are lower, DO shall not be less than natural background. 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.”

Site Description

Muddy Creek flows approximately 1.5 miles from Queen Anne Road in Chatham to the mouth of Pleasant Bay in the towns of Chatham and Harwich, Massachusetts and has a surface area of approximately 32 acres. The creek acts as an estuarine tributary to Pleasant Bay and flows under Route 28 via two culverts. The two culverts are approximately 2.6-ft high and 3.7-ft wide. The creek has been classified as a class SA water as it is supportive of soft shell clams, but it is only open to harvesting between December and May. The creek is separated into Upper Muddy Creek and Lower Muddy Creek by a dike approximately ½ mile upstream of the Route 28 culverts. This dike previously had a weir, but the weir has since washed away or been removed.

According to both the Final Year 2008 and Proposed Year 2010 List of Integrated Waters, Muddy Creek is impaired for Nutrients and Pathogens and falls under the TMDL for pathogens titled, “Bacteria TMDL For Muddy Creek” [04/28/2005-CN207.0] and the TMDL for nitrogen titled, “Pleasant Bay System Total Maximum Daily Loads For Total Nitrogen” [10/24/2007-CN244.0]. The pathogen TMDL states that the total contributing watershed is approximately 2145 acres and the creek contributes significant fresh water through surface and groundwater. These sub-watersheds were delineated by the United States Geological Survey for the Massachusetts Estuaries Project based upon MODFLOW/MODPATH and utilize the most current physical information and modeling.

MassDOT owns Route 28 which bisects Muddy Creek. Route 28 is a two lane roadway with impervious width of approximately 20-feet. MassDOT property also includes ROW of approximately 10-feet on either side of the roadway. The edges of pavement are not curbed and stormwater runoff sheds to the sides of the road and much of it infiltrates. Approximately 0.5 acres of impervious MassDOT property discharges to Muddy Creek. This watershed is shown in Figure 1.

Precipitation that falls on the pervious MassDOT right of way near Muddy Creek infiltrates and flows to the Creek through groundwater. As stated in the Pleasant Bay System TMDL for Total Nitrogen, it is unlikely that runoff would be channeled as a point source from areas more than 200-ft away. Additionally, the total pathogen TMDL for Cape Cod titled, “Final Pathogen TMDL for the Cape Cod Watershed” [08/28/2009-CN252.0] states that rates of natural surface runoff on Cape Cod are generally very low to zero due to soils characteristics. During the development of the WLA for pathogens it was assumed that no runoff occurs from the pervious areas. Due to the soils and geology of Cape Cod this assessment assumed that runoff on pervious surfaces percolates into the ground. This was further verified during the site visit on May 23rd, 2011.

Assessment under BMP 7R for Pathogens

The final pathogen TMDL for Muddy Creek states that levels of bacteria have been shown to be higher near Route 28 and that investigations should be undertaken in this area to look into runoff from Route 28. However, two DMF reports, a sanitary survey conducted in 1995 and a Triennial Report completed in 2001, showed that stormwater runoff samples collected at the site did not indicate elevated levels of fecal coliform contamination (Mass DEP, 2005). The TMDL also states that waterfowl are probably a significant source of bacterial contamination. Other sources include pet waste, on site (septic) systems and stormwater discharges from the municipal stormwater system according to the Water Quality Assessment Report (Mass DEP, 2011).

Section VI of the pathogen TMDL for Muddy Creek describes possible circulation and nitrogen attenuation in Muddy Creek as a result of culvert and weir modifications. Hydrodynamic and water quality modeling was completed for Muddy Creek as part of the Massachusetts Estuaries Project in 2003. One alternative of the modeling involving dike restoration and stormwater and culvert controls at Route 28 showed that nitrogen and pathogen levels could be lowered in the lower basin by increasing tidal flushing in the lower portion and increasing attenuation in the upper portion. However, these controls would drastically change the ecosystems in the upper portion and if circulation in Muddy Creek is improperly handled it can lead to an even greater problem with increased water column nitrogen concentrations. The TMDL states that these are just possible alternatives and are not recommendations by the Mass DEP or the MEP (Mass DEP, 2005).

Pathogen[1] concentrations in storm water vary widely temporally and spatially; concentrations can vary by an orders of magnitude within a given storm event (Mass DEP, 2009). Therefore, it is difficult to predict storm water pathogen concentrations with accuracy. Due to this difficulty, MassDOT is not conducting site specific assessments of loading at each location impaired for pathogens as part of this Retrofit Program. Instead these sites will be assessed collectively based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA. MassDOT believes this approach is consistent with an iterative adaptive management approach to storm water and is consistent with pathogen TMDLs for waters within Massachusetts.

To look for guidance on how to address the pathogen sources from storm water discharges, MassDOT referred to the measures specified in EPA's Draft Massachusetts Interstate, Merrimack and South Coastal (IMS) Small MS4 General Permit (IMS Small MS4 General Permit). Although this permit is in draft form it provides the best available guidance on EPA's expectations from permittees to achieve compliance with the Pathogen TMDL.

Assessment and Mitigation Plan

The existing NPDES MS4 permit that covers MassDOT stormwater discharges does not provide guidance on what measures are necessary to comply with the Bacteria Total Maximum Daily Load for Muddy Creek. However, the draft permit for MS4 stormwater discharges that covers this area (the IMS Small MS4 General Permit) does contains guidance on what measures EPA has determined are necessary to be consistent with this and other TMDLs that are applicable to storm water discharges. Although this permit is still in draft form, it provides the best available guidance on what measures to implement to achieve consistency with the TMDL.

[1] The term "pathogens" is used in this write up to refer to impairments in the 303(d) list including pathogens, e. coli, enterococcus, and other terms describing impairments related to bacteria.

Section 2.2.1 of the draft IMS Small MS4 General permit states:

> "b. Appendix G of the permit identifies areas for which there are approved TMDLs applicable to small MS4s. It also identifies, by section, the provisions in this permit that contain TMDL-based requirements that the permittee shall implement to be consistent with the approved TMDL. In addition to those specific requirements, EPA may notify the permittee of the need to comply with additional requirements to satisfy the requirements of the waste load allocation (WLA). If EPA determines more stringent requirements are necessary to satisfy the requirements of the WLA, EPA will impose such requirements through a modification to this permit pursuant to 40 CFR §122.62 or by their inclusion into this permit upon reissuance. Alternatively, EPA may notify the permittee that an individual permit application is necessary in accordance with Part 1.8."
>
> "c. For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Paragraph 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. Permittees may be subject to requirements of more than one TMDL."

Appendix G of the IMS Small MS4 General Permit indicates that stormwater discharges to Muddy Creek are required to implement the following measures:

- Part 2.4.2.1.1(c)(i) Public Outreach and Education: "Residential program: maintenance of septic systems; effects of outdoor activities such as lawn care (use of pesticides, herbicides, and fertilizers) on water quality; benefits of appropriate onsite infiltration of stormwater; effects of automotive work and car washing on water quality; proper disposal of swimming pool water; and proper management of pet waste. ….
    - o …For MS4s located in areas listed in Appendix G, Tables G-3 and Table G-4, subject to an approved TMDL for bacteria or pathogens, the permittee shall disseminate educational materials to dog owners at the time of issuance or renewal of a dog license, or other appropriate time. Education materials shall describe the detrimental impacts of improper management of pet waste, requirements for waste collection and disposal, and penalties for non-compliance. The permittee shall address proper maintenance of septic systems."
- Part 2.4.4: Illicit Discharge Detection and Elimination Program
- Part 2.4.7.1(a)(ii): "For MS4s located in the areas listed in Appendix G, Table G-3 and Table G-4, subject to an approved TMDL for either bacteria or pathogens, within 1 year of the effective date of this permit, the permittee shall undertake the following:
    - o Identify locations within its community where inappropriate pet waste management practices are immediately apparent and pose a threat to receiving water quality due to proximity and potential for direct conveyance of waste to its MS4. Within 2 years of the effective date of this permit, the permittee shall implement targeted management efforts in the identified areas. In neighborhood areas, management efforts shall include additional public education (e.g., door hangers) and enforcement (e.g., increased patrol for violators). In municipally-owned recreational areas where dog walking is allowed, the permittee shall install educational signage, pet waste baggies, and disposal receptacles (or require carry-out).
    - o In order to measure the effectiveness of its pet waste management practices, the permittee shall document in its annual reports information regarding the scope and extent of its education, compliance, and enforcement efforts (including the number of violations pursued and fines levied).
    - o Identify public lands where waterfowl congregate and feeding by the public occurs. Within 2 years of the effective date of this permit, the permittee shall begin

dissemination of educational materials to users of identified areas that pose a significant threat to receiving water quality due to proximity and potential for direct conveyance of waste to its MS4. The permittee shall accomplish this through the installation of signage or use other targeted techniques to educate the public about the detrimental impacts of feeding waterfowl (including the resulting feces deposition) and discourage such feeding practices. Within 3 years of the effective date of this permit, the permittee shall also implement practices that discourage the undesirable congregation of waterfowl in these areas, or otherwise isolate the direct drainage from these areas away from its MS4.

MassDOT has assessed its existing Storm Water Management Program (SWMP) for consistency with these requirements. They are discussed in detail below:

Public Outreach and Education: MassDOT public education programs related to pathogens include:

- MassDOT provides significant training of highway personnel and municipal employees through BMP 1A: MassHighway Training Assistance Program (MTAP) and BMP 1B: Baystate Roads Program which focus on subjects such as stormwater BMPs and the use of the MassDOT Stormwater Handbook to identify the appropriate (including infiltration) BMP for a site.
- MassDOT provides Environmental Awareness Training annual for maintenance facility personnel regarding good housekeeping and spill prevention (BMP 6B-2).
- MassDOT maintenance and material storage yards have strict compliance programs for hazardous waste, wetlands, hazardous materials, underground storage tanks, water quality, sold waste and asbestos controls. These are described in each facility's Environmental Handbook and tracked in the Environmental Management System. (BMP 6C-2)
- The MassDOT 511 Traveler Information System provides signage within the highway right-of-way that support litter law enforcement and encourages roadway users to notify MassDOT of litter and debris along the roadway. When calls are received, MassDOT crews are dispatched to clean up the litter or take other necessary actions. (BMP 6A-1)

Finally, many MassDOT rest areas include dog walking areas where appropriate signage and trash receptacles let pet owners know that they must properly dispose of pet waste. Public education and outreach related to residential programs related to lawn care and septic system upkeep is not applicable to MassDOT. While this pet waste program is not specifically discussed in MassDOT's SWMP, the program is in place and will be added to future SWMP revisions.

Illicit Discharge Detection and Elimination: As described in BMP 3D (Illicit Connection Review Program), MassDOT has implemented a robust IDDE program that commits to reviewing ten percent of roads covered under the MS4 permit each year and the program has focused on waterbodies that are pathogen impaired. MassDOT is committed to conducting illicit discharge detection on urban outfalls to the receiving water under assessment by the end of fall of 2011. Any detected illicit connections will be removed as soon as practicable. Due to the nature of MassDOT roads, linear with limited right of way, minimal illicit connections have been identified and identification through MassDOT employees during construction projects and maintenance work has been a more efficient method of identification.

Pet Waste Management: Many MassDOT rest areas include dog walking areas where appropriate signage and trash receptacles let pet owners know that they must properly dispose of pet waste. MassDOT does not own other facilities that encourage dog walking and there are no rest areas within this stretch of Route 28.

Waterfowl: Since MassDOT owns and operates roadway systems versus parks where waterfowl congregate, the waterfowl requirements do not appear to be applicable. Much of the highway runoff infiltrates into the ground which removes a significant amount of the bacteria load associated with the waterfowl from the surface runoff.

In combination, MassDOT believes that the measures outlined above are consistent with the applicable requirements and intent of the draft permit. Therefore, no further measures are proposed for compliance with the pathogen TMDL.

Assessment under BMP 7R for Total Nitrogen

As stated in the Pleasant Bay System TMDL for Total Nitrogen, most of the nitrogen affecting the Pleasant Bay Embayment system originates from the sediments with on-site subsurface wastewater disposal systems (septic systems) and atmospheric deposition providing the next largest sources. Considerably less nitrogen originates from fertilizers, runoff and natural background sources.

The TMDL for Total Nitrogen for the Pleasant Bay System addresses the impairment for Nutrients for Muddy Creek. Therefore, MassDOT assessed the contribution of nitrogen from MassDOT urban areas to this water body to address the impairment. 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 "Pleasant Bay System Total Maximum Daily Loads For Total Nitrogen" states that loading of nitrogen from stormwater from impervious areas is "…obviously negligible when compared to other sources." Based on this conclusion, it is clear that discharge from the 0.5 acres of MassDOT urban roadway that drains to Muddy Creek is de minimus and therefore no further measures are necessary.

This conclusion is confirmed by the requirements in EPA's draft permit for stormwater discharges from MS4s that covers this area (the IMS Small MS4 General Permit). This permit contains draft requirements for implementing BMPs to be consistent with applicable TMDLs. The requirements in this permit for consistency with the Pleasant Bay System TMDL are below:

> "2.2.1(g) Appendix G, Table G-4, lists the names of municipalities that have small MS4s located in the Cape Cod Watershed and Buzzards Bay Watershed that are subject to approved TMDLs for nitrogen and in some instances, pathogens.
>
> > i. Within two (2) years of the effective date of the permit, the permittee shall identify the sources of nitrogen which discharge to the waters listed in Appendix G, Table G-4 as having impairments due to nitrogen.
> >
> > ii. The permittee shall implement practices such that the total existing levels of nitrogen are maintained or decreased to the waters listed in Appendix G, Table G-4 as having impairments due to nitrogen."
>
> "2.4.2.1(c)(i) Public Outreach and Education "Residential program: maintenance of septic systems; effects of outdoor activities such as lawn care (use of pesticides, herbicides, and fertilizers) on water quality; benefits of appropriate onsite infiltration of stormwater; effects of automotive work and car washing on water quality; proper disposal of swimming pool water; and proper management of pet waste. If the small MS4 has greater than 50 percent of its

residents serviced by septic systems or is subject to an approved TMDL for nitrogen, the municipality shall include maintenance of septic systems as part of its education program.

For MS4s located in areas listed in Appendix G, Tables G-1, G-2 and G-4 subject to an approved TMDL for either phosphorus or nitrogen, the residential education program must address the proper use of fertilizer, alternatives to traditional fertilizers containing nutrients (phosphorus and nitrogen), and septic system maintenance. The education material shall describe methods of recycling lawn clipping and yard waste as fertilizer and mulch, or its proper collection and disposal. The educational materials shall include information encouraging the use of alternative forms of fertilizers containing lower nutrient concentrations, or slower releasing or less available forms of nutrients.

For MS4s located in areas listed in Appendix G, Table G-1, the permittee shall provide information on alternatives to detergents containing phosphates."

"2.4.2.1(c)(ii) Public Outreach and Education "Business/Commercial/Institution program: proper lawn maintenance (use of pesticides, herbicides and fertilizer); benefits of appropriate on-site infiltration of stormwater; building maintenance (use of detergents); use of salt or other de-icing and anti-icing materials (minimize their use); proper storage of salt or other de-icing/anti-icing materials (cover/prevent runoff to pollution prevention); proper management of waste materials and dumpsters (cover and pollution prevention); proper management of parking lot surfaces (sweeping); proper car care activities (washing of vehicles and maintenance); and proper disposal of swimming pool water (except dechlorinated swimming pool water) by entities such as motels, hotels, and health clubs (discharges should be free from pollutants).

For MS4s located in areas listed in Appendix G, Tables G-1, G-2 and G-4, subject to an approved TMDL for either phosphorus or nitrogen, the education program for this audience shall include information on the proper use of fertilizer, alternatives to fertilizers containing nutrients (phosphorus and nitrogen), and the benefits of street/parking lot sweeping for control of nutrients. The education material shall describe methods of recycling lawn clipping and yard waste as fertilizer and mulch, or its proper collection and disposal. The educational materials shall include information encouraging the use of alternative forms of fertilizers containing lower nutrient compositions, or slower releasing or less available forms of nutrients."

"2.4.2.1(c)(iv) Industrial program: equipment inspection to ensure timely maintenance; proper storage of industrial materials (emphasize pollution prevention); proper management and disposal of wastes; proper management of dumpsters; minimization of use of salt or other de-icing/anti-icing materials; proper storage of salt or other de-icing/anti-icing materials (cover/prevent runoff to storm system and ground water contamination); benefits of appropriate on-site infiltration of stormwater runoff from areas with low exposure to industrial materials such as roofs or employee parking; and proper maintenance of parking lot surfaces (sweeping).

For MS4s located in areas listed in Appendix G, Tables G-1, G-2 and G-4, subject to an approved TMDL for either phosphorus or nitrogen, the education program for this audience shall include information on the proper use of fertilizer, alternatives to fertilizers containing nutrients (phosphorus and nitrogen), and the benefits of street/parking lot sweeping for control of nutrients. The education material shall describe methods of recycling lawn clipping and yard waste as fertilizer and mulch, or its proper collection and disposal. The educational materials shall include information encouraging the use of alternative forms of fertilizers containing lower nutrient compositions, or slower releasing or less available forms of nutrients."

"2.4.7.1(a)(1) For MS4s located in the areas listed in Appendix G, Table G-1, G-2 and G-4, subject to an approved TMDL for either phosphorus or nitrogen, the permittee shall evaluate alternatives to traditional fertilizers and incorporate, to the extent practicable, their use on permittee owned spaces. The permittee shall also address public green space care and municipal leaf litter collection and disposal."

Appendix G of the Draft Permit also indicates that the approved TMDL waste load allocation (WLA) for total nitrogen for storm water discharges to this water body is "negligible."

MassDOT programs included in the Storm Water Management Plan (SWMP) related to nitrogen include:

1. **Vegetation Management Program (BMP 6A-5):** The VMP program establishes the criteria whereby MassDOT controls vegetation along state roads and highways in compliance with the Rights of Way Management Regulations (333 CMR 11.00). Under this regulatory program, MassDOT has prepared both a 5-Year Vegetation Management Plan (VMP) and a Yearly Operational Plan (YOP) for Vegetation Management. The provisions of MassDOT's VMP are summarized below.

   Integrated Roadside Vegetation Management

   MassDOT's VMP incorporates Integrated Roadside Vegetation Management (IRVM) methods which include roadside development (active planting to encourage appropriate competing vegetation, non-organic barriers), mechanical (mowing, hand cutting, selective trimming), and chemical (low volume foliar herbicide treatments).

   One goal of the VMP is to minimize the use of chemical controls, through minimizing areas of application, quantity of chemicals, and frequency of application. Chemical control techniques shall be limited to use on high traffic volume, high speed interstate and primary roadways in the Commonwealth where safety of motorists, MassDOT employees, and contractors precludes the use of mechanical methods. Using IRVM methods, MassDOT will employ only two types of herbicide application: Foliar treatment and cut stump surface treatment.

   - *Foliar Treatments* involve the selective application of approved herbicides and adjuvants diluted in water, to the foliage and stems of the target vegetation. The foliar treatment used shall be low pressure, below 60 psi at the nozzle, with a normal working pressure of 40 psi for application at volumes of less than 50 gallons/acre.
   - *Cut Stump Surface Treatment* is the application of an herbicide to the cut surface of a stump immediately following or during a cutting operation, to prevent re-sprouting.

   Identifying and Protecting Sensitive Areas

   Sensitive areas are defined as areas within rights-of-way in which public health, environmental or agricultural concerns warrant special protection to further minimize risks of unreasonable adverse effects (of herbicides) and include public groundwater supplies, public surface water supplies, private drinking water supplies, surface waters, wetlands, rivers, inhabited areas and agricultural areas.

   All herbicides used by MassDOT have been researched, tested and approved by the Department of Food & Agriculture for use in Sensitive Areas. The MassDOT VMP provides descriptions and procedures for how Sensitive Areas will be identified for

required protection, summarizes the restrictions and no-spray zones associated with application of herbicides within the right of way, and describes how no-spray zones will be identified and flagged.

In addition, MassDOT prepares its Yearly Operational Plan which includes the provisions of the VMP and proposed spray locations by route and municipality. A copy of the YOP are sent to the Conservation Commission, Board of Health (or designated health agent), and to the head of government (Mayor, City Manager, Chair of the Board of Selectmen) of each municipality where herbicides are to be applied along the rights of way during the calendar year.

Source Control and Operational Guidelines for Herbicide Applicators

The MassDOT VMP provides operational guidelines for applicators to properly manage herbicides. Source Control measures provided in the VMP include:

- Mixing and loading of herbicides at the maintenance facility in limited amounts of herbicide necessary to carry out only that day's work.
- Spray vehicles will be equipped with a clipboard log of the herbicides on board, a bag of adsorbent, activated charcoal, plastic bats, a broom and a shovel in case of a minor spill.
- Applicators to roadside rights of way must hold a valid pesticide certification from the Department of Food and Agriculture.
- Herbicide application will be restricted during certain adverse weather conditions, such as rain or wind.
- Low-pressure foliar application equipment will be calibrated to maintain pressure not exceeding 60 pounds per square inch at the nozzle.
- Monitoring will include project record keeping to maintain timely information on the nature, timing, and location of actions taken, including project location, weather conditions, miles completed, amount of material used, worker and equipment hours devoted to the project, and persons responsible for activity and follow-up evaluation.
- Chemically treated areas shall be monitored after the necessary translocation period of the herbicide to determine the effectiveness of the applications and to monitor any off target injury and migration of the spray solution.
- MassDOT will conduct training for District staff in methods of vegetation management, employee safety and record keeping.
- The VMP includes a Remedial Plan to address potential spills and related accidents.

Alternatives to Chemical Herbicide Study

MassDOT, in collaboration with the Federal Highway Administration, funds a research project at the University of Massachusetts to seek alternatives to chemical herbicides for roadside weed control. With the assistance of the UMass Department of Soil Sciences, MassDOT is experimenting and testing alternative research, chemicals, and non-conventional control methods.

MassDOT is committed to actively pursue testing and evaluation of alternative methods of vegetation control. Other methods for investigation of management of roadside vegetation under guardrails include hand mowing, steaming, flaming, mulching with organic materials, and mulching with sheeting made from recycled products such as

tires or plastic bottles. MassDOT continues to monitor the progress, provide updated information, notification, and assist the University of Massachusetts with the study. MassDOT will constantly monitor and evaluate the success of the vegetation management program and integrate appropriate new methods into the VMP and Yearly Operational Plans (YOP). YOPs are prepared by April of each year and posted on MassDOT's website within 30 days.

2. **BMP 1A: MassDOT Training Assistance Program (MTAP) and BMP 1B: Baystate Roads Program**: MassDOT provides significant training of highway personnel and municipal employees through BMP 1A: MassDOT Training Assistance Program (MTAP) and BMP 1B: Baystate Roads Program which focus on subjects such as stormwater BMPs and the use of the MassDOT Stormwater Handbook to identify the appropriate BMPs for a site, including those that will reduce nitrogen loading.

3. **MassDOT's 511 Traveler Information System (BMP 6A-1)**: The 511 program provides signage within the highway right-of-way that support litter law enforcement and encourages roadway users to notify MassDOT of litter and debris along the roadway. When calls are received, MassDOT crews are dispatched to clean up the litter or take other necessary actions.

Public education and outreach related to residential, commercials and industrial programs related to lawn care and fertilizer use is not applicable to MassDOT.

MassDOT has reviewed the measures it conducts under is Storm Water Management Program and has concluded that they are consistent with the intent of the applicable BMP requirements of the draft permit.

In combination, the TMDL's conclusion that storm water loading of TN is negligible and the consistency of MassDOT's SWMP with the Draft IMS permit's requirements indicate that no further measures are necessary at this location for compliance with the TMDL WLA.

Applicable Recommendations for Nitrogen Reduction

However, MassDOT has conducted a site visit to this location and identified a number of potential locations for installing BMPs. These opportunities are described in the following section. Although installation of these BMPs is not required, MassDOT will consider implementing them in the future as part of programmed projects or potentially as retrofits.

Assessment and Mitigation Plan

A site visit on May 23rd, 2011 indicated that there are no existing BMPs in place to treat MassDOT runoff before it discharges to Muddy Creek and the right-of-way (ROW) owned by MassDOT is extremely limited in this area with less than ten feet on either side and residential homes and wetlands adjacent to the right-of-way. These space constraints limit the options for installation of BMPs that provide nitrogen removal. Nitrogen removal is dependent upon vegetative uptake or infiltration and requires BMPs such as bioretention and retention basins or infiltration measures. There is limited space, and therefore, the only feasible BMP alternative for retrofit is installing leaching catch basins on Route 28 near Muddy Creek.

Infiltration BMPs rely upon the infiltration ability of underlying soils for proper function. Additionally, by adding infiltration BMPs, MassDOT would limit the volume of direct discharge to Muddy Creek. MassDOT performed a desktop analysis of soils within the areas where it recommends infiltration BMPs to determine soil type and associated Hydrologic Soil Group (HSG) using the United States Department of Agriculture's Natural Resources Conservation Service (NRCS) SSURGO-Certified

soils data, obtained from MassGIS. MassDOT assigned infiltration rates to each HSG as shown in Table 1 below.

Table 1. Infiltration Rates Assigned to NRCS Hydrologic Soil Groups

NRCS Hydrologic Soil Group (HSG)	Infiltration Rate (inches/hour)
A	2.41
B	0.52
C	0.17
D	N/A

The NRCS soils data shows that in the areas where infiltration BMPs are recommended, soils consist entirely of HSG A. The corresponding infiltration rates for this HSG are relatively high and thus suitable for the installation of infiltration BMPs. MassDOT will conduct site-specific soil testing before designing and installing infiltration BMPs.

The following sections describe the potential BMPs in further detail. Refer to Figure 1 for exact locations of storm water outfalls and potential BMPs.

Leaching Catch Basins

Leaching catch basins would allow infiltration of stormwater runoff. MassDOT will consider installing six leaching catch basins within the directly contributing area. Two of the leaching catch basins north of Muddy Creek might require that the runoff be piped further north to an area more suitable for infiltration. Currently, MassDOT contributes 0.5 acres of stormwater runoff to Muddy Creek. The six leaching catch basins within the directly contributing area would collect and infiltrate approximately all 0.5 acres of runoff. Along the roadway that crosses Muddy Creek it might be necessary to add curbing to direct runoff into the proposed catch basins. The location and drainage area received of the leaching catch basins is approximate and further analysis should be taken during design of these BMPs.

There is a possibility to install a water quality swale along Route 28 south of Muddy Creek, but steep slopes and sandy soils along Route 28 would require stabilization and might make it infeasible to install additional BMPs. Additionally, electric poles would be needed to be relocated.

The TMDL also indicates that modifications to the culvert at Route 28 and the weir upstream of Route 28 are possible scenarios that could increase tidal flushing in the lower portion and increase attenuation in the upper portion. However, these are just possible scenarios and the hydraulic impact would need to be explored with the Massachusetts Estuary Project (MEP). These modifications could prove costly and permitting could be difficult. Additionally, it should be noted that improperly handling the controls could increase nitrogen and pathogen levels within Muddy Creek. The possibility of including such changes could be explored as part of the programmed projects.

During future programmed project work for this section of roadway, MassDOT would review the possibility of installing additional BMPs if additional right-of-way could be obtained and other site constraints were appropriate.

Conclusions

Muddy Creek is subject to two TMDLs: TMDL for Total Nitrogen for the Pleasant Bay System and Final Pathogen TMDL for Muddy Creek. As stated in the Pathogen TMDL for Muddy Creek, the most likely sources of fecal coliform bacteria are waterfowl and stormwater runoff from Route 28 and other roads and paved surfaces abutting or crossing the creek. Review of EPA's draft Small MS4 General Permit for Interstate, Merrimack and South Coastal Watersheds indicates that if MassDOT's Storm Water Management Plan (SWMP) is consistent with certain pathogen related requirements of the permit (as defined in Appendix G) then no further measures are necessary for compliance with the pathogen TMDL. Similarly, the nitrogen TMDL for the Pleasant Bay System, which includes Muddy Creek, indicates that that storm water loading of TN is negligible and the IMS Small MS4 General Permit again indicates that if MassDOT's SWMP is consistent with the Draft IMS permit's requirements no further measures are necessary at this location for compliance with the TMDL WLA. MassDOT has reviewed the measures it conducts under is SWMP and has concluded that they are consistent with the intent of the applicable BMP requirements of the draft permit for both the pathogen and the total nitrogen TMDL. Therefore, no further measures are necessary or proposed at this time.

However, MassDOT has conducted a site visit to this location and identified a number of potential locations for installing BMPs; including six leaching catch basins. Although installation of these BMPs is not required, MassDOT will consider implementing them in the future as part of programmed projects or potentially as retrofits.

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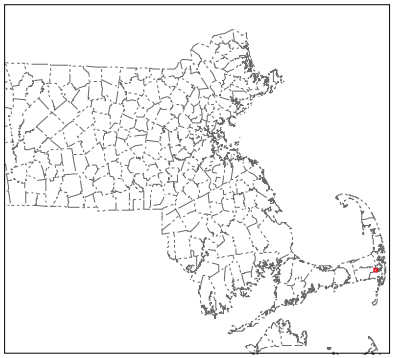

MA96-51

MassDOT Directly Contributing Watersheds

Stormwater Outfalls

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

Proposed BMPs

120 60 0 120 Feet

N

Figure 1
Muddy Creek
MA96-51

June 2011

Moving Massachusetts Forward. massDOT

Impaired Waters Assessment for Ryder Cove (MA 96-50)

Impaired Water Body

Name: Ryder Cove

Water Body ID: MA 96-50

Impairments

Ryder Cove (MA96-50) is impaired for Nutrients and Pathogens according to both the Final Year 2008 and the Proposed Year 2010 List of Integrated Waters. Ryder Cove is also listed in both documents as a Category 4a water body and is covered by a Total Maximum Daily Load (TMDL) for Total Nitrogen and a TMDL for Bacteria.

Relevant Water Quality Standards

Ryder Cove has been classified by the Massachusetts Surface Water Quality Standards as a Class SA water. Water quality standards of particular interest to the issues of cultural eutrophication are aesthetics, bacteria, dissolved oxygen, and nutrients. The Massachusetts water quality standards (314 CMR 4.0) contain numeric criteria for dissolved oxygen, but have only narrative standards that relate to the other variables, as described below:

- 314 CMR 4.05(5)(a) “Aesthetics. All surface waters shall be free from pollutants in concentrations 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.”
- 301 CMR 4.05 (4)(a) 4 “Bacteria.
    a) Waters designated for shellfishing: fecal coliform shall not exceed a geometric mean Most Probable Number (MPN) of 14 organisms per 100 ml, nor shall more than 10% of the samples exceed an MPN of 28 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 a geometric mean of 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 samples taken within 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.”

- 314 CMR 4.05 (4)(a) 1 “Dissolved Oxygen. Shall not be less than 6.0 mg/l. Where natural background conditions are lower, DO shall not be less than natural background. 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.”

Site Description

Ryder Cove is an elongated inland estuary which runs east-west in the northeastern part of Chatham, Massachusetts. The waterbody is approximately 1 mile long and 1/5th mile wide and has a surface area of approximately 109 acres. Ryder Cove extends from Route 28 in its western most part, to Bassing Harbor approximately 1 mile to the east.

According to both the Final Year 2008 and Proposed Year 2010 List of Integrated Waters, Ryder Cove is impaired for Nutrients and Pathogens and falls under the TMDL for pathogens titled, “Final Pathogen TMDL for the Cape Cod Watershed” [08/28/2009-CN252.0] and the TMDL for nitrogen titled, “Pleasant Bay System Total Maximum Daily Loads For Total Nitrogen” [10/24/2007-CN244.0].

MassDOT owns Route 28 which runs adjacent to Ryder Cove to the south. Route 28 is a two lane roadway with impervious width of approximately 21-feet. MassDOT property also includes right-of-way (ROW) of approximately 10-feet on either side of the roadway. The edges of pavement are not curbed and stormwater runoff sheds to the sides of the road and much of it infiltrates. Approximately 1.9 acres of impervious MassDOT property discharges to Ryder Cove. This watershed is shown in Figure 1 and Figure 2.

Precipitation that falls on the pervious MassDOT right of way near Ryder Cove infiltrates and flows to the Creek through groundwater. As stated in the Pleasant Bay System TMDL for Total Nitrogen, it is unlikely that runoff would be channeled as a point source from areas more than 200-ft away. Additionally, the total pathogen TMDL for Cape Cod titled, “Final Pathogen TMDL for the Cape Cod Watershed” [08/28/2009-CN252.0] states that rates of natural surface runoff on Cape Cod are generally very low to zero due to soils characteristics. During the development of the WLA for pathogens it was assumed that no runoff occurs from the pervious areas. Due to the soils and geology of Cape Cod this assessment assumed that runoff on pervious surfaces percolates into the ground. This was further verified during the site visit on May 23, 2011.

Assessment under BMP 7R for Pathogens

The final pathogen TMDL for the Cape Cod watershed states that most potential pollution sources are small and do not have any adverse impact on the resource area according to sanitary surveys. According to the Water Quality Assessment Report a potential source of pathogens is the illicit discharge of sewage from the marina/vessels (MA DEP, 2011) at the town landing and adjacent marina. The total pathogen TMDL states that other than septic issues, bird

populations and summertime boating activities play an "extremely predominant" role in creating the background levels of fecal contamination in coastal- estuarine areas. However, according to the Division of Marine Fisheries, Ryder Cove has excellent water quality conditions overall. Pathogen[1] concentrations in storm water vary widely temporally and spatially; concentrations can vary by an orders of magnitude within a given storm event (Mass DEP, 2009). Therefore, it is difficult to predict storm water pathogen concentrations with accuracy. Due to this difficulty, MassDOT is not conducting site specific assessments of loading at each location impaired for pathogens as part of this Retrofit Program. Instead these sites will be assessed collectively based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA. MassDOT believes this approach is consistent with an iterative adaptive management approach to storm water and is consistent with pathogen TMDLs for waters within Massachusetts.

To look for guidance on how to address the pathogen sources from storm water discharges, MassDOT referred to the measures specified in EPA's Draft Massachusetts Interstate, Merrimack and South Coastal (IMS) Small MS4 General Permit (IMS Small MS4 General Permit). Although this permit is in draft form it provides the best available guidance on EPA's expectations from permittees to achieve compliance with the Pathogen TMDL.

Assessment and Mitigation Plan

The existing NPDES MS4 permit that covers MassDOT stormwater discharges does not provide guidance on what measures are necessary to comply with the Pathogen Total Maximum Daily Load for the Cape Cod Watershed. However, the draft permit for MS4 stormwater discharges that covers this area (the IMS Small MS4 General Permit) does contain guidance on what measures EPA has determined are necessary to be consistent with this and other TMDLs that are applicable to storm water discharges. Although this permit is still in draft form, it provides the best available guidance on what measures to implement to achieve consistency with the TMDL.

Section 2.2.1 of the draft IMS Small MS4 General permit states:

> "b. Appendix G of the permit identifies areas for which there are approved TMDLs applicable to small MS4s. It also identifies, by section, the provisions in this permit that contain TMDL-based requirements that the permittee shall implement to be consistent with the approved TMDL. In addition to those specific requirements, EPA may notify the permittee of the need to comply with additional requirements to satisfy the requirements of the waste load allocation (WLA). If EPA determines more stringent requirements are necessary to satisfy the requirements of the WLA, EPA will impose such requirements through a modification to this permit pursuant to 40 CFR §122.62 or by their inclusion into this permit upon reissuance. Alternatively, EPA may notify the permittee that an individual permit application is necessary in accordance with Part 1.8."
>
> "c. For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Paragraph 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. Permittees may be subject to requirements of more than one TMDL."

Appendix G of the IMS Small MS4 General Permit indicates that stormwater discharges to Ryder Cove are required to implement the following measures:

- Part 2.4.2.1.1(c)(i) Public Outreach and Education: "Residential program: maintenance of septic systems; effects of outdoor activities such as lawn care (use of pesticides, herbicides, and fertilizers) on water quality; benefits of appropriate onsite infiltration of

[1] The term "pathogens" is used in this write up to refer to impairments in the 303(d) list including pathogens, e. coli, enterococcus, and other terms describing impairments related to bacteria.

stormwater; effects of automotive work and car washing on water quality; proper disposal of swimming pool water; and proper management of pet waste. ….

- …For MS4s located in areas listed in Appendix G, Tables G-3 and Table G-4, subject to an approved TMDL for bacteria or pathogens, the permittee shall disseminate educational materials to dog owners at the time of issuance or renewal of a dog license, or other appropriate time. Education materials shall describe the detrimental impacts of improper management of pet waste, requirements for waste collection and disposal, and penalties for non-compliance. The permittee shall address proper maintenance of septic systems."

- Part 2.4.4: Illicit Discharge Detection and Elimination Program
- Part 2.4.7.1(a)(ii): "For MS4s located in the areas listed in Appendix G, Table G-3 and Table G-4, subject to an approved TMDL for either bacteria or pathogens, within 1 year of the effective date of this permit, the permittee shall undertake the following:
  - Identify locations within its community where inappropriate pet waste management practices are immediately apparent and pose a threat to receiving water quality due to proximity and potential for direct conveyance of waste to its MS4. Within 2 years of the effective date of this permit, the permittee shall implement targeted management efforts in the identified areas. In neighborhood areas, management efforts shall include additional public education (e.g., door hangers) and enforcement (e.g., increased patrol for violators). In municipally-owned recreational areas where dog walking is allowed, the permittee shall install educational signage, pet waste baggies, and disposal receptacles (or require carry-out).
  - In order to measure the effectiveness of its pet waste management practices, the permittee shall document in its annual reports information regarding the scope and extent of its education, compliance, and enforcement efforts (including the number of violations pursued and fines levied).
  - Identify public lands where waterfowl congregate and feeding by the public occurs. Within 2 years of the effective date of this permit, the permittee shall begin dissemination of educational materials to users of identified areas that pose a significant threat to receiving water quality due to proximity and potential for direct conveyance of waste to its MS4. The permittee shall accomplish this through the installation of signage or use other targeted techniques to educate the public about the detrimental impacts of feeding waterfowl (including the resulting feces deposition) and discourage such feeding practices. Within 3 years of the effective date of this permit, the permittee shall also implement practices that discourage the undesirable congregation of waterfowl in these areas, or otherwise isolate the direct drainage from these areas away from its MS4.

MassDOT has assessed its existing Storm Water Management Program (SWMP) for consistency with these requirements. They are discussed in detail below:

<u>Public Outreach and Education:</u> MassDOT public education programs related to pathogens include:

- MassDOT provides significant training of highway personnel and municipal employees through BMP 1A: MassHighway Training Assistance Program (MTAP) and BMP 1B: Baystate Roads Program which focus on subjects such as stormwater BMPs and the use of the MassDOT Stormwater Handbook to identify the appropriate (including infiltration) BMP for a site.
- MassDOT provides Environmental Awareness Training annual for maintenance facility personnel regarding good housekeeping and spill prevention (BMP 6B-2).
- MassDOT maintenance and material storage yards have strict compliance programs for hazardous waste, wetlands, hazardous materials, underground storage tanks, water quality, sold waste and asbestos controls. These are described in each

facility's Environmental Handbook and tracked in the Environmental Management System. (BMP 6C-2)

- The MassDOT 511 Traveler Information System provides signage within the highway right-of-way that support litter law enforcement and encourages roadway users to notify MassDOT of litter and debris along the roadway. When calls are received, MassDOT crews are dispatched to clean up the litter or take other necessary actions. (BMP 6A-1)

Finally, many MassDOT rest areas include dog walking areas where appropriate signage and trash receptacles let pet owners know that they must properly dispose of pet waste. Public education and outreach related to residential programs related to lawn care and septic system upkeep is not applicable to MassDOT. While this pet waste program is not specifically discussed in MassDOT's SWMP, the program is in place and will be added to future SWMP revisions.

Illicit Discharge Detection and Elimination: As described in BMP 3D (Illicit Connection Review Program), MassDOT has implemented a robust IDDE program that commits to reviewing ten percent of roads covered under the MS4 permit each year and the program has focused on waterbodies that are pathogen impaired. MassDOT is committed to conducting illicit discharge detection on urban outfalls to the receiving water under assessment by the end of fall of 2011. Any detected illicit connections will be removed as soon as practicable. Due to the nature of MassDOT roads, linear with limited right of way, minimal illicit connections have been identified and identification through MassDOT employees during construction projects and maintenance work has been a more efficient method of identification.

Pet Waste Management: Many MassDOT rest areas include dog walking areas where appropriate signage and trash receptacles let pet owners know that they must properly dispose of pet waste. MassDOT does not own other facilities that encourage dog walking and there are no rest areas within this stretch of Route 28.

Waterfowl: Since MassDOT owns and operates roadway systems versus parks where waterfowl congregate, the waterfowl requirements do not appear to be applicable. Much of the highway runoff infiltrates into the ground which removes a significant amount of the bacteria load associated with the waterfowl from the surface runoff.

In combination, MassDOT believes that the measures outlined above are consistent with the applicable requirements and intent of the draft permit. Therefore, no further measures are proposed for compliance with the pathogen TMDL as part of the Retrofit Imitative.

Assessment under BMP 7R for Total Nitrogen

As stated in the Pleasant Bay System TMDL for Total Nitrogen, most of the nitrogen affecting the Pleasant Bay Embayment system originates from the sediments with on-site subsurface wastewater disposal systems (septic systems) and atmospheric deposition providing the next largest sources. Considerably less nitrogen originates from fertilizers, runoff and natural background sources.

The TMDL for Total Nitrogen for the Pleasant Bay System addresses the impairment for Nutrients for Ryder Cove. Therefore, MassDOT assessed the contribution of Nitrogen from MassDOT urban areas to this water body to address the impairment. 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 "Pleasant Bay System Total Maximum Daily Loads For Total Nitrogen" states that loading of nitrogen from stormwater from impervious areas is "…obviously negligible when compared to other sources." Based on this conclusion, it is clear that discharge from the 1.9 acres of

MassDOT urban roadway that drains to Ryder Cove is de minimus and therefore no further measures are necessary.

This conclusion is confirmed by the requirements in EPA's draft permit for stormwater discharges from MS4s that covers this area (the IMS Small MS4 General Permit). This permit contains draft requirements for implementing BMPs to be consistent with applicable TMDLs. The requirements in this permit for consistency with the Pleasant Bay System TMDL are below:

"2.2.1(g) Appendix G, Table G-4, lists the names of municipalities that have small MS4s located in the Cape Cod Watershed and Buzzards Bay Watershed that are subject to an approved TMDLs for nitrogen and in some instances, pathogens.

i. Within two (2) years of the effective date of the permit, the permittee shall identify the sources of nitrogen which discharge to the waters listed in Appendix G, Table G-4 as having impairments due to nitrogen.

ii. The permittee shall implement practices such that the total existing levels of nitrogen are maintained or decreased to the waters listed in Appendix G, Table G-4 as having impairments due to nitrogen."

"2.4.2.1(c)(i) Public Outreach and Education "Residential program: maintenance of septic systems; effects of outdoor activities such as lawn care (use of pesticides, herbicides, and fertilizers) on water quality; benefits of appropriate onsite infiltration of stormwater; effects of automotive work and car washing on water quality; proper disposal of swimming pool water; and proper management of pet waste. If the small MS4 has greater than 50 percent of its residents serviced by septic systems or is subject to an approved TMDL for nitrogen, the municipality shall include maintenance of septic systems as part of its education program.

For MS4s located in areas listed in Appendix G, Tables G-1, G-2 and G-4 subject to an approved TMDL for either phosphorus or nitrogen, the residential education program must address the proper use of fertilizer, alternatives to traditional fertilizers containing nutrients (phosphorus and nitrogen), and septic system maintenance. The education material shall describe methods of recycling lawn clipping and yard waste as fertilizer and mulch, or its proper collection and disposal. The educational materials shall include information encouraging the use of alternative forms of fertilizers containing lower nutrient concentrations, or slower releasing or less available forms of nutrients.

For MS4s located in areas listed in Appendix G, Table G-1, the permittee shall provide information on alternatives to detergents containing phosphates."

"2.4.2.1(c)(ii) Public Outreach and Education "Business/Commercial/Institution program: proper lawn maintenance (use of pesticides, herbicides and fertilizer); benefits of appropriate on-site infiltration of stormwater; building maintenance (use of detergents); use of salt or other de-icing and anti-icing materials (minimize their use); proper storage of salt or other de-icing/anti-icing materials (cover/prevent runoff to pollution prevention); proper management of waste materials and dumpsters (cover and pollution prevention); proper management of parking lot surfaces (sweeping); proper car care activities (washing of vehicles and maintenance); and proper disposal of swimming pool water (except dechlorinated swimming pool water) by entities such as motels, hotels, and health clubs (discharges should be free from pollutants).

For MS4s located in areas listed in Appendix G, Tables G-1, G-2 and G-4, subject to an approved TMDL for either phosphorus or nitrogen, the education program for this audience shall include information on the proper use of fertilizer, alternatives to fertilizers containing nutrients (phosphorus and nitrogen), and the benefits of street/parking lot sweeping for control of nutrients. The education material shall describe methods of recycling lawn clipping and yard waste as fertilizer and mulch, or its proper collection and disposal. The educational materials shall include information encouraging the use of alternative forms of fertilizers

containing lower nutrient compositions, or slower releasing or less available forms of nutrients."

"2.4.2.1(c)(iv) Industrial program: equipment inspection to ensure timely maintenance; proper storage of industrial materials (emphasize pollution prevention); proper management and disposal of wastes; proper management of dumpsters; minimization of use of salt or other de-icing/anti-icing materials; proper storage of salt or other de-icing/anti-icing materials (cover/prevent runoff to storm system and ground water contamination); benefits of appropriate on-site infiltration of stormwater runoff from areas with low exposure to industrial materials such as roofs or employee parking; and proper maintenance of parking lot surfaces (sweeping).

For MS4s located in areas listed in Appendix G, Tables G-1, G-2 and G-4, subject to an approved TMDL for either phosphorus or nitrogen, the education program for this audience shall include information on the proper use of fertilizer, alternatives to fertilizers containing nutrients (phosphorus and nitrogen), and the benefits of street/parking lot sweeping for control of nutrients. The education material shall describe methods of recycling lawn clipping and yard waste as fertilizer and mulch, or its proper collection and disposal. The educational materials shall include information encouraging the use of alternative forms of fertilizers containing lower nutrient compositions, or slower releasing or less available forms of nutrients."

"2.4.7.1(a)(1) For MS4s located in the areas listed in Appendix G, Table G-1, G-2 and G-4, subject to an approved TMDL for either phosphorus or nitrogen, the permittee shall evaluate alternatives to traditional fertilizers and incorporate, to the extent practicable, their use on permittee owned spaces. The permittee shall also address public green space care and municipal leaf litter collection and disposal."

Appendix G of the Draft Permit also indicates that the approved TMDL waste load allocation (WLA) for total nitrogen for storm water discharges to this water body is "negligible."

MassDOT programs included in the Storm Water Management Plan (SWMP) related to nitrogen include:

1. **Vegetation Management Program (BMP 6A-5):** The VMP program establishes the criteria whereby MassDOT controls vegetation along state roads and highways in compliance with the Rights of Way Management Regulations (333 CMR 11.00). Under this regulatory program, MassDOT has prepared both a 5-Year Vegetation Management Plan (VMP) and a Yearly Operational Plan (YOP) for Vegetation Management. The provisions of MassDOT's VMP are summarized below.

   Integrated Roadside Vegetation Management

   MassDOT's VMP incorporates Integrated Roadside Vegetation Management (IRVM) methods which include roadside development (active planting to encourage appropriate competing vegetation, non-organic barriers), mechanical (mowing, hand cutting, selective trimming), and chemical (low volume foliar herbicide treatments).

   One goal of the VMP is to minimize the use of chemical controls, through minimizing areas of application, quantity of chemicals, and frequency of application. Chemical control techniques shall be limited to use on high traffic volume, high speed interstate and primary roadways in the Commonwealth where safety of motorists, MassDOT employees, and contractors precludes the use of mechanical methods. Using IRVM methods, MassDOT will employ only two types of herbicide application: Foliar treatment and cut stump surface treatment.

   - *Foliar Treatments* involve the selective application of approved herbicides and adjuvants diluted in water, to the foliage and stems of the target vegetation. The foliar treatment used shall be low pressure, below 60 psi at the nozzle, with a

normal working pressure of 40 psi for application at volumes of less than 50 gallons/acre.

- *Cut Stump Surface Treatment* is the application of an herbicide to the cut surface of a stump immediately following or during a cutting operation, to prevent re-sprouting.

Identifying and Protecting Sensitive Areas

Sensitive areas are defined as areas within rights-of-way in which public health, environmental or agricultural concerns warrant special protection to further minimize risks of unreasonable adverse effects (of herbicides) and include public groundwater supplies, public surface water supplies, private drinking water supplies, surface waters, wetlands, rivers, inhabited areas and agricultural areas.

All herbicides used by MassDOT have been researched, tested and approved by the Department of Food & Agriculture for use in Sensitive Areas. The MassDOT VMP provides descriptions and procedures for how Sensitive Areas will be identified for required protection, summarizes the restrictions and no-spray zones associated with application of herbicides within the right of way, and describes how no-spray zones will be identified and flagged.

In addition, MassDOT prepares its Yearly Operational Plan which includes the provisions of the VMP and proposed spray locations by route and municipality. A copy of the YOP are sent to the Conservation Commission, Board of Health (or designated health agent), and to the head of government (Mayor, City Manager, Chair of the Board of Selectmen) of each municipality where herbicides are to be applied along the rights of way during the calendar year.

Source Control and Operational Guidelines for Herbicide Applicators

The MassDOT VMP provides operational guidelines for applicators to properly manage herbicides. Source Control measures provided in the VMP include:

- Mixing and loading of herbicides at the maintenance facility in limited amounts of herbicide necessary to carry out only that day's work.
- Spray vehicles will be equipped with a clipboard log of the herbicides on board, a bag of adsorbent, activated charcoal, plastic bats, a broom and a shovel in case of a minor spill.
- Applicators to roadside rights of way must hold a valid pesticide certification from the Department of Food and Agriculture.
- Herbicide application will be restricted during certain adverse weather conditions, such as rain or wind.
- Low-pressure foliar application equipment will be calibrated to maintain pressure not exceeding 60 pounds per square inch at the nozzle.
- Monitoring will include project record keeping to maintain timely information on the nature, timing, and location of actions taken, including project location, weather conditions, miles completed, amount of material used, worker and equipment hours devoted to the project, and persons responsible for activity and follow-up evaluation.
- Chemically treated areas shall be monitored after the necessary translocation period of the herbicide to determine the effectiveness of the applications and to monitor any off target injury and migration of the spray solution.
- MassDOT will conduct training for District staff in methods of vegetation management, employee safety and record keeping.

- The VMP includes a Remedial Plan to address potential spills and related accidents.

Alternatives to Chemical Herbicide Study

MassDOT, in collaboration with the Federal Highway Administration, funds a research project at the University of Massachusetts to seek alternatives to chemical herbicides for roadside weed control. With the assistance of the UMass Department of Soil Sciences, MassDOT is experimenting and testing alternative research, chemicals, and non-conventional control methods.

MassDOT is committed to actively pursue testing and evaluation of alternative methods of vegetation control. Other methods for investigation of management of roadside vegetation under guardrails include hand mowing, steaming, flaming, mulching with organic materials, and mulching with sheeting made from recycled products such as tires or plastic bottles. MassDOT continues to monitor the progress, provide updated information, notification, and assist the University of Massachusetts with the study. MassDOT will constantly monitor and evaluate the success of the vegetation management program and integrate appropriate new methods into the VMP and Yearly Operational Plans (YOP). YOPs are prepared by April of each year and posted on MassDOT's website within 30 days.

2. **BMP 1A: MassDOT Training Assistance Program (MTAP) and BMP 1B: Baystate Roads Program**: MassDOT provides significant training of highway personnel and municipal employees through BMP 1A: MassDOT Training Assistance Program (MTAP) and BMP 1B: Baystate Roads Program which focus on subjects such as stormwater BMPs and the use of the MassDOT Stormwater Handbook to identify the appropriate BMPs for a site, including those that will reduce nitrogen loading.
3. **MassDOT's 511 Traveler Information System (BMP 6A-1)**: The 511 program provides signage within the highway right-of-way that support litter law enforcement and encourages roadway users to notify MassDOT of litter and debris along the roadway. When calls are received, MassDOT crews are dispatched to clean up the litter or take other necessary actions.

Public education and outreach related to residential, commercials and industrial programs related to lawn care and fertilizer use is not applicable to MassDOT.

MassDOT has reviewed the measures it conducts under is Storm Water Management Program and has concluded that they are consistent with the intent of the applicable BMP requirements of the draft permit.

In combination, the TMDL's conclusion that storm water loading of TN is negligible and the consistency of MassDOT's SWMP with the Draft IMS permit's requirements indicate that no further measures are necessary at this location for compliance with the TMDL WLA.

Applicable Recommendations for Nitrogen Reduction

However, MassDOT has conducted a site visit to this location and identified a number of potential locations for installing BMPs. These opportunities are described in the following section. Although installation of these BMPs is not required, MassDOT will consider implementing them in the future as part of programmed projects or potentially as retrofits.

Assessment and Mitigation Plan

A site visit on May 23rd, 2011 indicated that there are no existing BMPs in place to treat MassDOT runoff before it discharges to Ryder Cove and the right-of-way (ROW) owned by MassDOT is extremely limited in this area with less than ten feet on either side and residential homes and wetlands adjacent to the right-of-way. These space constraints limit the options for installation of BMPs that provide nitrogen removal. Nitrogen removal is dependent upon

vegetative uptake or infiltration and requires BMPs such as bioretention and retention basins or infiltration measures. There is limited space, and therefore, the only feasible BMP alternative for retrofit is installing leaching catch basins on Route 28 near Ryder Cove.

Infiltration BMPs rely upon the infiltration ability of underlying soils for proper function. Additionally, by adding infiltration BMPs, MassDOT would limit the volume of direct discharge to Ryder Cove. MassDOT performed a desktop analysis of soils within the areas where it recommends infiltration BMPs to determine soil type and associated Hydrologic Soil Group (HSG) using the United States Department of Agriculture's Natural Resources Conservation Service (NRCS) SSURGO-Certified soils data, obtained from MassGIS. MassDOT assigned infiltration rates to each HSG as shown in Table 1 below.

Table 1. Infiltration Rates Assigned to NRCS Hydrologic Soil Groups

NRCS Hydrologic Soil Group (HSG)	Infiltration Rate (inches/hour)
A	2.41
B	0.52
C	0.17
D	N/A

The NRCS soils data shows that in the areas where infiltration BMPs are recommended, soils consist entirely of HSG A or B. The corresponding infiltration rates for this HSG are relatively high and thus suitable for the installation of infiltration BMPs. MassDOT will conduct site-specific soil testing before designing and installing infiltration BMPs.

The following sections describe the potential BMPs in further detail. Refer to Figure 1 and Figure 2 for exact location of storm water outfalls and potential BMPs.

Leaching Catch Basins

Leaching catch basins would allow infiltration of stormwater runoff. MassDOT will consider installing thirteen leaching catch basins within the directly contributing area for Ryder Cove. Currently, MassDOT contributes 1.9 acres of stormwater runoff to Ryder Cove. The thirteen leaching catch basins within the directly contributing area would collect approximately all 1.9 acres of runoff. Two of the proposed leaching catch basins are on the corners of the road leading to the Ryder's Cove Boatyard. There are currently two existing catch basins here, but during the site visit on March 23rd, 2011 they were determined to be full of sediment. MassDOT should clean these catch basins, and during this process determine if the catch basins are leaching catch basins. If they are already leaching catch basins, new proposed structures would not be needed. Some of the leaching catch basins are very close to the cove and associated marsh land, and therefore, the runoff might need to be piped to nearby areas more suitable for infiltration. The location and drainage area received of the leaching catch basins is approximate and further analysis should be taken during design of these BMPs.

During future programmed project work for this section of roadway, MassDOT would review the possibility of installing other BMPs if additional right-of-way could be obtained and other site constraints were appropriate.

Conclusions

Ryder Cove is subject to two TMDLs: TMDL for Total Nitrogen for the Pleasant Bay System and Final Pathogen TMDL for the Cape Cod Watershed. As stated in the Pathogen TMDL for the Cape Cod Watershed, the most likely sources of fecal coliform bacteria are primarily from boat wastes; failing septic systems; pets, wildlife, and birds; and stormwater. Review of EPA's draft Small MS4 General Permit for Interstate, Merrimack and South Coastal Watersheds indicates that if MassDOT's SWMP is consistent with certain pathogen related requirements of the permit (as defined in Appendix G) then no further measures are necessary for compliance with the

pathogen TMDL. Similarly, the nitrogen TMDL for the Pleasant Bay System, which includes Ryder Cove, indicates that that storm water loading of TN is negligible and the IMS Small MS4 General Permit again indicates that if MassDOT's SWMP is consistent with the Draft IMS permit's requirements no further measures are necessary at this location for compliance with the TMDL WLA. MassDOT has reviewed the measures it conducts under is Storm Water Management Program and has concluded that they are consistent with the intent of the applicable BMP requirements of the draft permit for both the pathogen and the total nitrogen TMDL. Therefore, no further measures are necessary or proposed at this time.

However, MassDOT has conducted a site visit to this location and identified a number of potential locations for installing BMPs; including thirteen leaching catch basins. Although installation of these BMPs is not required, MassDOT will consider implementing them in the future as part of programmed projects or potentially as retrofits.

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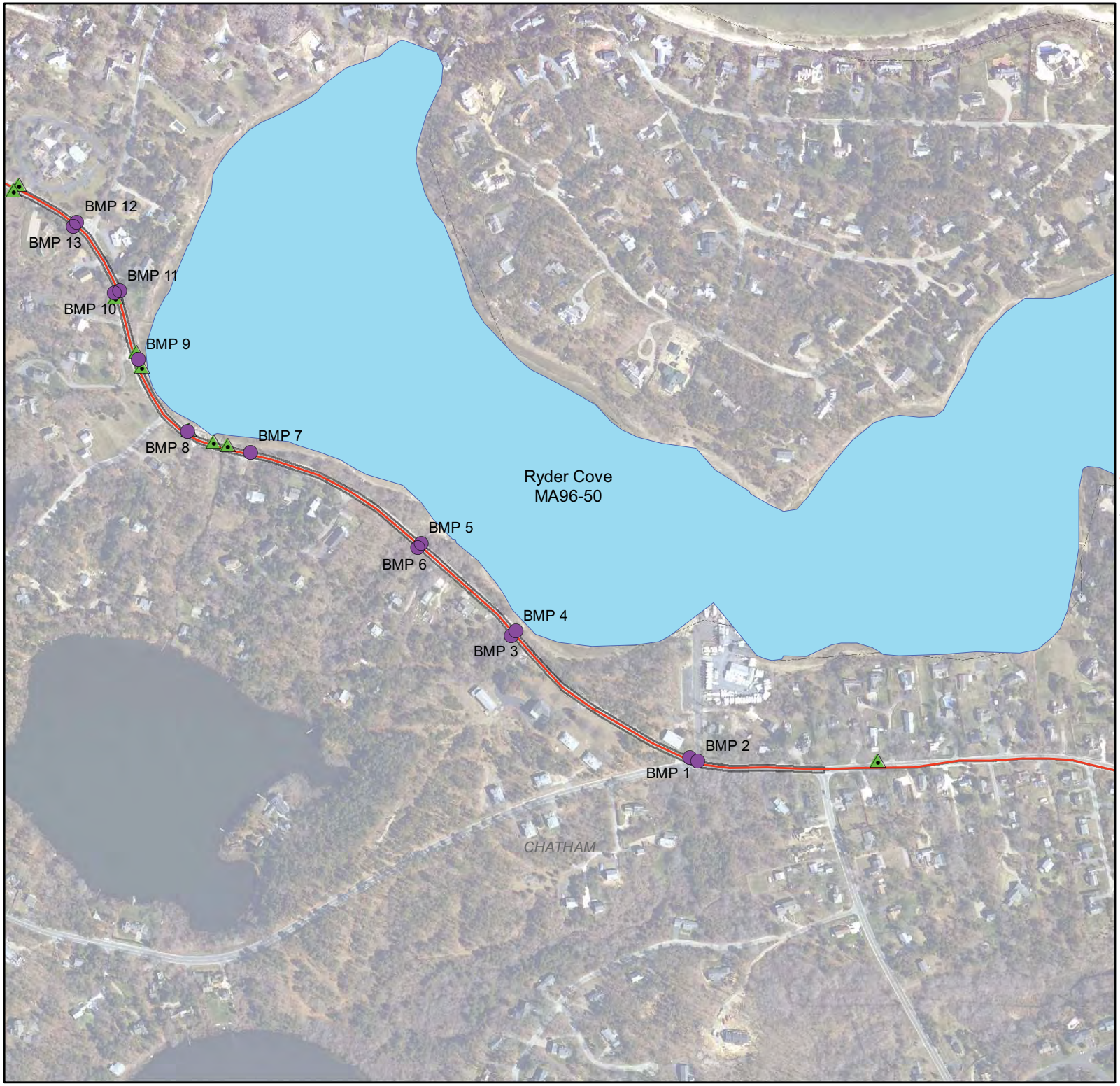

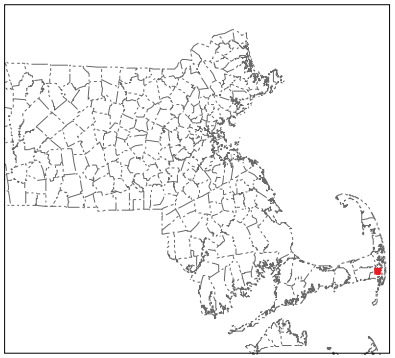

MA96-50

MassDOT Directly Contributing Watersheds

Stormwater Outfalls

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

Proposed BMPs

300 150 0 300 Feet

N

Figure 1
Ryder Cove
MA96-50

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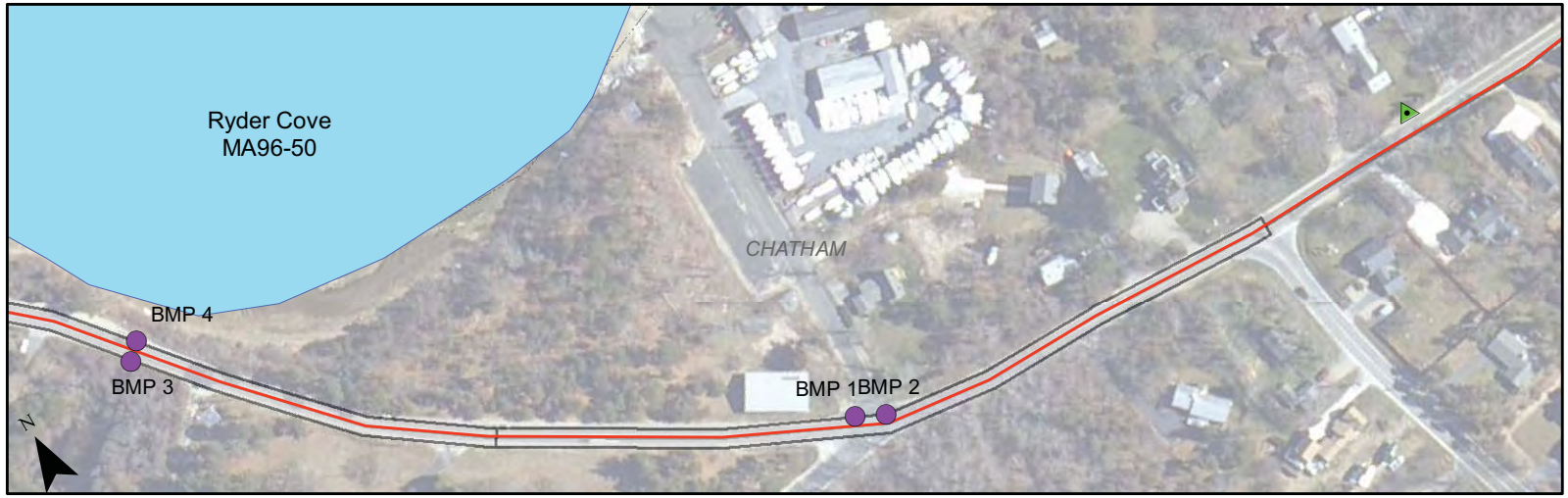

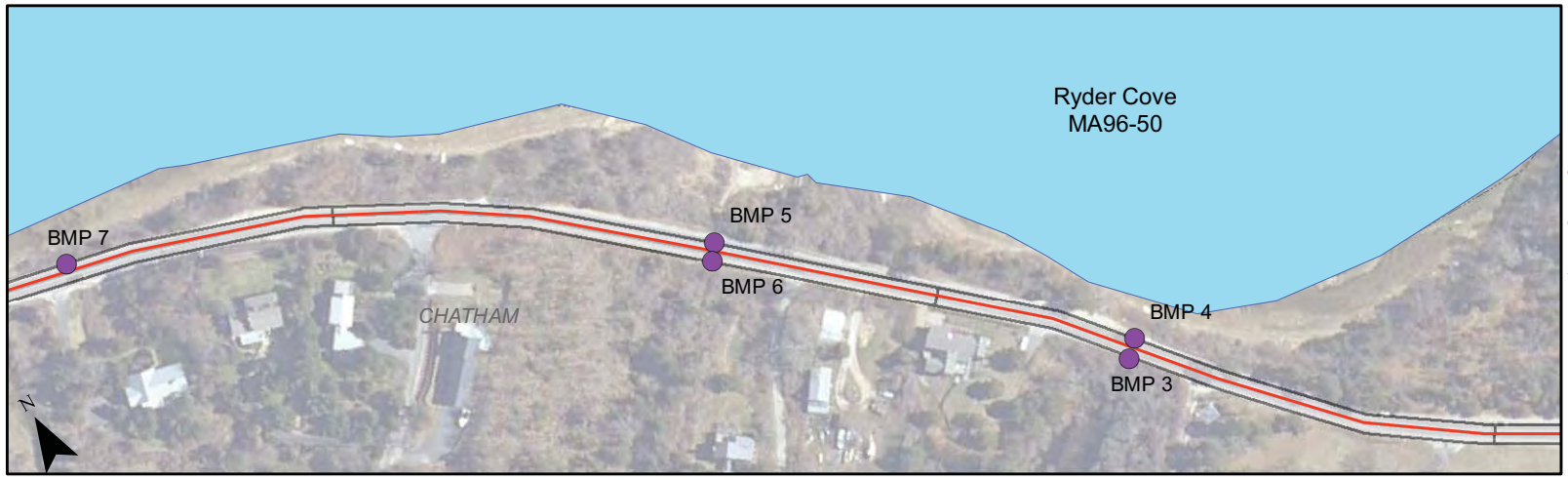

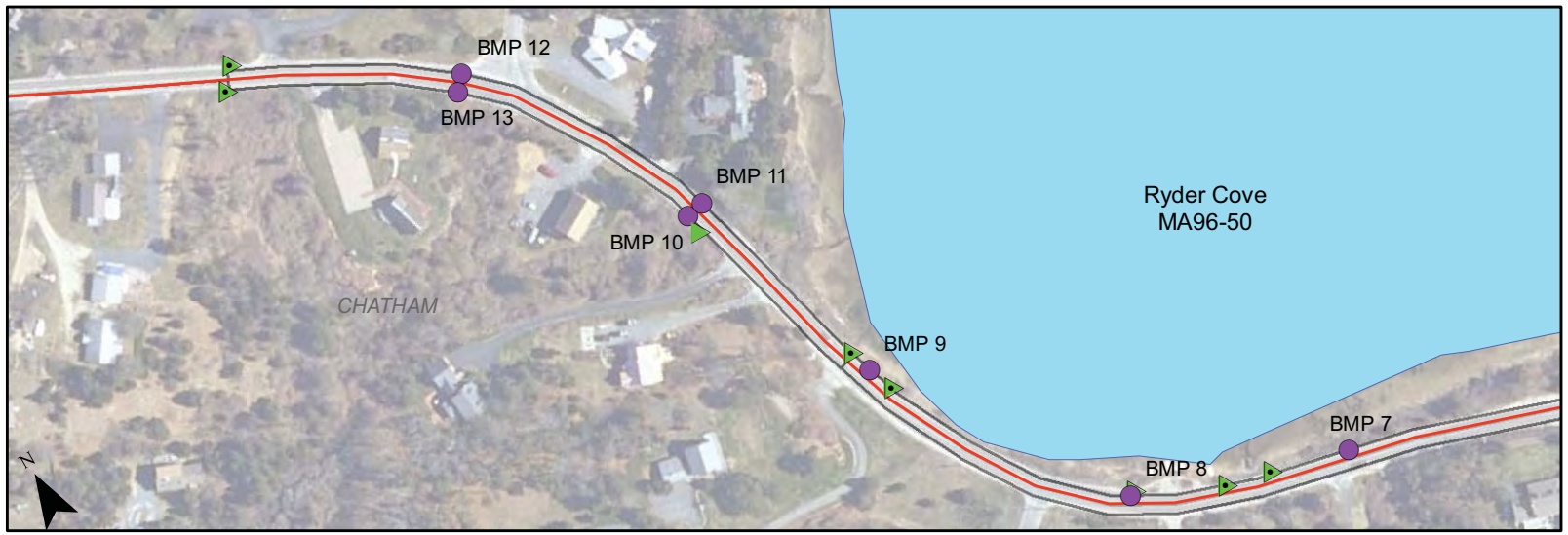

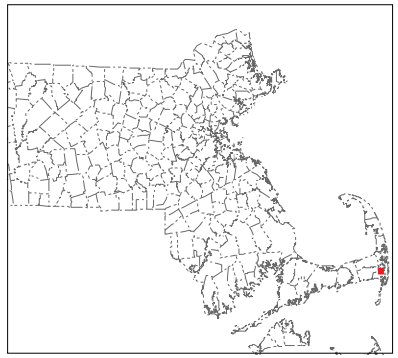

MA96-50

MassDOT Directly Contributing Watersheds

Stormwater Outfalls

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

Proposed BMPs

125 62.5 0 125 Feet

N

Figure 2
Ryder Cove
MA96-50

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Attachment 2:
Assessments which Identified no Discharges from MassDOT Outfalls to Impaired Segments under Review

Impaired Waters Assessment for Mill Pond (MA84081)

Impaired Waterbody

Name: Mill Pond (South Basin)

Location: Littleton, MA

Water Body ID: MA84081

Impairments

Mass DEP 2008 303d List: Noxious aquatic plants

Mass DEP 2010 Draft 303d List Changes: no changes

Relevant Water Quality Standards: Water Body Class: B

- 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.

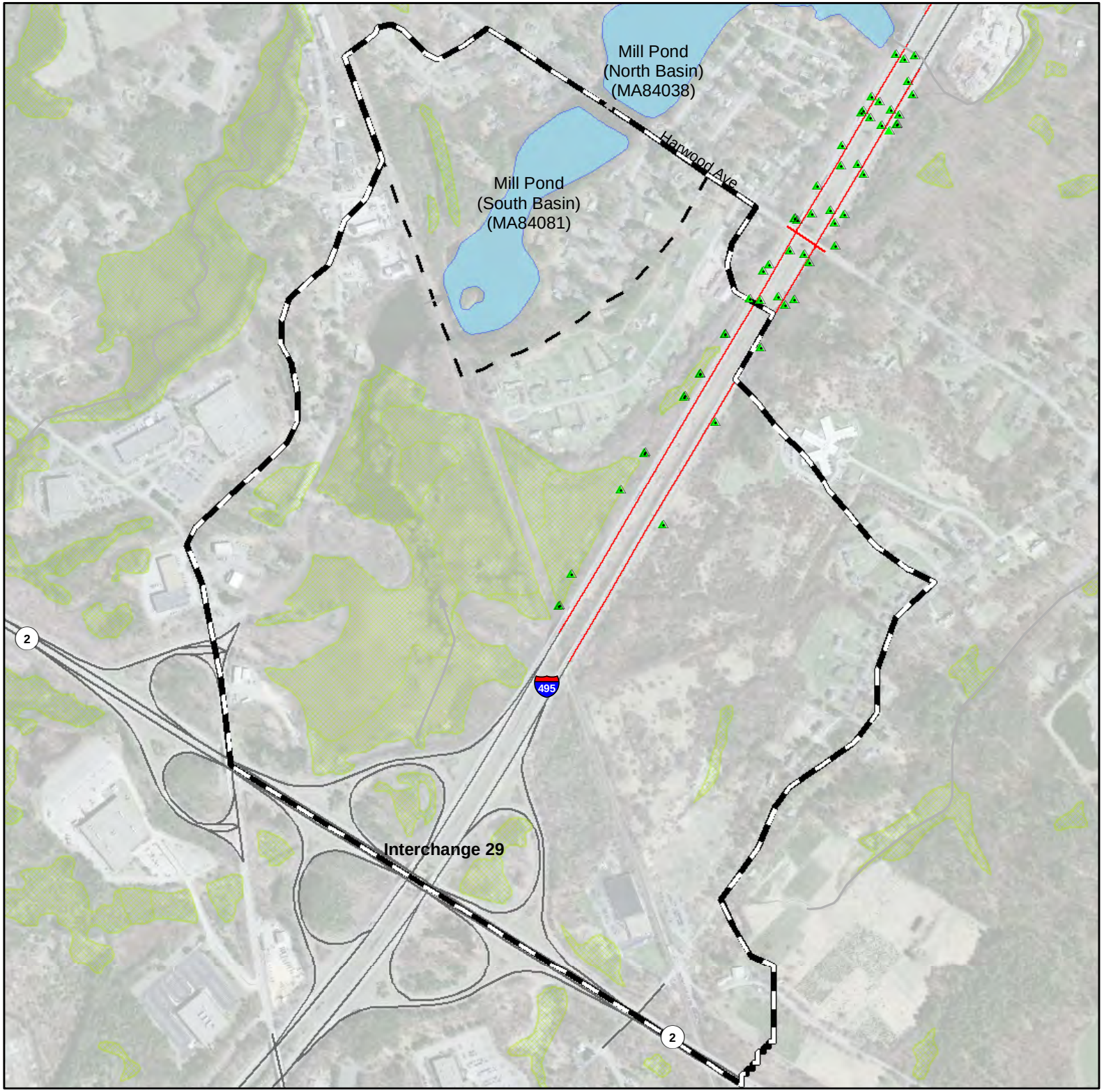
Site Description

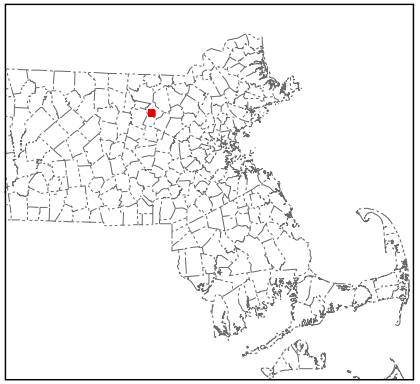
The south basin of Mill Pond (MA84081) is located in the Town of Littleton, Massachusetts. This basin has a surface area of 12.4 acres and a contributing watershed area of approximately 380 acres. This Mill Pond basin is bounded at its outlet on the north side by Harwood Avenue where it discharges to the north basin of Mill Pond (MA84038), and on the south side by a railroad causeway.

The watershed for the south basin of Mill Pond includes a wetland area that spans approximately 60 acres. The subwatershed, defined as the area draining directly to the impaired water body is approximately 62 acres (Figure 1). The land cover in this subwatershed is evenly divided between residential development and forest.

Assessment under BMP 7U for No Discharge Determination

In compliance with the specific steps outlined in BMP 7U, MassDOT first determined that nutrients, organic enrichment/low DO, and noxious aquatic plants impairments could be related to storm water as part of Step 1. Step 2, requires that MassDOT perform a desktop review of the sub-basin to determine if MassDOT outfalls directly discharge to the receiving water under assessment. Since a desktop review of the Long Pond area could not definitively make this determination, MassDOT continued to Step 3 and performed a site survey. AECOM determined during a site visit on May 13th and 19th, 2011, that runoff from MassDOT property located within the Mill Pond (MA84081) watershed does not directly discharge to Mill Pond. The large wetland that is located south of Mill Pond receives runoff from sections of I-495 from the interchange at Route 2 to the drainage divide that is approximately 0.8 miles north of this interchange. Because this drainage does not discharge directly to Mill Pond, MassDOT has determined further assessment of this water body is not required.





Stormwater Outfall
MassDOT Roads in Urban Areas
MassDOT Roads
Mill Pond Watershed
Mill Pond (MA84081) Subwatershed
NWI Wetland Area
Impaired Water Bodies
Non-Impaired Stream Segment

N

0 500 1,000 Feet

Figure 1
Mill Pond
South Basin
Watershed
MA84081

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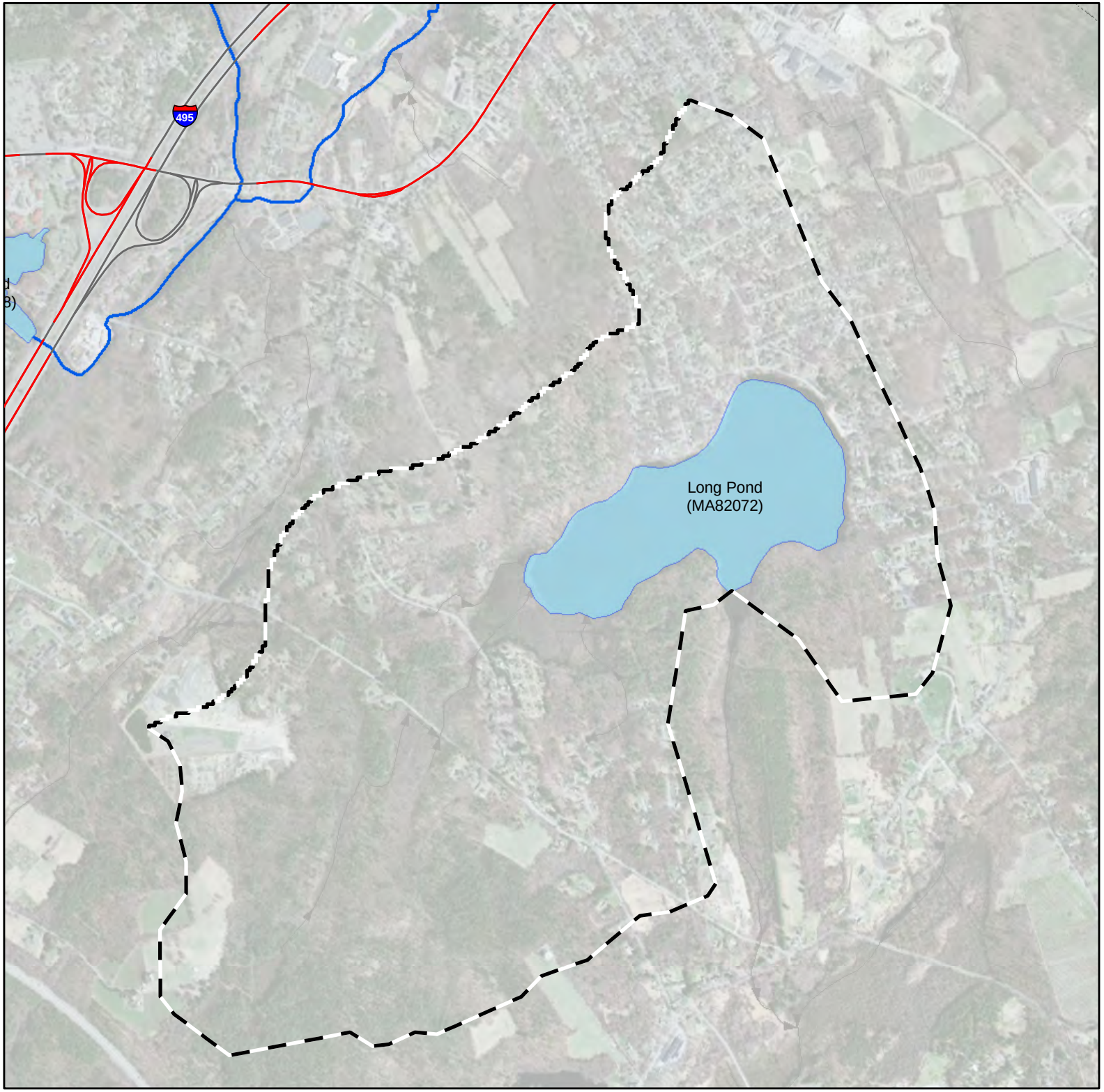
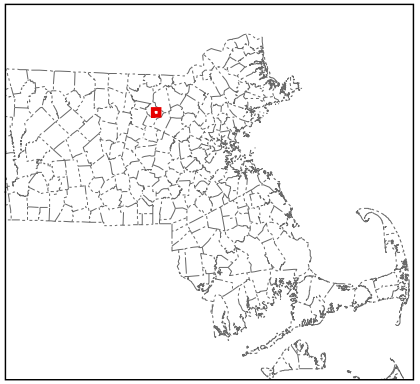
The Long Pond watershed includes urbanized areas of Littleton to the northeast and southwest as well as undeveloped areas and wetlands in the southwestern portion of the watershed (Figure 1).

Assessment under BMP 7U for No Discharge Determination

In compliance with the specific steps outlined in BMP 7U, MassDOT first determined that nutrients, organic enrichment/low DO, and noxious aquatic plants impairments could be related to storm water as part of Step 1. Step 2, requires that MassDOT perform a desktop review of the sub-basin to determine if MassDOT outfalls directly discharge to the receiving water under assessment. Since a desktop review of the Long Pond area could not make this determination, MassDOT proceeded to a site survey as indicated in Step 3 of BMP 7U. Based on the watershed mapping and field verification performed on May 13th and 19th, 2011 of drainage to Long Pond, there is no MassDOT property within the watershed for Long Pond (Figure 1); therefore, MassDOT has determined further assessment of this water body is not required.





MassDOT Roads in Urban Areas
MassDOT Roads
Long Pond Watershed
Impaired Water Body
Impaired Stream Segments
Non-Impaired Stream Segments

N

0 1,000 2,000 Feet

Figure 1
Long Pond Watershed MA82072

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Impaired Waters Assessment for Round Cove (MA96-75)

Impaired Waterbody

Name: Round Cove

Location: Harwich, MA

Water Body ID: MA96-75

Impairments

Round Cove (MA96-75) is impaired for Nutrients according to both the Final Year 2008 and the Proposed Year 2010 List of Integrated Waters. Round Cove is also listed in both documents as a Category 4a water body and is covered by a Total Maximum Daily Load (TMDL) for Total Nitrogen.

Relevant Water Quality Standards

Round Cove has been classified by the Massachusetts Surface Water Quality Standards as a Class SA water. Water quality standards of particular interest to the issues of cultural eutrophication are aesthetics, dissolved oxygen, and nutrients. The Massachusetts water quality standards (314 CMR 4.0) contain numeric criteria for dissolved oxygen, but have only narrative standards that relate to the other variables, as described below:

- 314 CMR 4.05(5)(a) “Aesthetics. All surface waters shall be free from pollutants in concentrations 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 (4)(a) 1 “Dissolved Oxygen. Shall not be less than 6.0 mg/l. Where natural background conditions are lower, DO shall not be less than natural background. 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.”

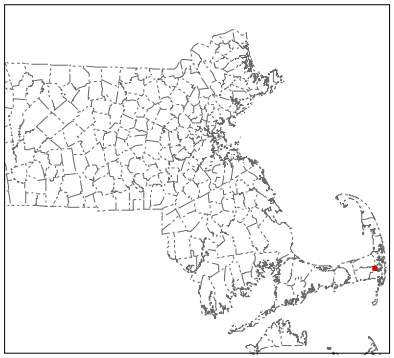
Site Description

Round Cove is located in Harwich, Massachusetts near the head of Pleasant Bay and adjacent to Route 28 and Wequasett Resort. The cove has a surface area of approximately 13 acres and outlets to Pleasant Bay. According to both the Final Year 2008 and Proposed Year 2010 List of Integrated Waters, Round Cove is impaired for Nutrients and falls under the TMDL for nitrogen titled, “Pleasant Bay System Total Maximum Daily Loads For Total Nitrogen” [10/24/2007-CN244.0].

MassDOT owns Route 28 which runs north-south to the east of Round Cove. Route 28 is a two lane roadway with impervious width of approximately 20-feet. MassDOT property also includes ROW of approximately 10-feet on either side of the roadway. The edges of pavement are not curbed and stormwater runoff sheds to the sides of the road and collects in catch basins.

Assessment under BMP 7U for No Discharge Determination

Based on a site visit on May 23, 2011 it was determined that MassDOT does not directly contribute runoff to Round Cove. Along the portion of Route 28 adjacent to Round Cove catch basins are located on both sides of the road. Runoff from the east side of the road is piped to leaching catch basins on the west side of the road where runoff infiltrates into the soils. The leaching catch basins are located further than 200-ft from Round Cove and runoff into the leaching catch basins infiltrates into the ground. The Pleasant Bay System TMDL for Total Nitrogen assumes that only runoff within a 200-ft buffer of a waterbody is considered a direct discharge and runoff outside of this buffer infiltrates into the ground and is not a direct discharge. Therefore, it was determined the runoff does not directly discharge to Round Cove. MassDOT’s roadway and Round Cove are shown in Figure 1. MassDOT has determined further assessment of this waterbody is not required under the Retrofit Initiative.



MA96-75

MassDOT Directly Contributing Watersheds

Stormwater Outfalls

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

240 120 0 240 Feet

N

Figure 1
Round Cove
MA96-75

June 2011

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Impaired Waters Assessment for Crows Pond (MA96-47)

Impaired Waterbody

Name: Crows Pond

Location: Chatham, MA

Water Body ID: MA96-47

Impairments

Crows Pond (MA96-47) is impaired for Nutrients according to both the Final Year 2008 and the Proposed Year 2010 List of Integrated Waters. Crows Pond is also listed in both documents as a Category 4a water body and is covered by a Total Maximum Daily Load (TMDL) for Total Nitrogen. During the TMDL creation effort it was determined that Crows Pond was not impaired for nutrients; however it has not been removed from the draft 303d list for 2010.

Relevant Water Quality Standards

Crows Pond has been classified by the Massachusetts Surface Water Quality Standards as a Class SA water. Water quality standards of particular interest to the issues of cultural eutrophication are aesthetics, dissolved oxygen, and nutrients. The Massachusetts water quality standards (314 CMR 4.0) contain numeric criteria for dissolved oxygen, but have only narrative standards that relate to the other variables, as described below:

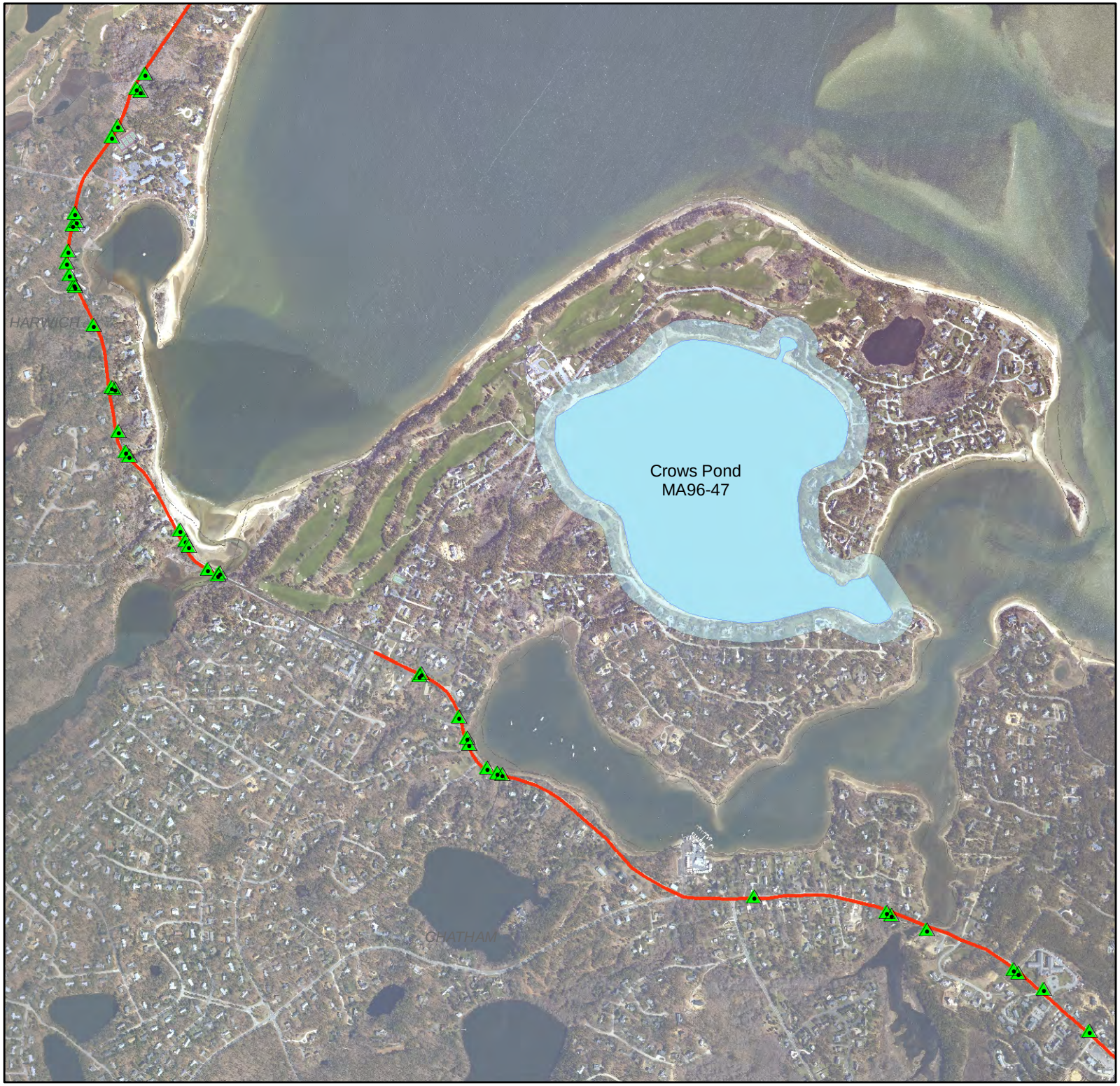
- 314 CMR 4.05(5)(a) “Aesthetics. All surface waters shall be free from pollutants in concentrations that settle to form objectionable deposits; float as debris, scum, or other matter to form nuisances, produce objectionable odor, color, taste, or turbidity, or produce undesirable or nuisance species of aquatic life.”
- 314 CMR 4.05 (4)(a) 1 “Dissolved Oxygen. Shall not be less than 6.0 mg/l. Where natural background conditions are lower, DO shall not be less than natural background. 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.”

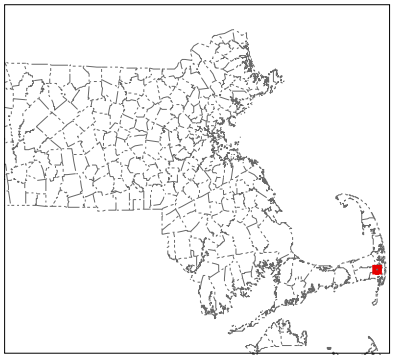
Site Description

Crows Pond is located in Chatham, Massachusetts and is part of the Pleasant Bay system. Crows Pond outlets to Bassing Harbor and has a surface area of approximately 122 acres. Crows Pond is located between Ryder Cove, Bassing Harbor, Pleasant Bay, and Eastward Ho Golf Course. According to both the Final Year 2008 and Proposed Year 2010 List of Integrated Waters, Round Cove is impaired for Nutrients and falls under the TMDL for nitrogen titled, “Pleasant Bay System Total Maximum Daily Loads For Total Nitrogen” [10/24/2007-CN244.0]. During development of the TMDL it was determined that the water body is not impaired for nutrients and a Preservation TMDL was developed. Figure 1 shows Crows Pond and MassDOT owned Route 28.

Assessment under BMP 7U for No Discharge Determination

Based on a site visit on May 23, 2011 it was determined that MassDOT does not directly contribute runoff to Crows Pond. The nearest MassDOT owned road is Route 28, which is over 2,000-ft from Crows Pond. During the site visit it was determined that there are no piped systems which discharge water close to Crows Pond. The Pleasant Bay System TMDL for Total Nitrogen assumes that only runoff within a 200-ft buffer of a waterbody is considered a direct discharge and runoff outside of this buffer infiltrates into the ground and is not a direct discharge. MassDOT has determined further assessment of this waterbody is not required under the Retrofit Initiative.





MA96-47

MassDOT Directly Contributing Watersheds

Stormwater Outfalls

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

990 495 0 990 Feet

N

Figure 1
Crows Pond
MA96-47

June 2011

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No MassDOT Discharge Review Under Step 2 of BMP 7U

Under Step 2 of BMP 7U, MassDOT committed to map the locations of MassDOT urban outfalls relative to 303(d) waters. This step included "*performing a desktop review of the sub-basin of the 303(d) water body to determine the specific locations of MassDOT outfalls and their receiving waters. This procedure will help determine whether MassDOT's outfalls in fact are potentially discharging in to the water body at issue, and will identify the number of outfalls that may need to be addressed through a mitigation plan. If MassDOT concludes based on its mapping that MassDOT's outfalls clearly are not discharging to the 303(d) water, it will document the basis for the conclusion and will conduct no further assessment of the water body at issue*." Step 2 of BMP 7R includes a similar desktop review.

Appendix L-1 of the June 8, 2010 submittal to the court, as part of the CLF vs. MassDOT lawsuit, identified waterbodies that potentially receive runoff from MassDOT urban roads and included Category 4a and 5 impaired waterbodies. In 2009, USGS published a new GIS datalayer of nested sub-basins[1]. These new more detailed sub-basins allowed AECOM to, in most cases, define the specific watershed to an individual impaired segment when developing Appendix L-1. In some cases the sub-basin continued to include more than one impaired waterbody (and other non-impaired waterbodies) and, therefore, AECOM has been reviewing these sub-basins to identify which of the sub-basin's receiving waters do potentially receive MassDOT discharge from *urban area roads* and which do not. AECOM reviewed each sub-basin in detail and identified waters that do not receive direct discharge from MassDOT. These were identified based on a visual examination of the location of the discharge and the location of the receiving water body. Note that in some cases these water bodies receive discharge from non-urban highways. MassDOT's NPDES storm water permit and MassDOT's impaired waters program covers urban areas. Storm water from non-urban areas is addressed under MassDOT's Programmed Project Initiative.

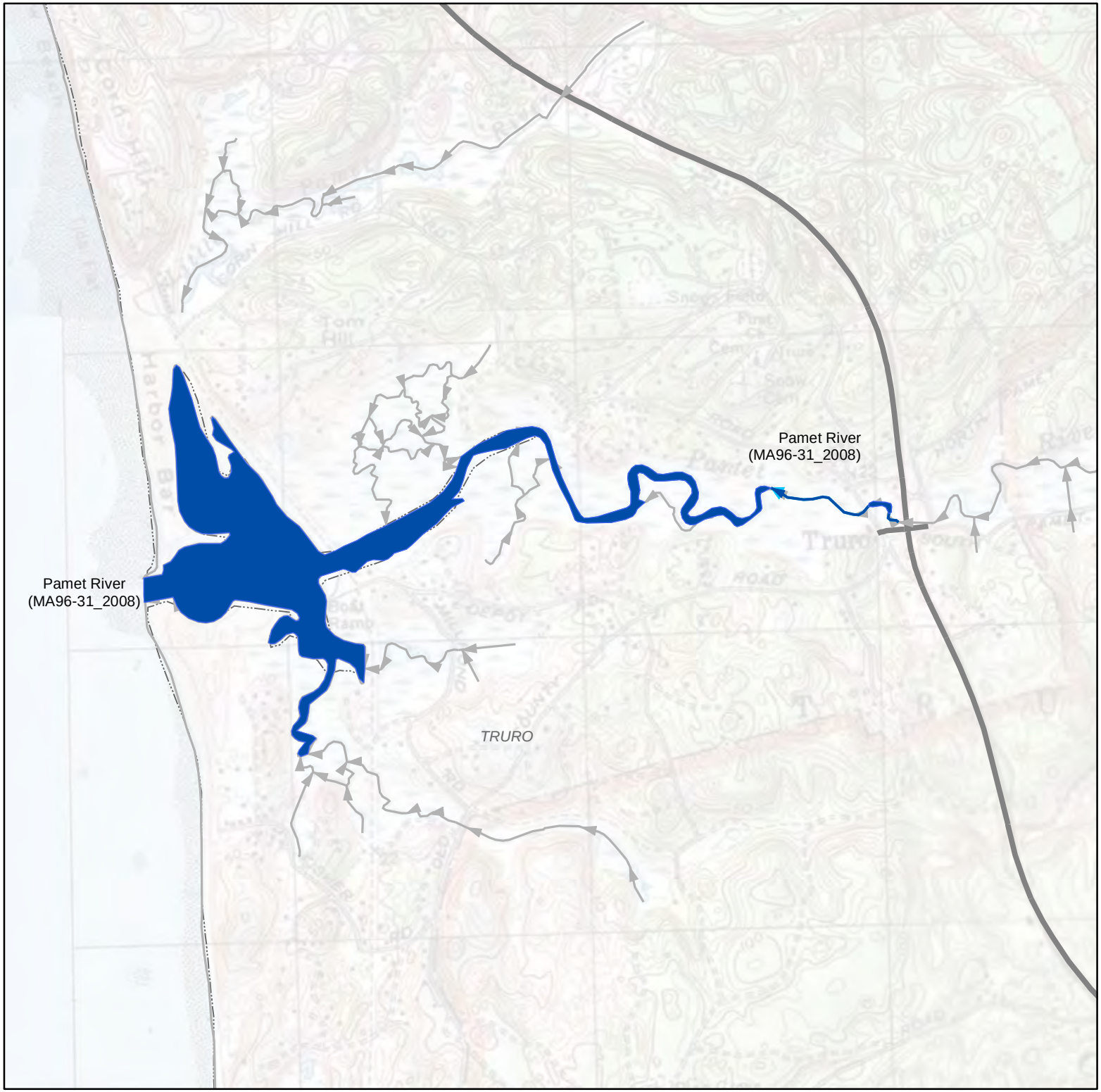
The figures in this section summarize this quarter's desktop review and those receiving waters that have been identified as not directly receiving MassDOT discharges during this more detailed review. The figures show the impaired waterbody segment being assessed in dark blue. The other impaired waterbody segments within the sub-basin are in bright blue. MassDOT urban area roads are indicated in red with the outfalls identified as green circles. The gray portions of MassDOT roadways are outside of urban areas and therefore not covered by the existing NPDES permit. These areas are not considered in this assessment.

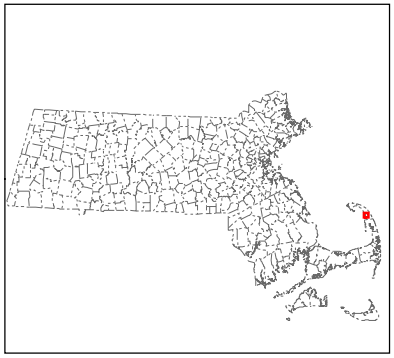
The water bodies MassDOT has identified that do not receive discharge from MassDOT are listed in the table below and shown in the attached figures.

[1] MassGIS states the purpose of the datalayer as follows: "This data layer was created in cooperation with the Environmental Protection Agency (EPA) to assist local communities in environmental planning and stormwater runoff studies. The purpose of this data layer is to provide basin boundaries and impervious surface data at a more discretized scale than is available with current Watershed Boundary Dataset (WBD) subdivisions." The GIS layer is available at http://water.usgs.gov/GIS/metadata/usgswrd/XML/ds451_subbasins.xml.

Table 3-1: Impaired Segments Where Assessment Identified no Discharges from MassDOT Outfalls to Water Body

Water Body Segment ID	Water Body Name	Watershed Name	TMDL
MA96-31	Pamet River	Cape Cod	Pathogen
MA96-39	Popponesset Creek	Cape Cod	Pathogen
MA96-40	Popponesset Bay	Cape Cod	Nitrogen
MA96068	Duck Pond	Cape Cod	Mercury
MA96070	Dyer Pond	Cape Cod	Mercury
MA96117	Great Pond	Cape Cod	Mercury
MA96179	Long Pond	Cape Cod	Mercury
MA96114	Great Pond	Cape Cod	Mercury
MA96303	Snow Pond	Cape Cod	Mercury
MA96268	Ryder Pond	Cape Cod	Mercury
MA96298	Slough Pond	Cape Cod	Mercury
MA96-67	Herring River	Cape Cod	-
MA96157	Johns Pond	Cape Cod	Mercury
MA96126	Hamblin Pond	Cape Cod	Mercury
MA96188	Lower Mill Pond	Cape Cod	-
MA96324	Upper Mill Pond	Cape Cod	-
MA96331	Walkers Pond	Cape Cod	-
MA96194	Mashpee Pond	Cape Cod	Mercury
MA96346	Wakeby Pond	Cape Cod	Mercury
MA96244	Peters Pond	Cape Cod	Mercury
MA96257	Red Lily Pond	Cape Cod	-
MA96277	Santuit Pond	Cape Cod	-
MA96289	Sheep Pond	Cape Cod	Mercury
MA96302	Snake Pond	Cape Cod	Mercury





Impaired Water Body Being Assessed

Impaired Water Body

Impaired Stream Being Assessed

Impaired Stream Segment

Non-Impaired Stream Segment

MA DOT Roads

MA DOT Urban Area Roads

Town Boundaries

Stormwater Outfalls

1,000 500 0 1,000 Feet

N

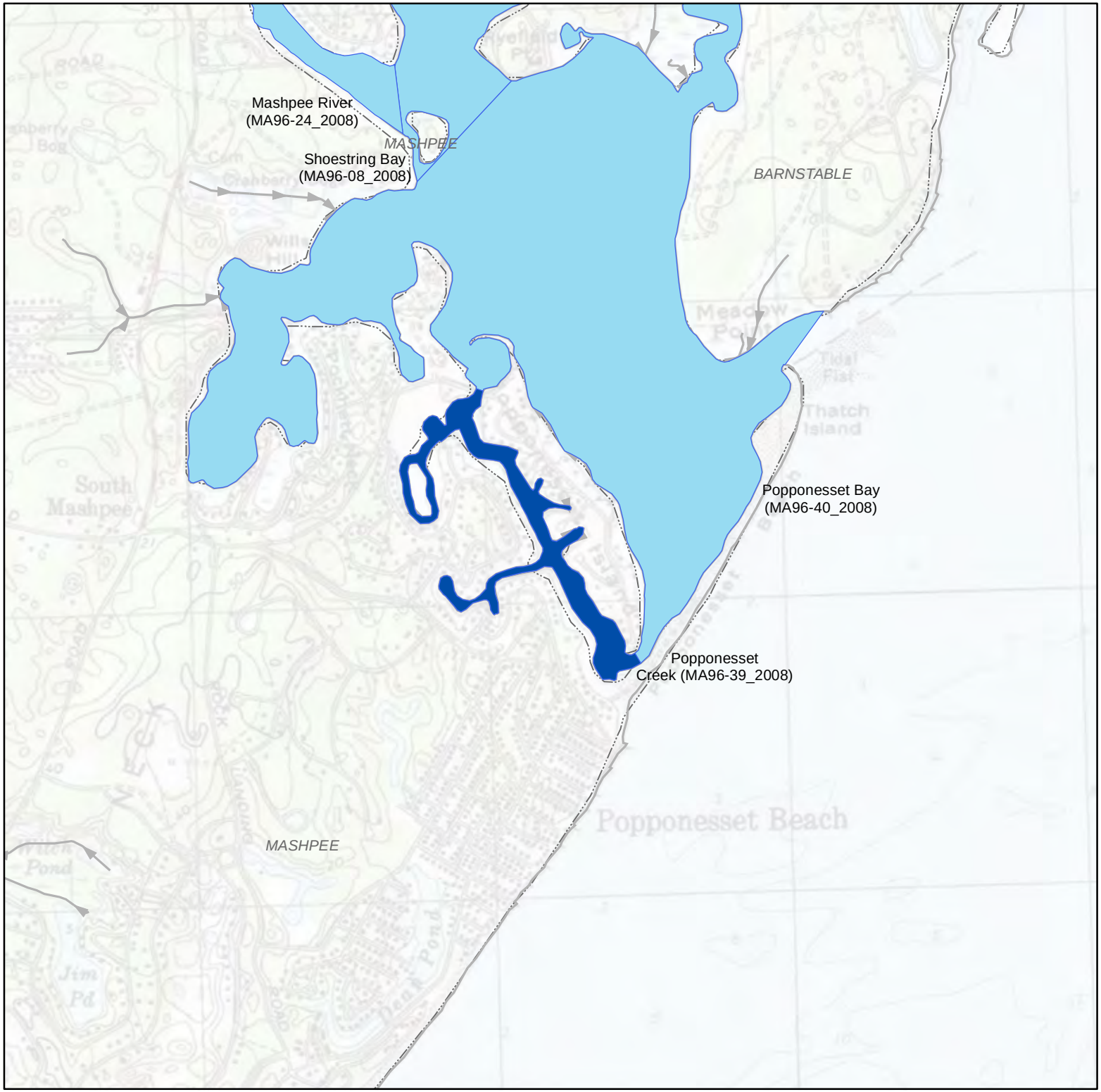
MA96-31_2008

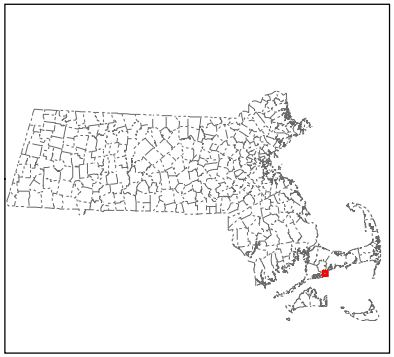
Pamet River

Cape Cod

June 2011

Moving Massachusetts Forward. massDOT





Impaired Water Body Being Assessed

Impaired Water Body

Impaired Stream Being Assessed

Impaired Stream Segment

Non-Impaired Stream Segment

MA DOT Roads

MA DOT Urban Area Roads

Town Boundaries

Stormwater Outfalls

1,000 500 0 1,000 Feet

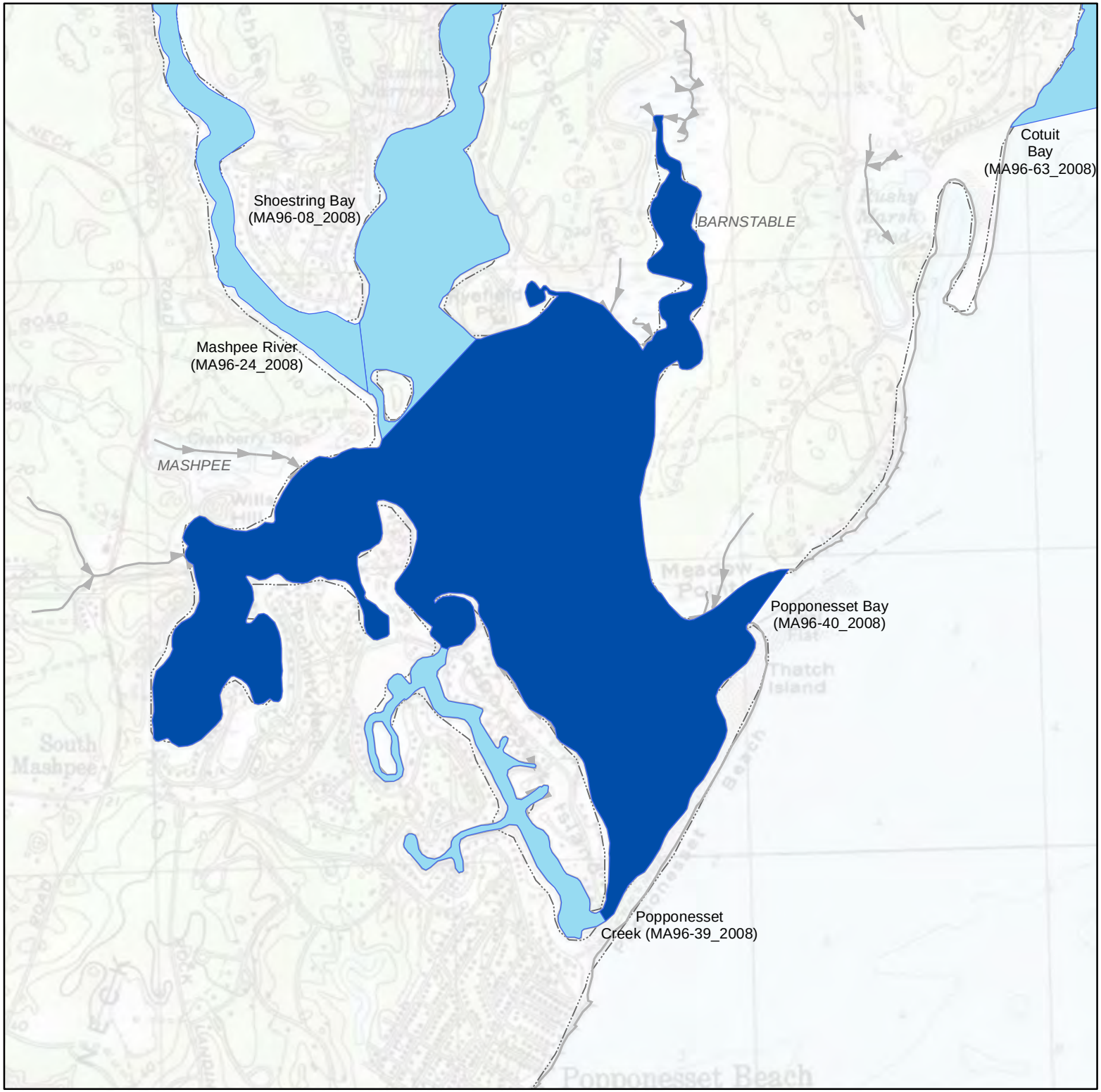
N

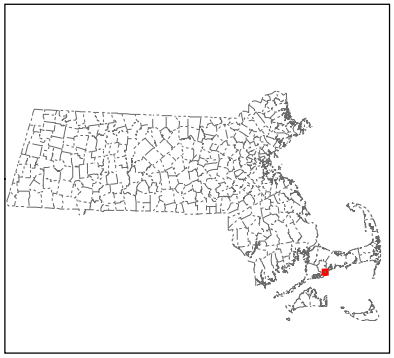
MA96-39_2008

Popponesset Creek

Cape Cod

June 2011





Impaired Water Body Being Assessed

Impaired Water Body

Impaired Stream Being Assessed

Impaired Stream Segment

Non-Impaired Stream Segment

MA DOT Roads

MA DOT Urban Area Roads

Town Boundaries

Stormwater Outfalls

1,000 500 0 1,000 Feet

N

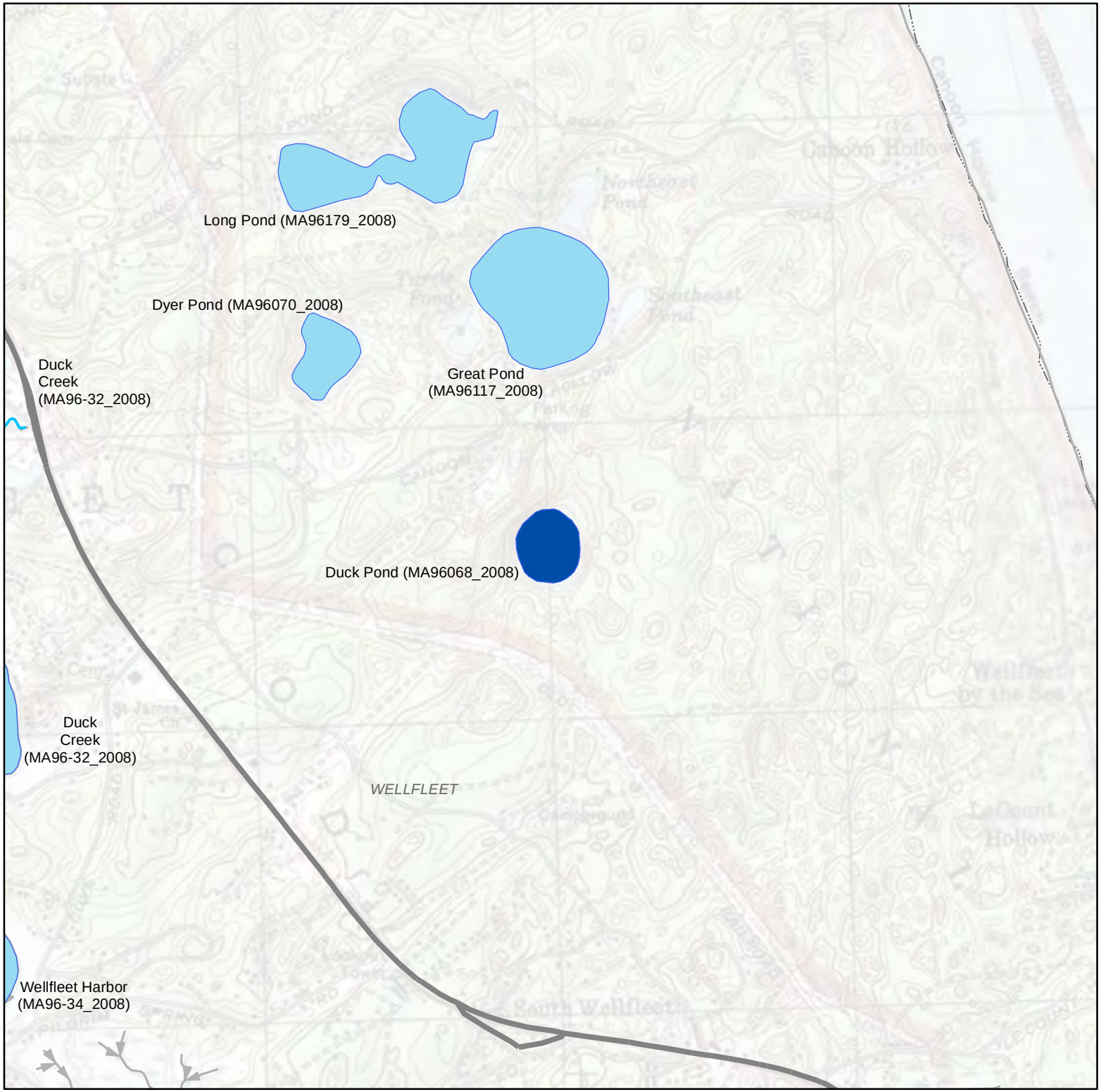
MA96-40_2008

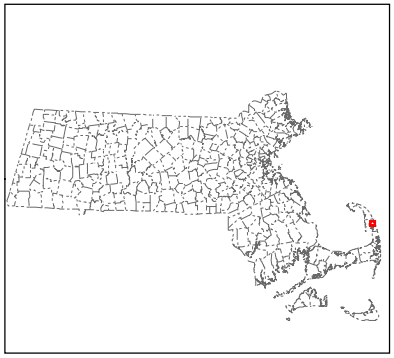
Popponesset Bay

Cape Cod

June 2011

Moving Massachusetts Forward. massDOT





Impaired Water Body Being Assessed

Impaired Water Body

Impaired Stream Being Assessed

Impaired Stream Segment

Non-Impaired Stream Segment

MA DOT Roads

MA DOT Urban Area Roads

Town Boundaries

Stormwater Outfalls

1,000 500 0 1,000 Feet

N

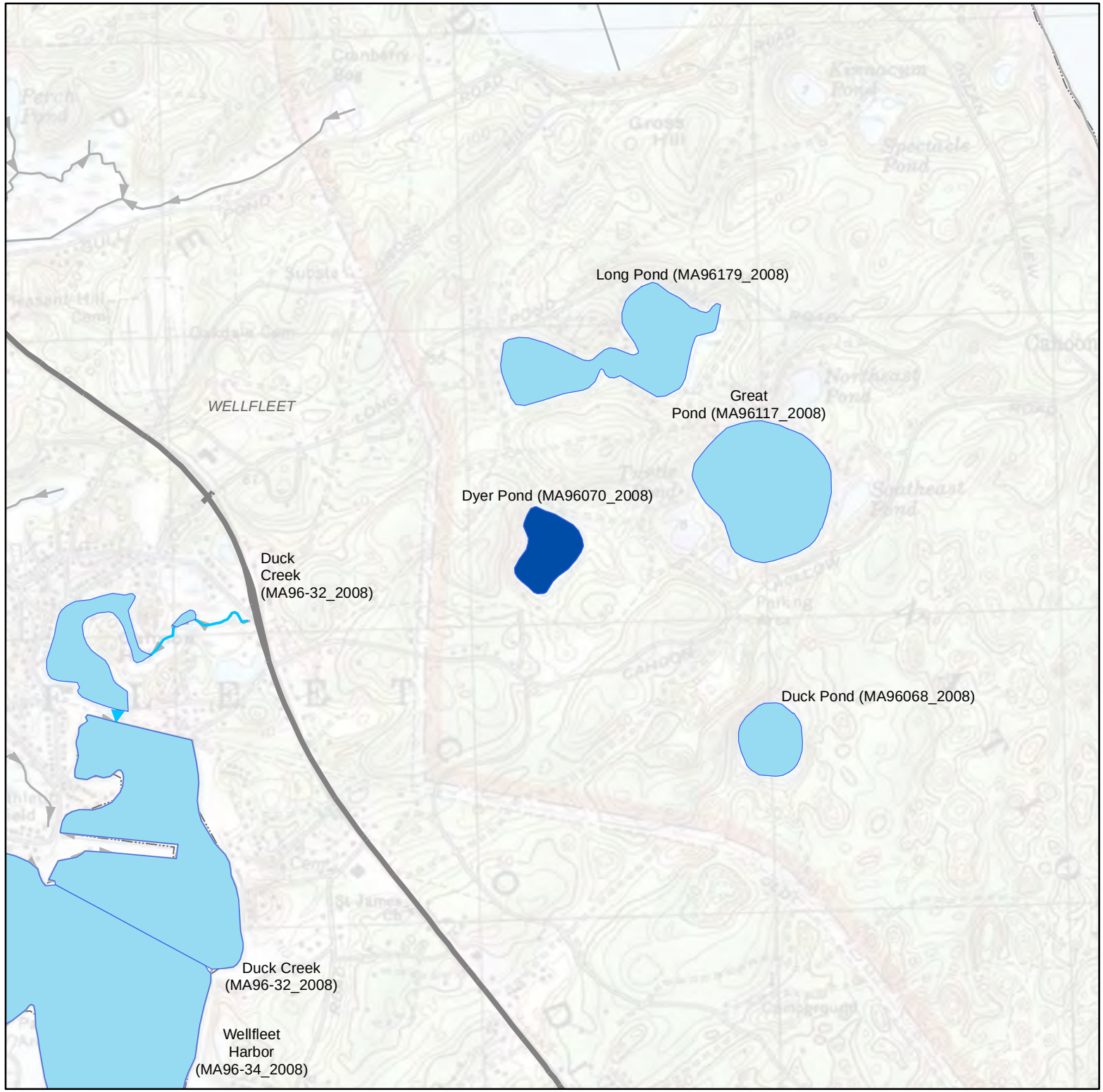
MA96068_2008

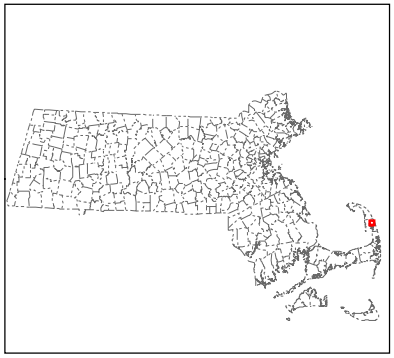
Duck Pond

Cape Cod

June 2011

Moving Massachusetts Forward. massDOT





Impaired Water Body Being Assessed

Impaired Water Body

Impaired Stream Being Assessed

Impaired Stream Segment

Non-Impaired Stream Segment

MA DOT Roads

MA DOT Urban Area Roads

Town Boundaries

Stormwater Outfalls

1,000 500 0 1,000 Feet

N

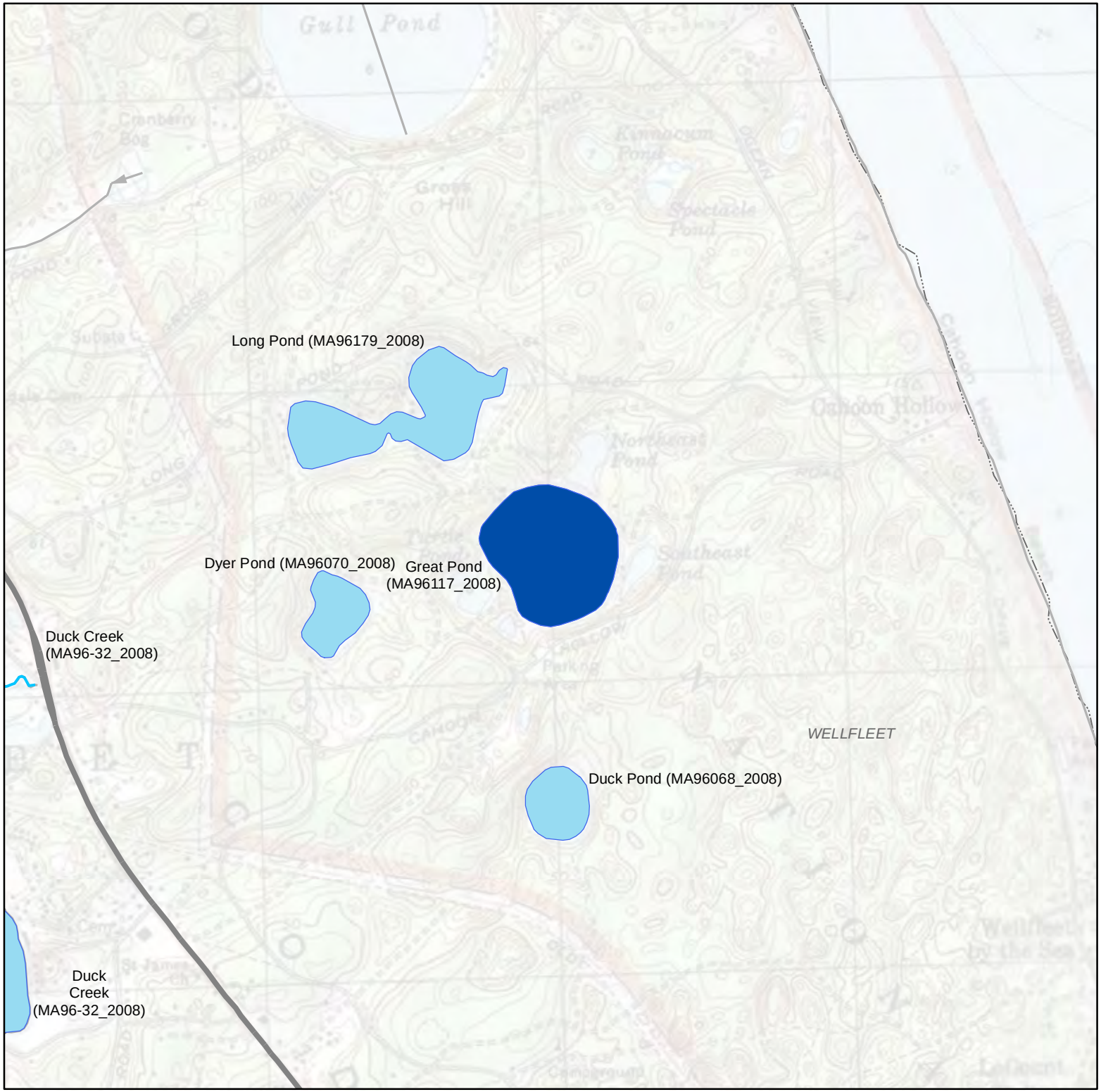
MA96070_2008

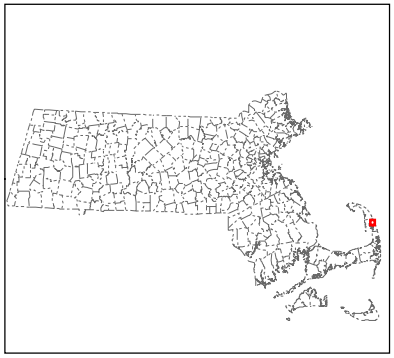
Dyer Pond

Cape Cod

June 2011

massDOT





- Impaired Water Body Being Assessed
- Impaired Water Body
- Impaired Stream Being Assessed
- Impaired Stream Segment
- Non-Impaired Stream Segment
- MA DOT Roads
- MA DOT Urban Area Roads
- Town Boundaries
- Stormwater Outfalls

1,000 500 0 1,000 Feet

N

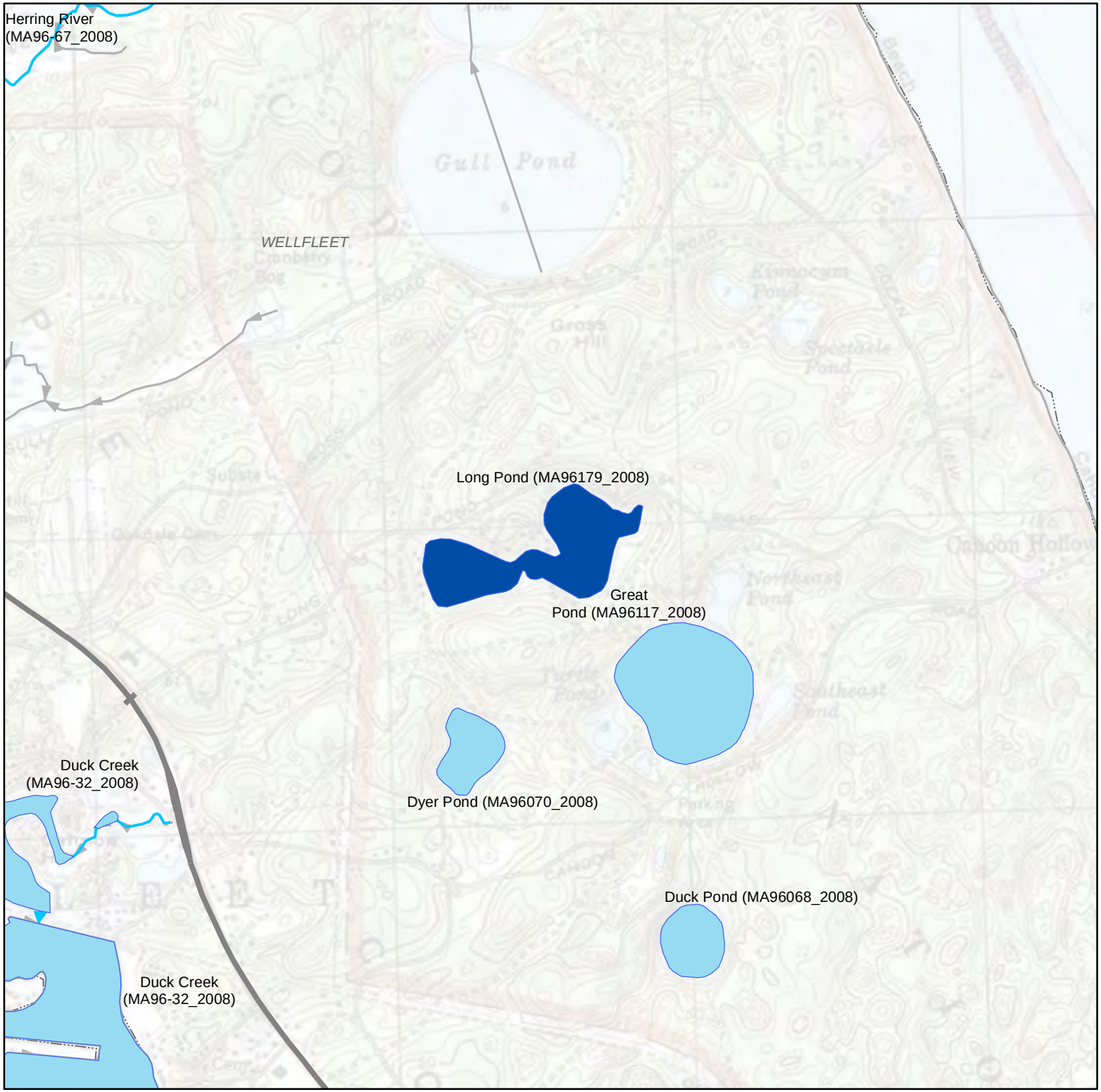
MA96117_2008

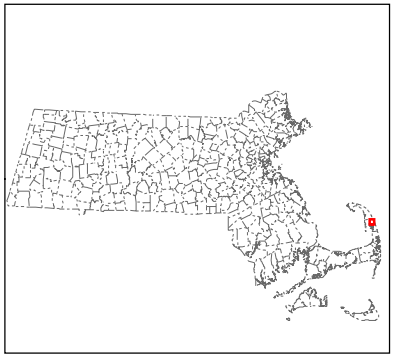
Great Pond

Cape Cod

June 2011

Moving Massachusetts Forward. massDOT





Impaired Water Body Being Assessed

Impaired Water Body

Impaired Stream Being Assessed

Impaired Stream Segment

Non-Impaired Stream Segment

MA DOT Roads

MA DOT Urban Area Roads

Town Boundaries

Stormwater Outfalls

1,000 500 0 1,000 Feet

N

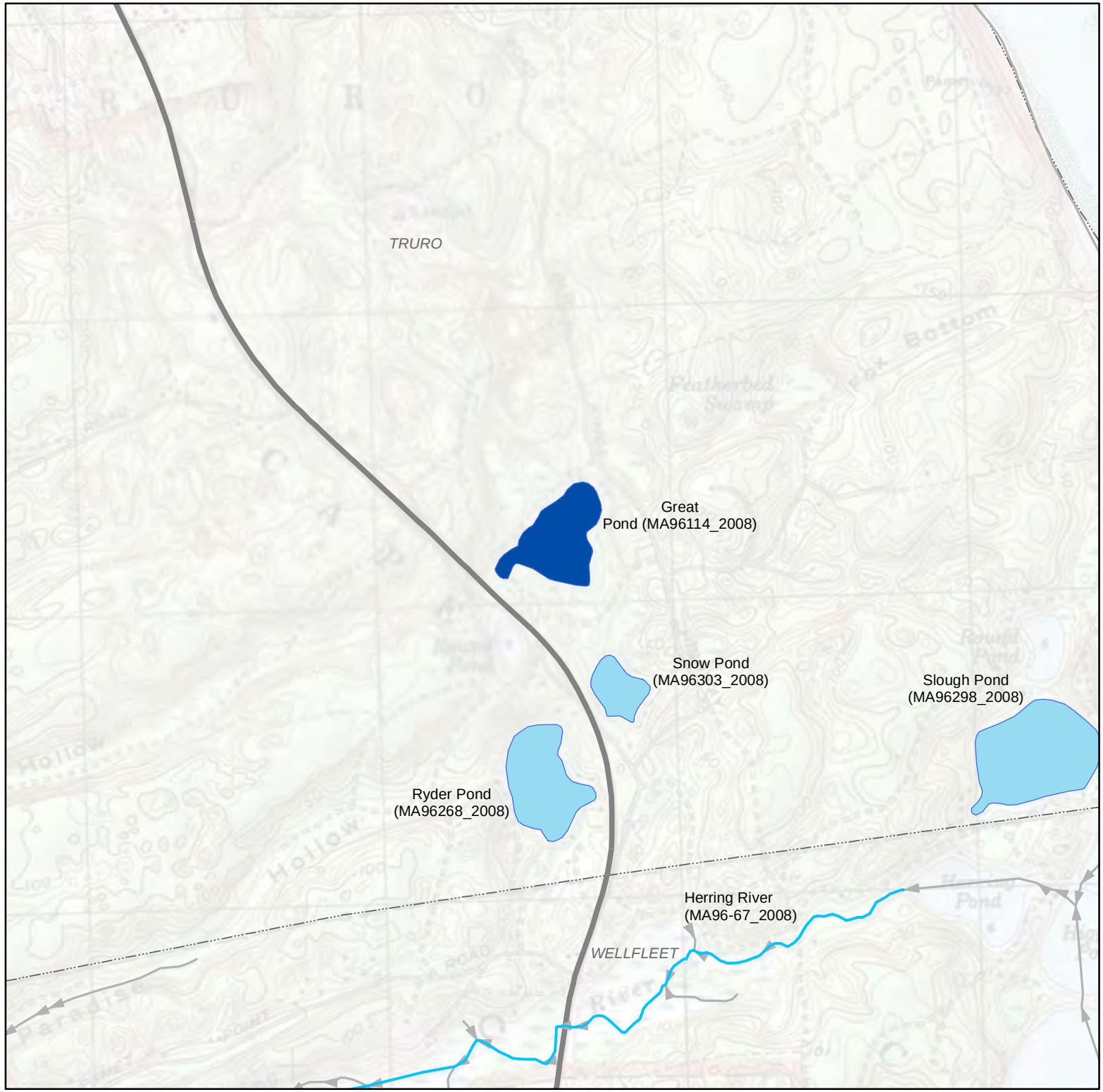
MA96179_2008

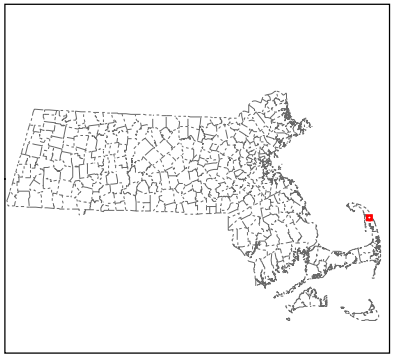
Long Pond

Cape Cod

June 2011

Moving Massachusetts Forward. massDOT





Impaired Water Body Being Assessed

Impaired Water Body

Impaired Stream Being Assessed

Impaired Stream Segment

Non-Impaired Stream Segment

MA DOT Roads

MA DOT Urban Area Roads

Town Boundaries

Stormwater Outfalls

1,000 500 0 1,000 Feet

N

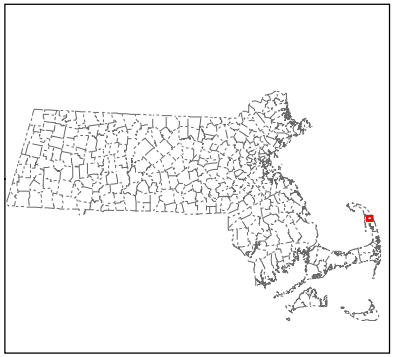
MA96114_2008

Great Pond

Cape Cod

June 2011

massDOT



Impaired Water Body Being Assessed

Impaired Water Body

Impaired Stream Being Assessed

Impaired Stream Segment

Non-Impaired Stream Segment

MA DOT Roads

MA DOT Urban Area Roads

Town Boundaries

Stormwater Outfalls

1,000 500 0 1,000 Feet

N

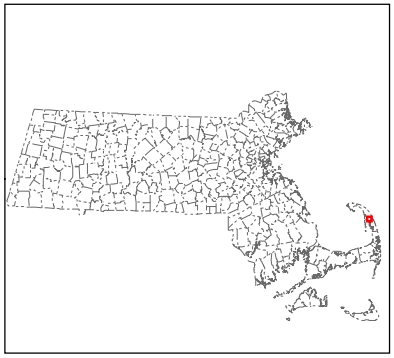
MA96303_2008

Snow Pond

Cape Cod

June 2011

massDOT



Impaired Water Body Being Assessed

Impaired Water Body

Impaired Stream Being Assessed

Impaired Stream Segment

Non-Impaired Stream Segment

MA DOT Roads

MA DOT Urban Area Roads

Town Boundaries

Stormwater Outfalls

1,000 500 0 1,000 Feet

N

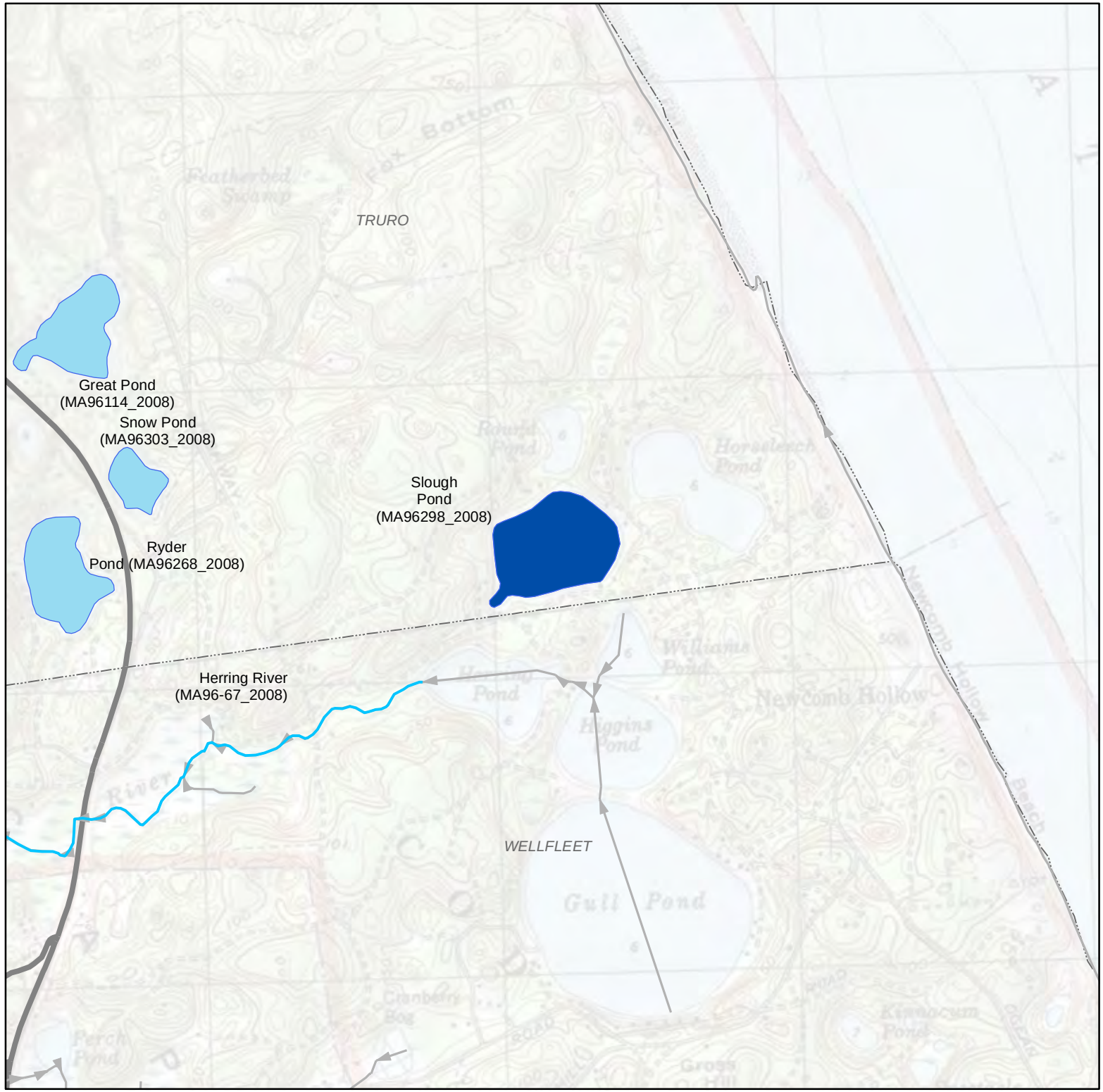
MA96268_2008

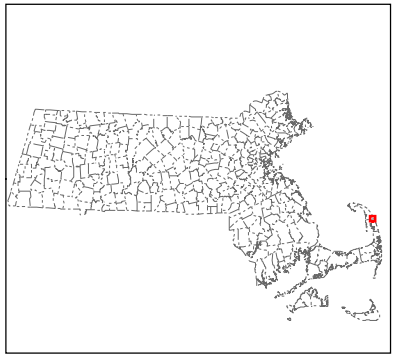
Ryder Pond

Cape Cod

June 2011

massDOT





Impaired Water Body Being Assessed

Impaired Water Body

Impaired Stream Being Assessed

Impaired Stream Segment

Non-Impaired Stream Segment

MA DOT Roads

MA DOT Urban Area Roads

Town Boundaries

Stormwater Outfalls

1,000 500 0 1,000 Feet

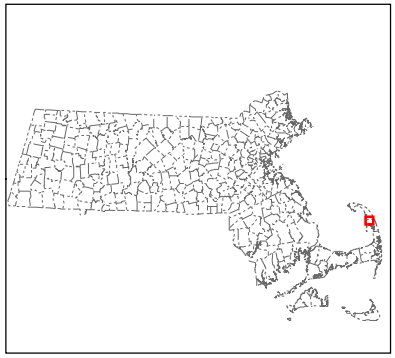
N

MA96298_2008

Slough Pond

Cape Cod

June 2011



Impaired Water Body Being Assessed

Impaired Water Body

Impaired Stream Being Assessed

Impaired Stream Segment

Non-Impaired Stream Segment

MA DOT Roads

MA DOT Urban Area Roads

Town Boundaries

Stormwater Outfalls

2,000 1,000 0 2,000 Feet

N

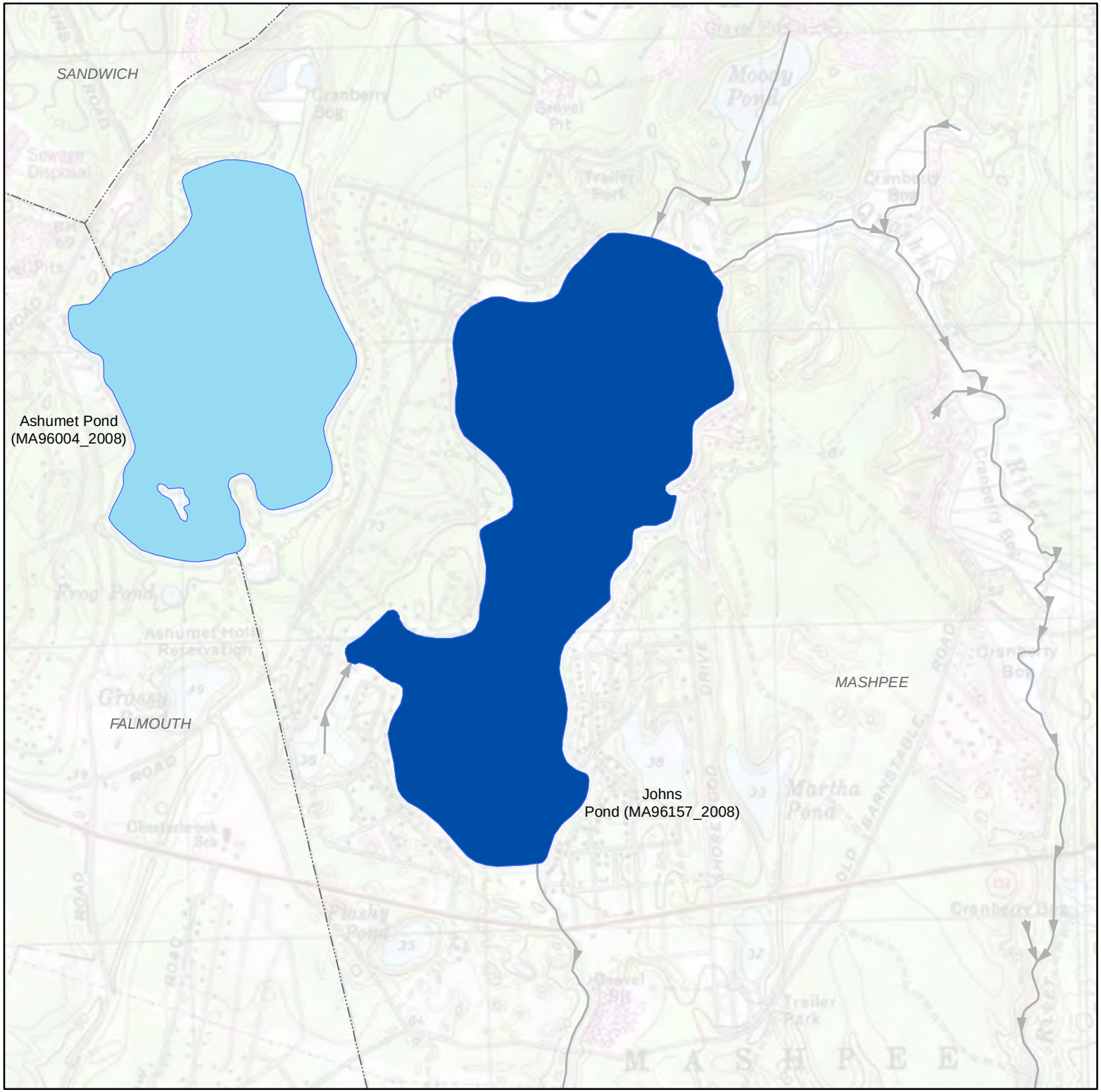
MA96-67_2008

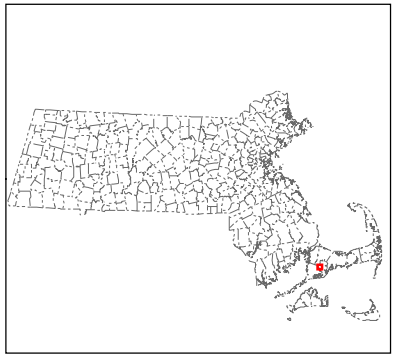
Herring River

Cape Cod

June 2011

massDOT





Impaired Water Body Being Assessed

Impaired Water Body

Impaired Stream Being Assessed

Impaired Stream Segment

Non-Impaired Stream Segment

MA DOT Roads

MA DOT Urban Area Roads

Town Boundaries

Stormwater Outfalls

1,000 500 0 1,000 Feet

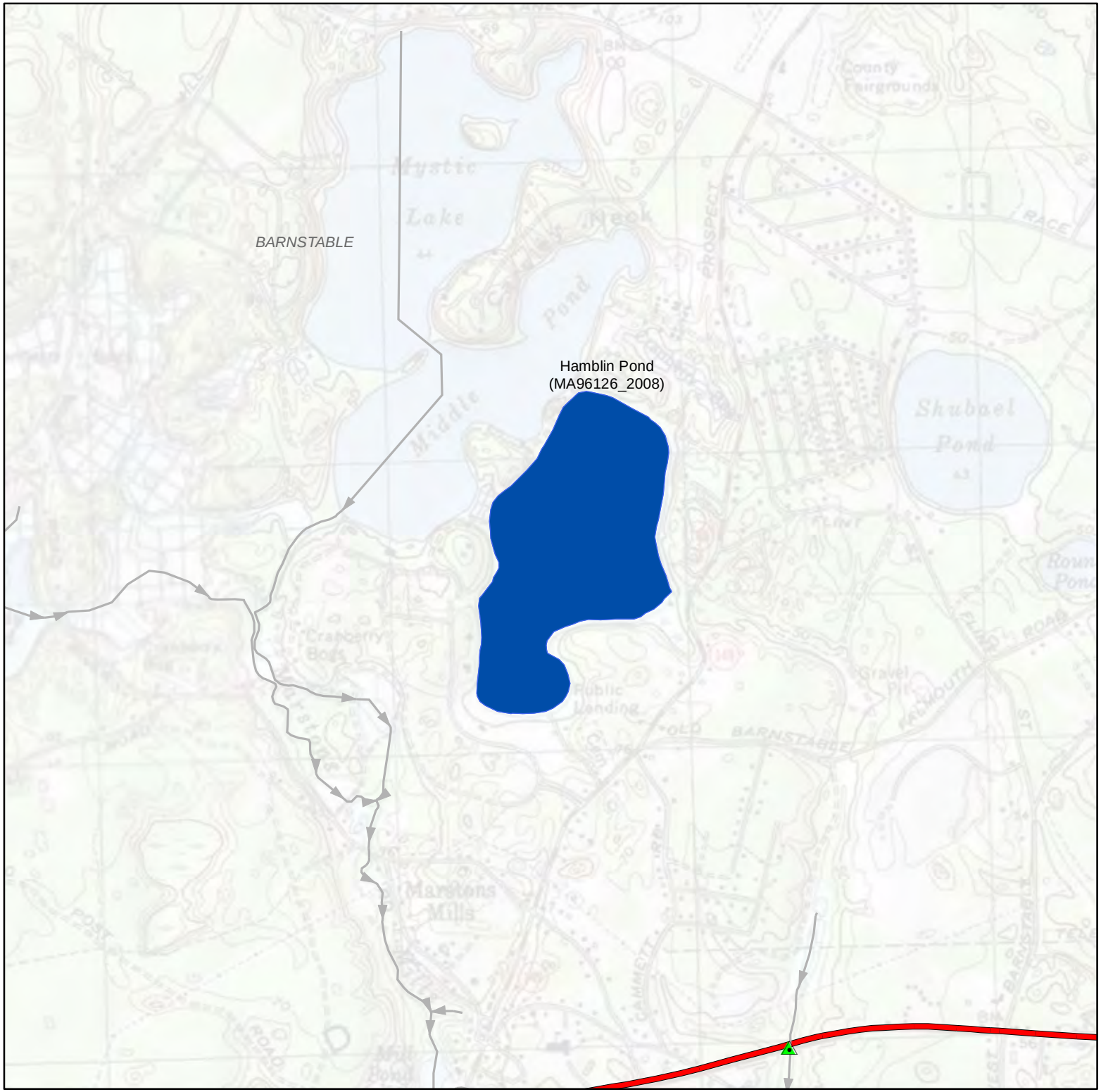
N

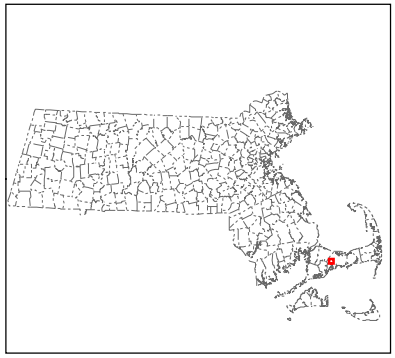
MA96157_2008

Johns Pond

Cape Cod

June 2011





Impaired Water Body Being Assessed

Impaired Water Body

Impaired Stream Being Assessed

Impaired Stream Segment

Non-Impaired Stream Segment

MA DOT Roads

MA DOT Urban Area Roads

Town Boundaries

Stormwater Outfalls

1,000 500 0 1,000 Feet

N

MA96126_2008

Hamblin Pond

Cape Cod

June 2011

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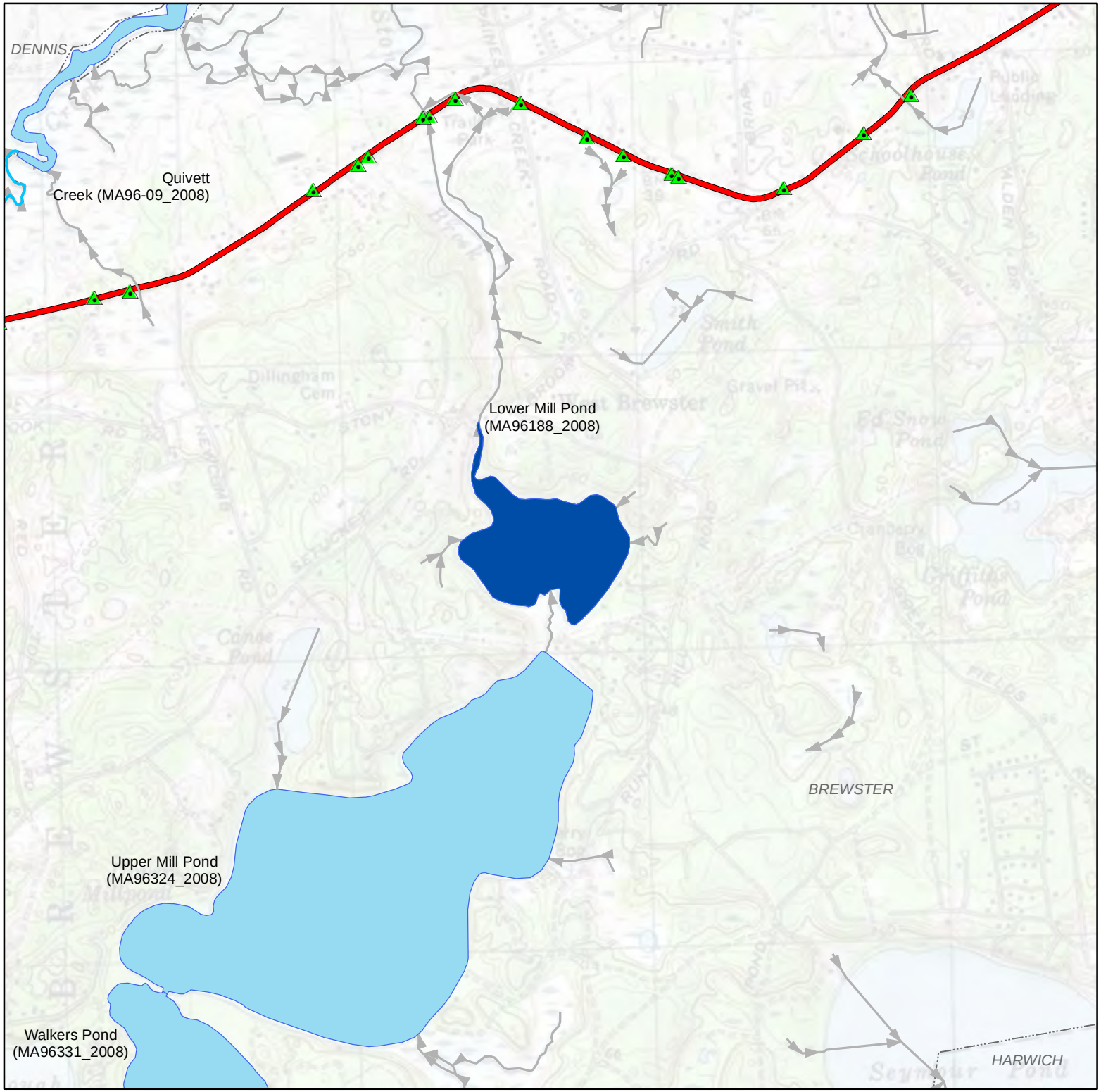
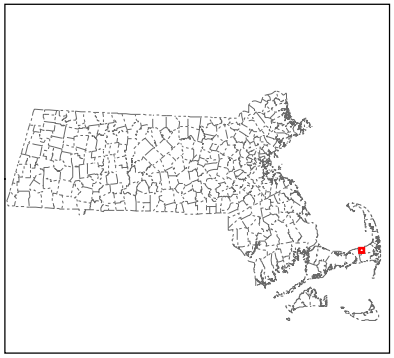




Impaired Water Body Being Assessed

Impaired Water Body

Impaired Stream Being Assessed

Impaired Stream Segment

Non-Impaired Stream Segment

MA DOT Roads

MA DOT Urban Area Roads

Town Boundaries

Stormwater Outfalls

1,000 500 0 1,000 Feet

N

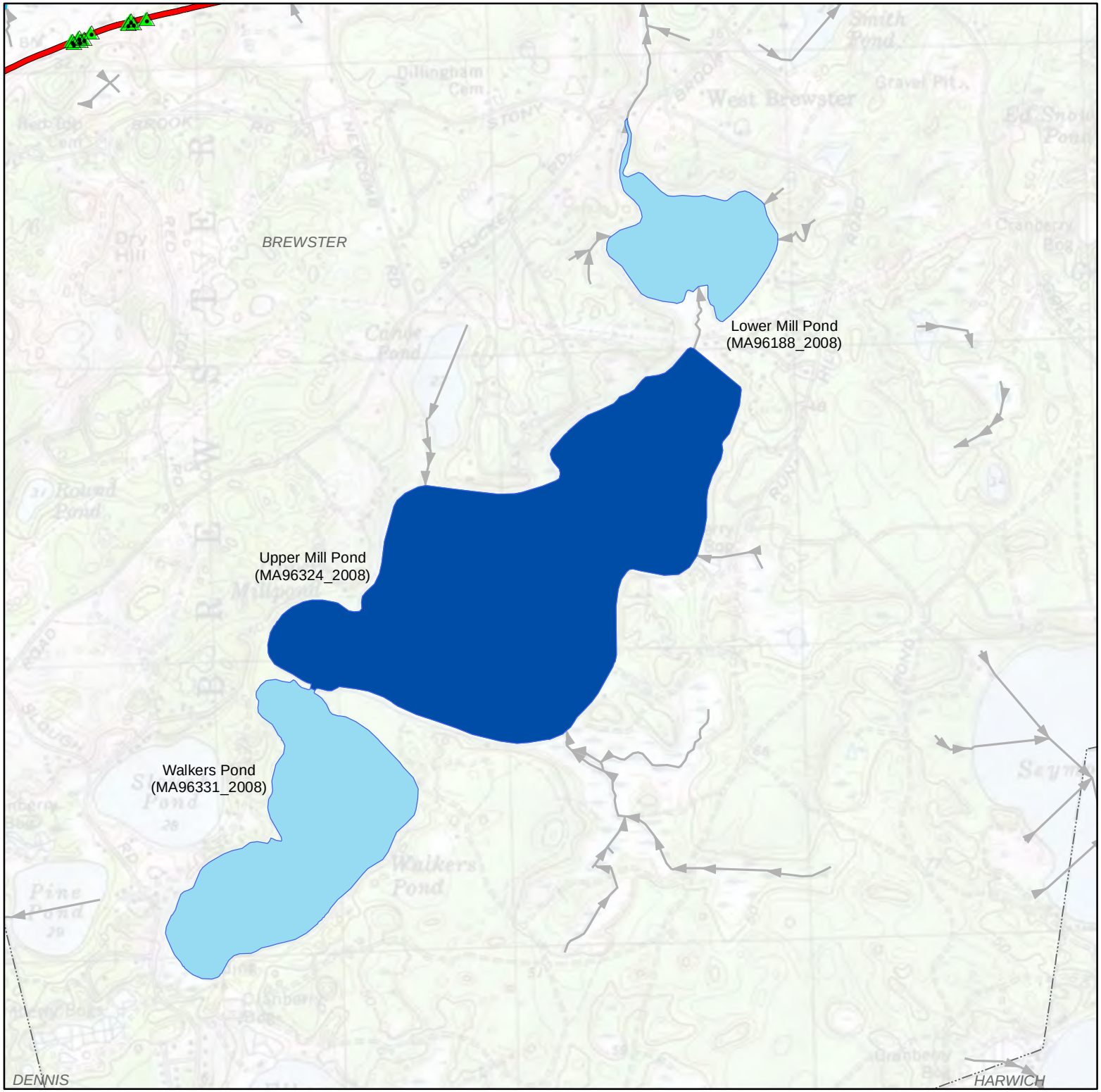
MA96188_2008

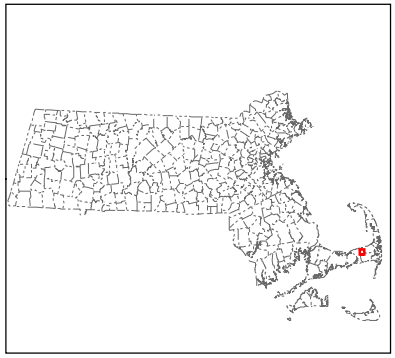
Lower Mill Pond

Cape Cod

June 2011

massDOT





Impaired Water Body Being Assessed

Impaired Water Body

Impaired Stream Being Assessed

Impaired Stream Segment

Non-Impaired Stream Segment

MA DOT Roads

MA DOT Urban Area Roads

Town Boundaries

Stormwater Outfalls

1,000 500 0 1,000 Feet

N

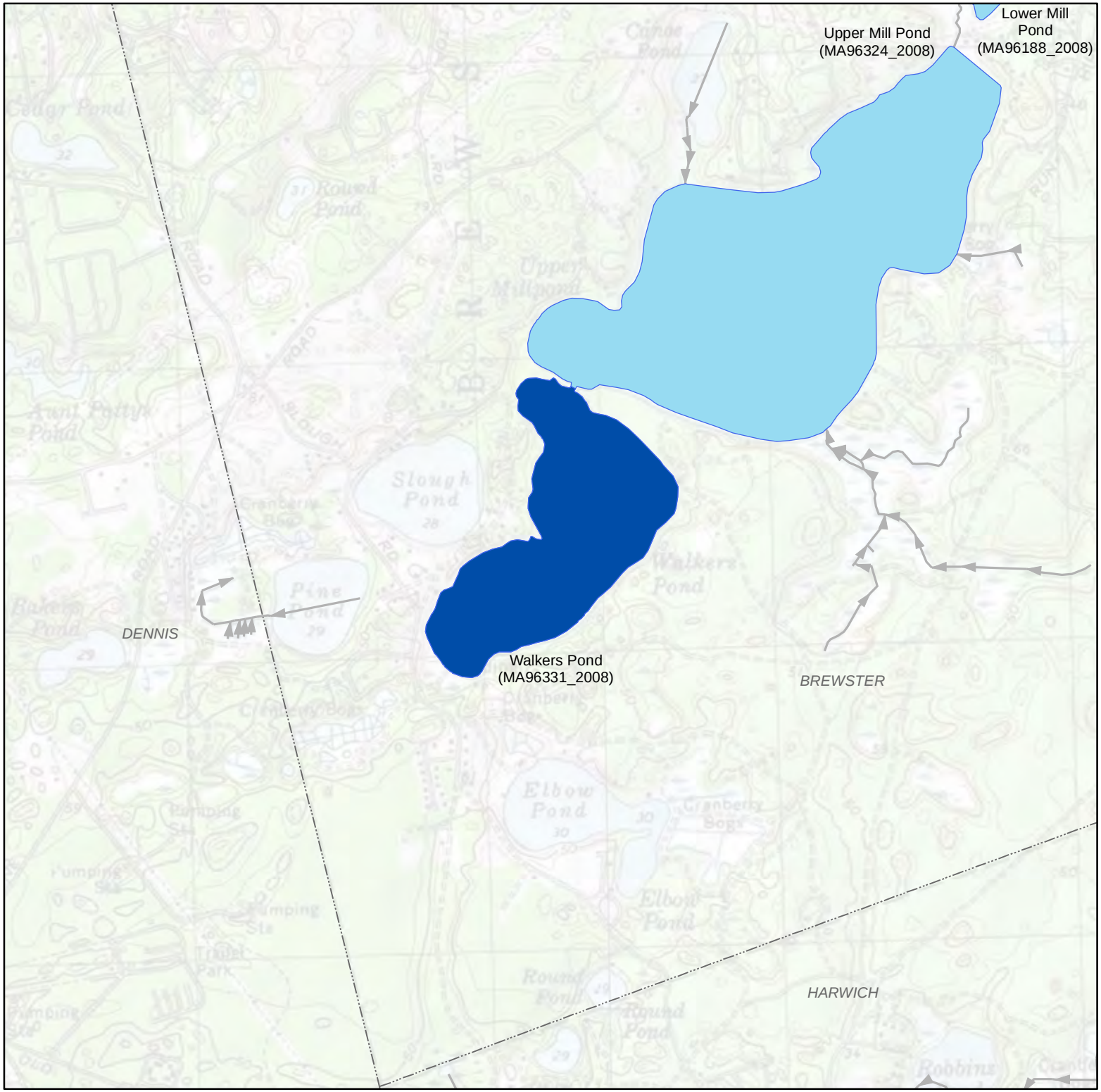
MA96324_2008

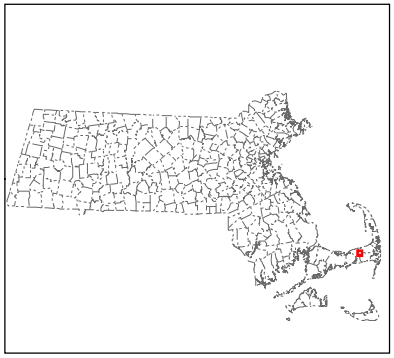
Upper Mill Pond

Cape Cod

June 2011

massDOT





Impaired Water Body Being Assessed

Impaired Water Body

Impaired Stream Being Assessed

Impaired Stream Segment

Non-Impaired Stream Segment

MA DOT Roads

MA DOT Urban Area Roads

Town Boundaries

Stormwater Outfalls

1,000 500 0 1,000 Feet

N

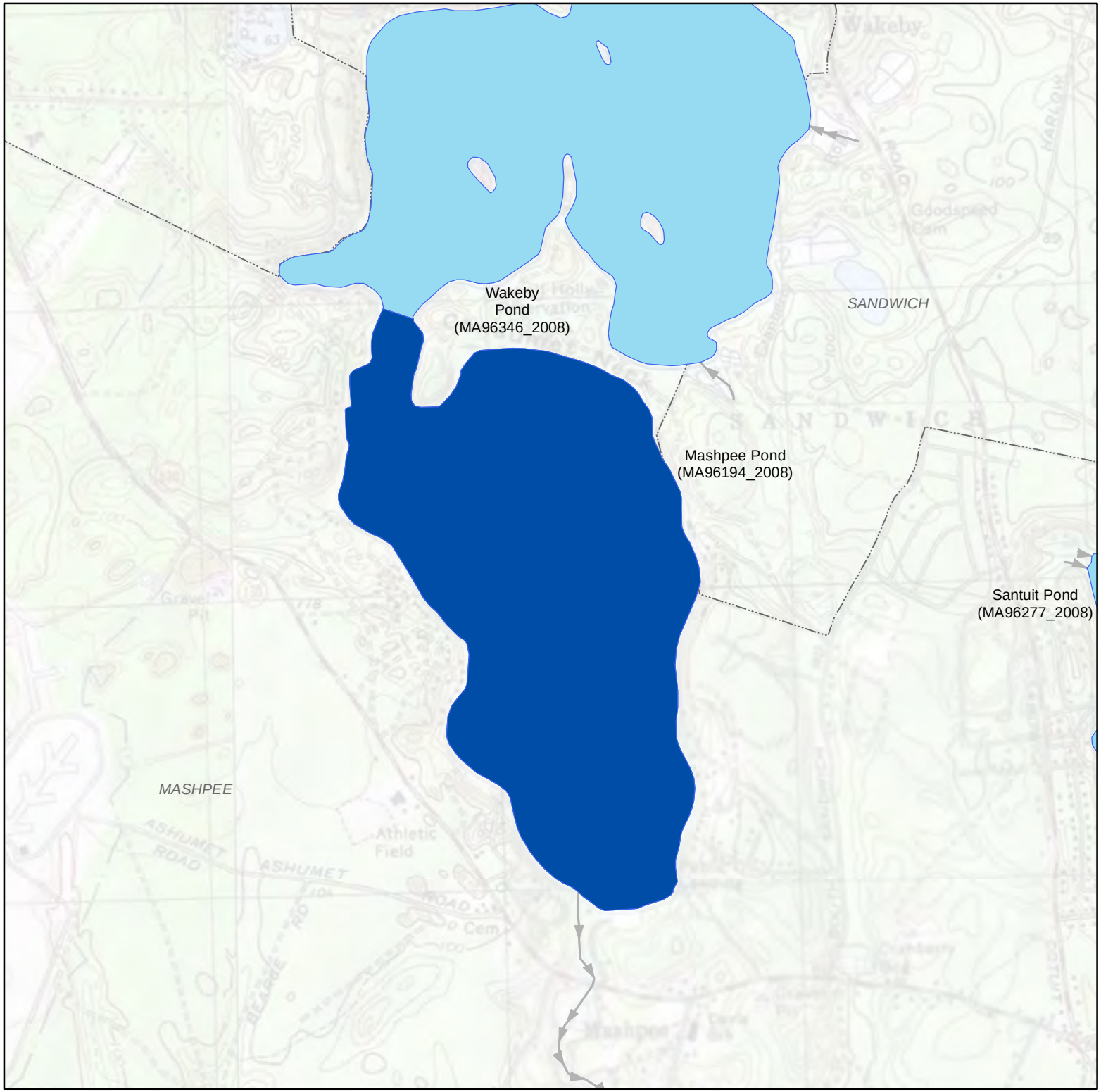
MA96331_2008

Walkers Pond

Cape Cod

June 2011

massDOT

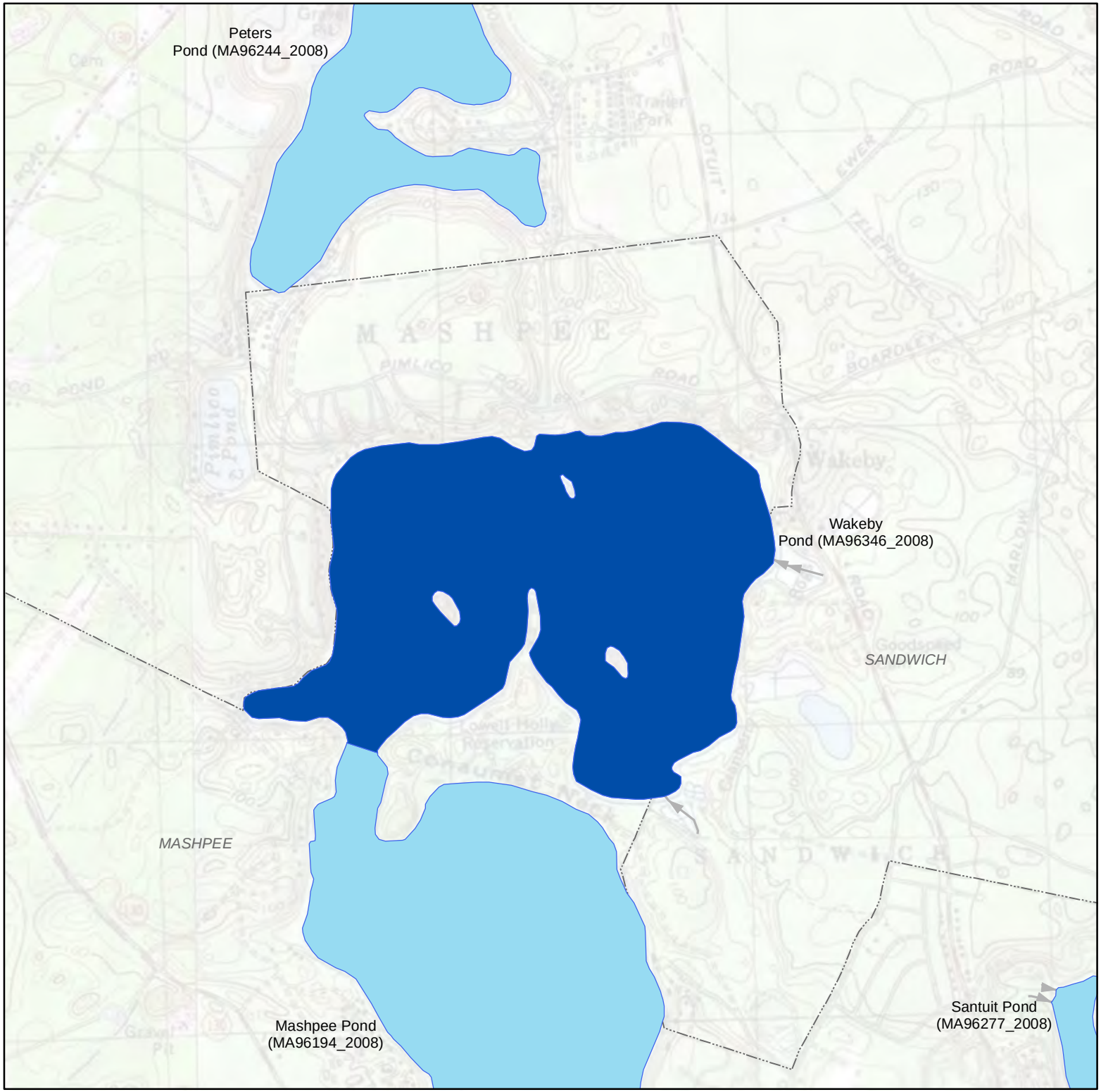


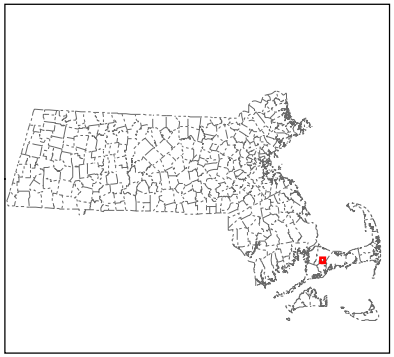
MA96194_2008

Mashpee Pond

Cape Cod

June 2011





Impaired Water Body Being Assessed

Impaired Water Body

Impaired Stream Being Assessed

Impaired Stream Segment

Non-Impaired Stream Segment

MA DOT Roads

MA DOT Urban Area Roads

Town Boundaries

Stormwater Outfalls

1,000 500 0 1,000 Feet

N

MA96346_2008

Wakeby Pond

Cape Cod

June 2011

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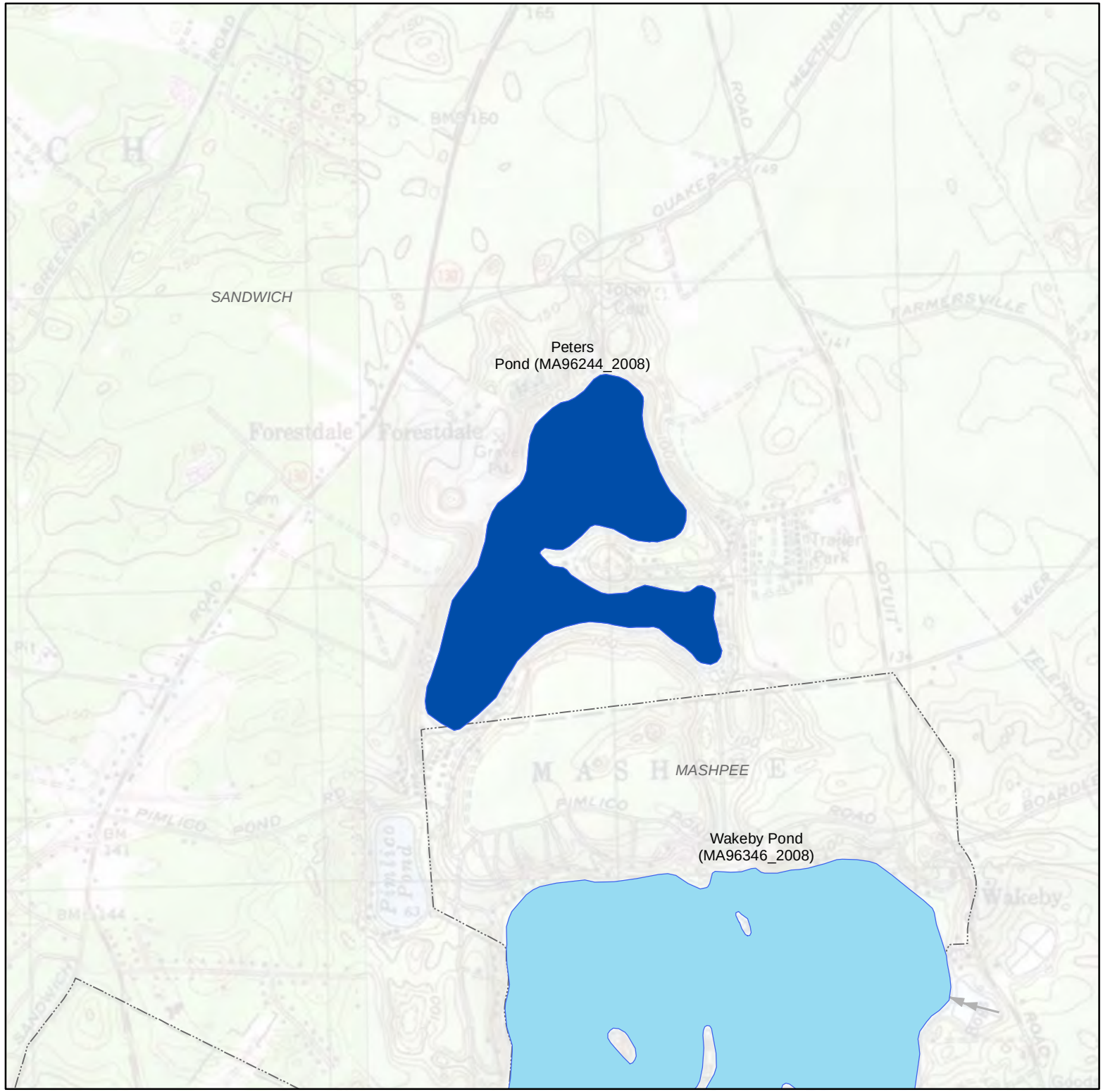
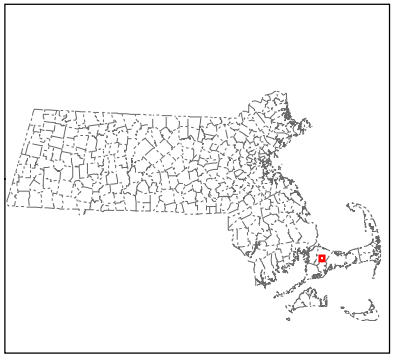




Impaired Water Body Being Assessed

Impaired Water Body

Impaired Stream Being Assessed

Impaired Stream Segment

Non-Impaired Stream Segment

MA DOT Roads

MA DOT Urban Area Roads

Town Boundaries

Stormwater Outfalls

1,000 500 0 1,000 Feet

N

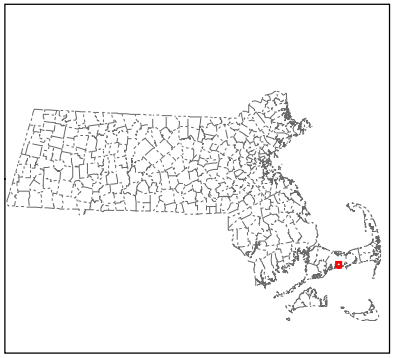
MA96244_2008

Peters Pond

Cape Cod

June 2011

massDOT



Impaired Water Body Being Assessed

Impaired Water Body

Impaired Stream Being Assessed

Impaired Stream Segment

Non-Impaired Stream Segment

MA DOT Roads

MA DOT Urban Area Roads

Town Boundaries

Stormwater Outfalls

1,000 500 0 1,000 Feet

N

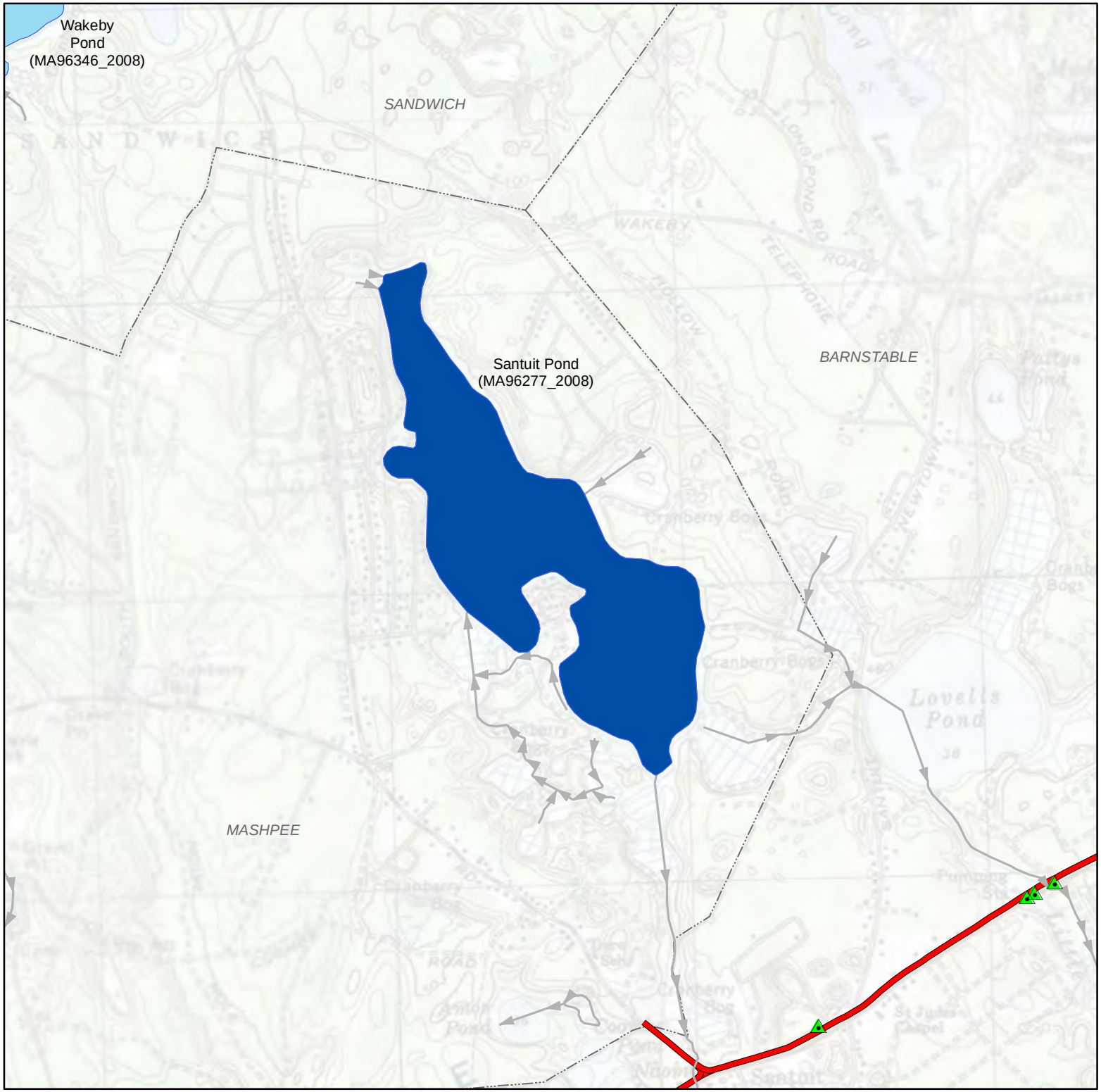
MA96257_2008

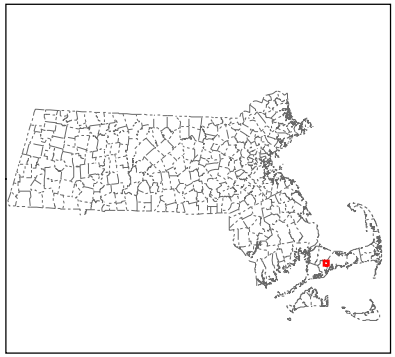
Red Lily Pond

Cape Cod

June 2011

massDOT





Impaired Water Body Being Assessed

Impaired Water Body

Impaired Stream Being Assessed

Impaired Stream Segment

Non-Impaired Stream Segment

MA DOT Roads

MA DOT Urban Area Roads

Town Boundaries

Stormwater Outfalls

1,000 500 0 1,000 Feet

N

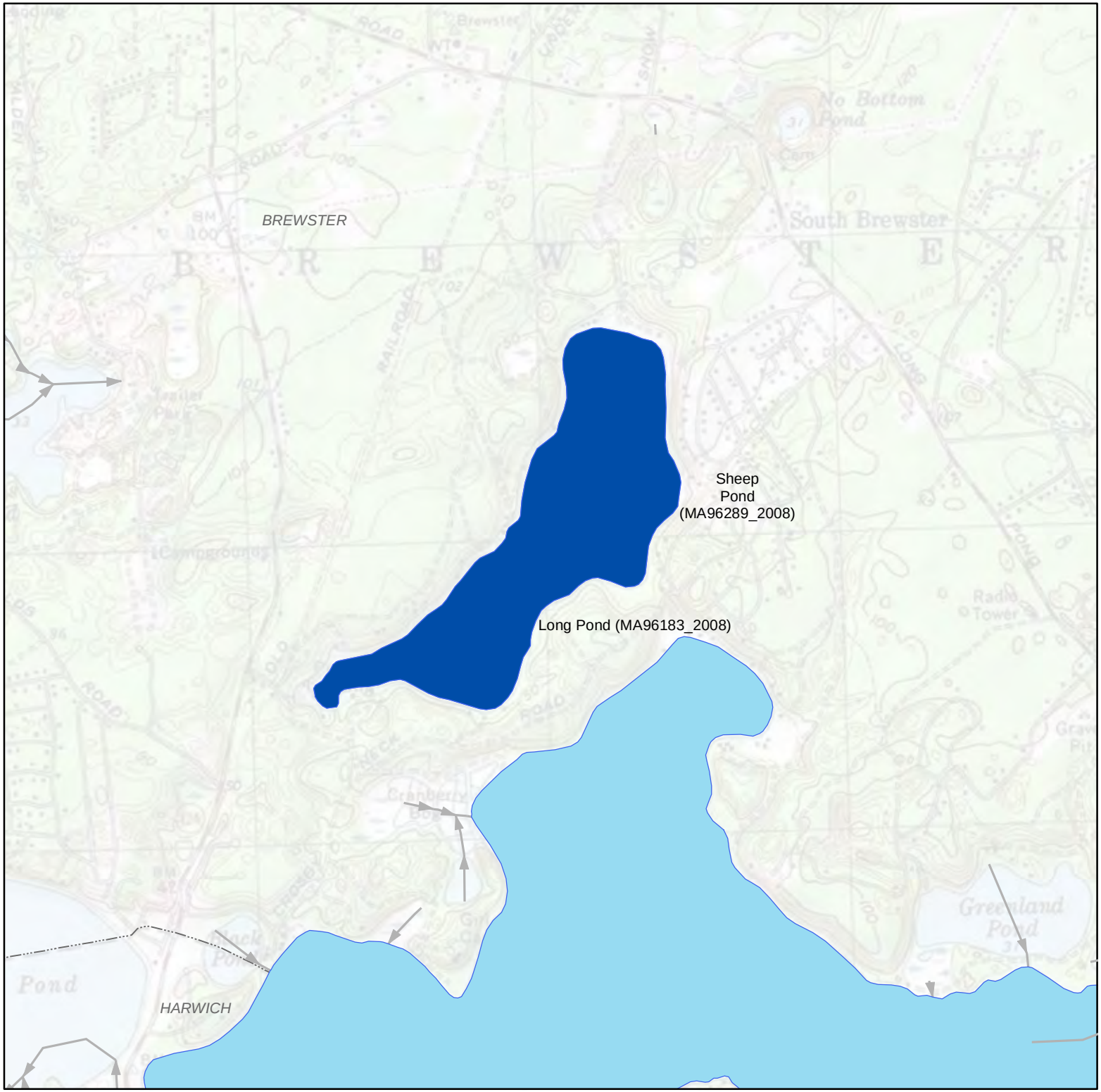
MA96277_2008

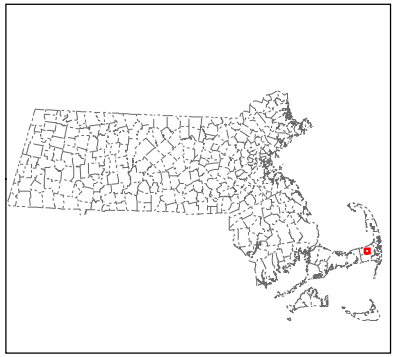
Santuit Pond

Cape Cod

June 2011

Moving Massachusetts Forward. massDOT





Impaired Water Body Being Assessed

Impaired Water Body

Impaired Stream Being Assessed

Impaired Stream Segment

Non-Impaired Stream Segment

MA DOT Roads

MA DOT Urban Area Roads

Town Boundaries

Stormwater Outfalls

1,000 500 0 1,000 Feet

N

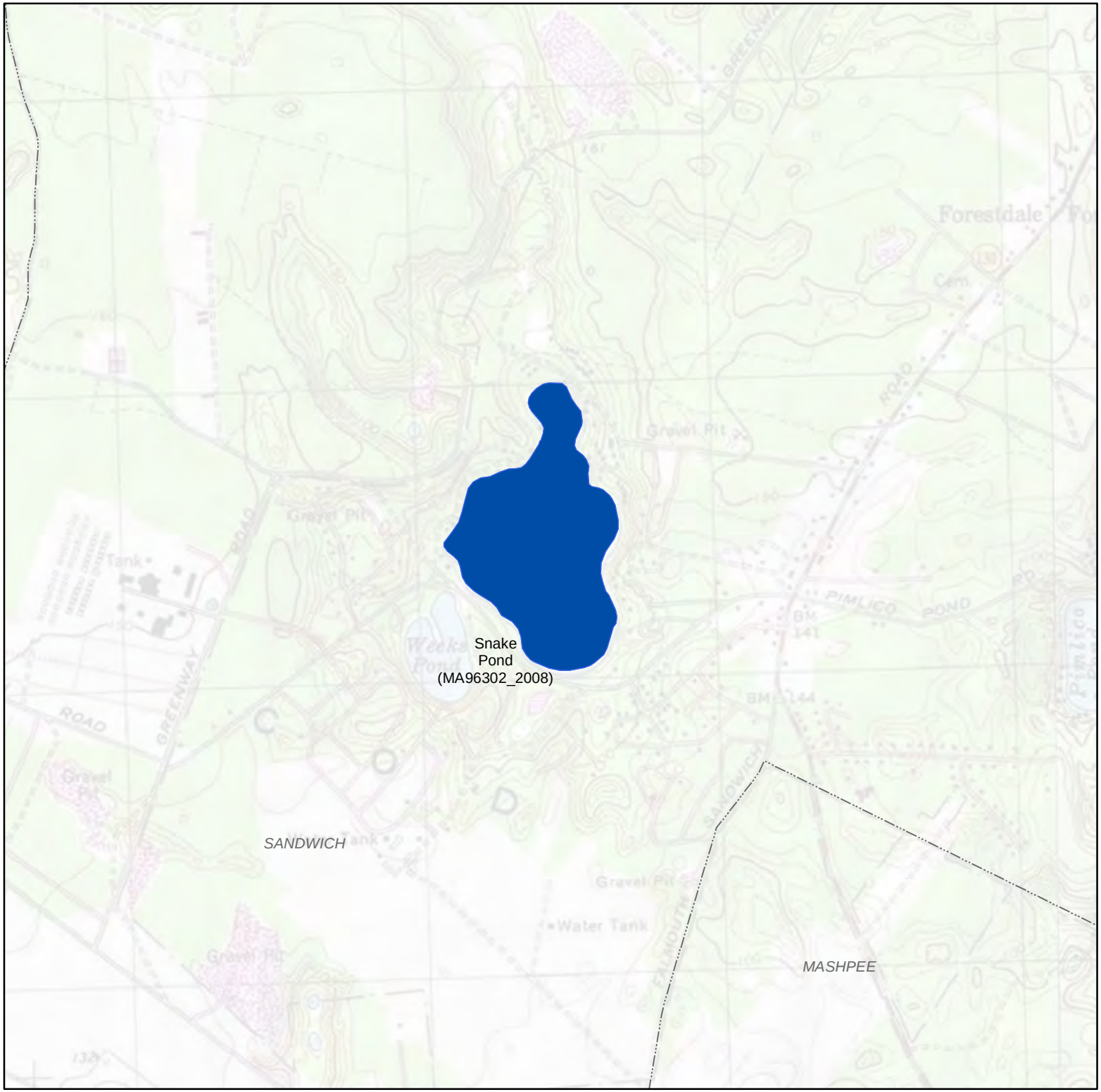
MA96289_2008

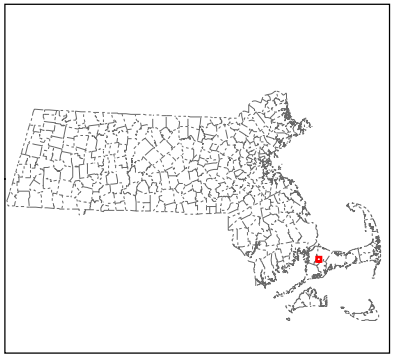
Sheep Pond

Cape Cod

June 2011

massDOT





Impaired Water Body Being Assessed

Impaired Water Body

Impaired Stream Being Assessed

Impaired Stream Segment

Non-Impaired Stream Segment

MA DOT Roads

MA DOT Urban Area Roads

Town Boundaries

Stormwater Outfalls

1,000 500 0 1,000 Feet

N

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Snake Pond

Cape Cod

June 2011

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