MassDOT Quarter 3 Submittal

(December 8, 2010 – March 7, 2011)

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

March 8, 2011

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Massachusetts Department of Transportation
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March 8, 2011

David Gray
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Boston, MA 02110

Subject: Quarter 3 Submittal under MassDOT's Impaired Waters Program

Dear Mr. Gray,

The attached report documents MassDOT's third quarter of the Impaired Waters Program to report on 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 (the "Impaired Waters Program") and BMP 7R: TMDL Watershed Review.

During the third quarter, MassDOT completed assessments on 40 water bodies from Appendix L-1 (dated July 22, 2010, included in MassDOT's July 23 submittal). This quarters submittal includes the following three attachments:

1. **Lowe's Pond:** Attachment 1 includes an assessment for Lowe's Pond (MA 42034) under BMP 7U (TMDL for phosphorus). The assessment includes 15 recommended BMPs to meet the TMDL waste load allocation. Design and permitting of these BMPs will now progress under MassDOT's design contract.
2. **<9% Impervious Cover Watersheds:** Attachment 2 includes water bodies assessed under BMP 7U (other impairments not covered by TMDL reports) where the assessment indicated that the stormwater runoff from MassDOT property is not contributing to the impairment. The analysis used the Impervious Cover (IC) Method and determined that less than 9% of the watershed to the receiving water is impervious. When less than 9% of the watershed is impervious cover, water quality impairments are likely to be caused by other factors.
3. **No Discharge from MassDOT Outfalls:** Attachment 3 includes assessments where desktop review of the subbasin indicates that MassDOT urban roads do not drain to the receiving water in question. This includes receiving waters on the Cape where outfalls are further than 200 feet from the receiving waters. EPA and DEP expressly stated in the Cape Cod TMDLs that stormwater further than 200 feet is unlikely to reach the waterbody due to the soils and geology of the Cape and will instead infiltrate. Therefore, these water bodies have been determined to also not receive discharge from MassDOT urban roads.

Since the winter weather kept MassDOT and its consultant from performing sites visits necessary to locate areas for retrofit BMPs, much of the third quarter was spent further refining which impaired water are impacted by MassDOT. These segments will require full assessments and are more likely to require retrofits.

MassDOT has completed contracts with two design firms (VHB and Tetratech) who are developing design and construction documents for BMPs proposed in assessments previously

submitted. VHB is designing the BMPs proposed in the Blackstone River (MA51-03) assessment included in the Quarter 2 submittal. Tetratech is designing BMPs proposed in the Quarter 2 Burncoat Pond (MA51012) assessment and is nearing the 75% design stage. Design of the BMPs recommended for Lowe's Pond will also be completed by one of the two design firms and included in construction contracts.

MassDOT also continues to proactively include structural BMPs into programmed projects as part of MassDOT's "Impaired Waters Program: Programmed Projects" Initiative. This new initiative ensures that every construction project under design has been assessed for the impact of highways on impaired waterbodies. The assessment includes a review of drainage patterns to determine impaired waters that are affected by runoff from these portions of MassDOT roads and an evaluation of existing BMPs in the area. In addition, any known water quality impairments and TMDL documents (if applicable) are considered to determine whether stormwater BMP improvements may be required at each site. MassDOT is coordinating this process with its on-going assessments under BMP 7U and 7R to ensure consistency in its assessments and recommendations. By adding structural BMPs as part of planned projects, MassDOT efficiently addresses the water quality impacts as part of planned projects. MassDOT also, as a general matter, will be able to build more comprehensive BMPs with fewer site constraints than through a typical "retrofit" project.

An example of the work completed this quarter under the Programmed Projects Initiative was the review of federally funded FY2011 repaving jobs to determine the need and ability to install structural BMPs. The reviews determined that additional structural BMPs would be built as part of the following projects:

1. the Route 2 resurfacing project that drains to the North Nashua River (MA81-03) in Leominster,
2. the Interstate 395 repaving job in Oxford that drains to Lowes Pond (MA42034) and
3. the Route 95 job in Canton that drains to Traphole Brook (MA73-17) in Walpole, MA; Neponset River (MA73-01) in Canton/Norwood; Neponset River (MA73-02) in Norwood; and Ponkapog Brook (MA73-27) in Canton.

Additionally, structural BMPs are planned for other programmed projects. The numerous structural BMPs included in design contracts in 2010/2011, as part of the new program, will be summarized in the Permit Year 8 Annual Report to be submitted to EPA by April 30, 2011. These BMP upgrades will be realized in the coming years as part of ongoing Statewide Transportation Improvement Projects.

This submittal brings the total number of impaired waters assessments to 109. Of these impaired waters assessments, 38 have included waters with TMDLs. The fourth quarter assessments will focus on waters with TMDLs and identifying sites that require retrofits.

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
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cc: Kathleen Woodward, Esq., EPA Region I
Al Caldarelli, Esq., MassDOT

Attachment 1:
Impaired Waters Assessment for Lowes Pond (MA42034)

Impaired Waters Assessment for Lowes Pond (MA 42034)

Impaired Water Body

Name: Lowes Pond

Water Body ID: MA 42034

Impairments

Lowes Pond (MA42034) is impaired for Noxious Aquatic Plants according to both the Final Year 2008 and the Proposed Year 2010 List of Integrated Waters. Lowes Pond is also listed in both documents as a Category 4a water body and is covered by a Total Maximum Daily Load (TMDL) for Phosphorus.

Relevant Water Quality Standards

- Water Body Classification: Class B

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

- 314 CMR 4.05 (5)(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

Lowes Pond is a small water body in Oxford, MA of approximately 33.4 acres. The pond lies downstream of McKinstry Pond and outlets to Lowes Brook through a dam which holds back approximately 10 vertical feet of water. According to both the Final Year 2008 and Proposed Year 2010 List of Integrated Waters, Lowes Pond is impaired for Noxious Aquatic Plants and falls under the Total Maximum Daily Load (TMDL) for Phosphorus for selected basins within the French River Watershed.

MassDOT's Interstate 395 (I-395) bisects Lowes Pond just south of the interchange between I-395 and Sutton Avenue (Exit 4). I-395 is a major north-south highway running from Interstate 90 (I-90) in Auburn to the Massachusetts-Connecticut border. The entire highway is a divided, two-lane roadway with small, piped storm water collection systems discharging to outfalls along either side. Lowes Pond is channeled beneath the highway via two concrete culverts approximately 25 to 30 feet in width. A small portion of the southbound on-ramp at the Sutton Avenue interchange is immediately adjacent to the pond's shore.

Approximately 96 acres of MassDOT's property directly contribute storm water runoff to Lowes Pond. This watershed, shown in Figure 1, is comprised entirely of I-395, including roadway, shoulder, and median areas. Storm water from roughly 47% of the MassDOT catchment area (approximately 45 acres) is directed into a series of four interconnected storm water wetlands before discharging to Lowes Pond. Three out of the four of the storm water wetlands are located within the cloverleaf of the interchange between I-395 and Sutton Avenue (Exit 4). The fourth wetland is located along the right-hand shoulder of the northbound off-ramp at this same interchange. The wetlands are hydraulically connected by a series of concrete culverts, ultimately discharging to Lowes Pond along the right-hand shoulder of the southbound on-ramp for I-395 at the Sutton Avenue interchange.

Storm water from approximately 2 acres of the MassDOT catchment area flows directly from Outfalls 13582-13585 into Lowes Pond with little overland flow. These outfalls are positioned on a slope of approximately one horizontal to three vertical and are within 10 to 15 feet of the shoreline. Refer to Figure 2 for exact locations.

Storm water from the remainder of the watershed generally discharges through outfalls to culverts and conveyance ditches along the shoulder and within median of I-395. Conveyance ditches consist mostly of heavily-eroded channels that direct storm water along the shoulder of the highway and finally into Lowes Pond.

Assessment under BMP 7R for Phosphorus

The TMDL for Phosphorus addresses the impairment for Noxious Aquatic Plants for Lowes Pond. Therefore, MassDOT assessed the contribution of Phosphorus from MassDOT urban areas to this water body using the approach described in BMP 7R (TMDL Watershed Review).

TMDL

The Massachusetts Department of Environmental Protection's (MassDEP) TMDL report titled "Total Maximum Daily Loads of Phosphorus for Selected French Basin Lakes" (EPA, 2002) can be summarized as follows in reference to Lowes Pond:

- Pollutant of Concern: Phosphorus
- Impairment for Lowes Pond Addressed in TMDL: Nutrients (Total Phosphorus)
- Applicable Waste Load Allocation (WLA): See Tables 3 (p. 56), 4k (p. 62), and 2k (p. 105) of TMDL.
  - Description of Associated Land Use: Commercial/Industrial
  - Commercial/Industrial Land Use Current Load (TP): 94 kg/yr (207.7 lbs/yr)
  - Commercial/ Industrial Land Use Target WLA (TP): 23 kg/yr (50.7 lbs/yr)
  - Commercial/Industrial Area in Watershed: 94.2 ha (232.8 acres)
  - Commercial/Industrial Land Use Target Areal WLA (TP): 0.24 kg/ha/yr (0.22 lb/acre/yr)
- Applicable Recommendations: "Public education, Non-Point Source (NPS) Watershed Survey, Lake Management Plan, Residential BMPs, Urban Stormwater BMPs, Highway BMPs" (Table 7, page 72)

Estimated Loading from MassDOT

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

- MassDOT estimates the TP loading from its impervious areas as 1.65 lb/acre/yr. This loading rate is based on data collected in a study of storm water runoff conducted by the United States Geological Survey (USGS) (Smith and Granato, in press). The study analyzed storm water samples from 12 sites located on highways operated by MassDOT across Massachusetts between September 2005 and September 2007. Samples were taken under a variety of weather conditions during this period.
- MassDOT estimates the TP loading from its pervious areas as 0.6 lb/acre/yr. This loading rate is based on the loading rate for hayland provided in the United States Environmental Protection Agency's (EPA) document EPA 440/5-80-011, "Modeling phosphorus loading and Pond response under uncertainty: a manual and compilation of export coefficients" (Reckhow, 1980). Hayland was chosen to represent the pervious right-of-way areas which are typically cleared areas that are mowed only once per year.
- Estimated MassDOT area that drains directly to Lowes Pond is approximately 96 acres.
- MassDOT calculated the current TP loading from its storm water runoff to Lowes Pond using the estimated loading rates and area listed above. This TP loading is 92.2 lb/yr without accounting for existing BMPs or treatment throughout the watershed.
- MassDOT calculated the target TP WLA for its storm water runoff to Lowes Pond using the target areal WLA of 0.22 lb/acre/yr)included in the TMDL report. This target TP WLA is 20.9 lb/yr.

Assessment and Mitigation Plan

MassDEP's TMDL report titled "Total Maximum Daily Loads of Phosphorus for Selected French Basin Lakes" does not specifically quantify the current TP loading or target TP WLA for MassDOT property. Instead, the report lumps MassDOT's property in with the "commercial/industrial" land use for which it lists a current TP loading rate of 94 kg/yr (207.7 lbs/yr) and a target TP WLA of 23 kg/yr (50.7 lbs/yr).

MassDOT calculated its current TP loading rate (92.2 lbs/yr) and its target the TP WLA (20.9 lbs/yr) using values provided in MassDEP's TMDL report. The difference between these two values represents the required reduction in TP that MassDOT must achieve to comply with the TMDL. For the watershed contributing to Lowes Pond, this required reduction is 71.3 lbs, or 77%.

Table 2 summarizes MassDOT's existing and recommended storm water BMPs and shows the approximate reduction in TP the recommended BMPs will provide for each outfall. MassDOT has assigned TP removal efficiencies to existing and recommended BMPs based upon MassDEP's Massachusetts Stormwater Handbook (2008) and a report written by the United States Environmental Protection Agency's (EPA) Region 1 titled "Stormwater Best Management Practices (BMP) Performance Analysis." This report analyzed the long-term performance of selected BMPs for various pollutants associated with storm water runoff.

Existing BMPs consist of a series of four interconnected storm water wetlands. These storm water wetlands treat runoff from approximately 45 acres of MassDOT's property before discharging to Lowes Pond and are estimated to remove a total of approximately 30.9 lbs of TP. Although the storm water wetlands individually provide an approximate reduction in TP load of only 40%, MassDOT has listed the cumulative reduction each storm water wetland catchment will receive once it travels through the remaining storm water wetlands in series.

MassDOT has prepared recommendations for additional BMPs to address the TMDL's targeted TP loading for Lowes Pond. In general, these recommendations focus on the following:

- Converting existing grass ditches into water quality swales by reestablishing vegetative cover to slow runoff velocity and promote infiltration and adding check dams to provide detention and promote the settling of suspended particles.
- Rerouting existing outfalls to the median areas and adding additional vegetation (where necessary) to slow runoff velocities and promote infiltration.
- Installing infiltration BMPs to reduce peak flows and volumes, promote infiltration, and allow for settling of suspended particles.

The recommended BMPs provide 77% removal of TP from MassDOT's directly contributing urban property, meeting the 77% reduction required by the TMDL. Refer to Figure 2 for exact locations of the recommended BMPs.

In most instances, MassDOT chose infiltration BMPs because they provide a very high percentage of TP removal when sized for a one-inch water quality volume. Infiltration BMPs rely upon the infiltration ability of underlying soils for proper function. 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 mostly of HSG A. The corresponding infiltration rates for this HSG are relatively high and thus suitable for the installation of infiltration BMPs. At several outfalls, MassDOT did observe some standing water possibly indicating poor infiltration. This standing water, however, is likely due to accumulated silt and sediment, and once excavated and replaced with suitable material the areas should allow for better infiltration of storm water into the subsurface. MassDOT will conduct site-specific soil testing before designing and installing infiltration BMPs.

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

Table 2. Removal Efficiencies of Existing and Recommended Water Quality BMPs

BMP Identifier	BMP Type	TP Reduction Effectiveness	MassDOT Catchment Area (acres)		Pre-BMP Load (lb/yr)	Reduction Achieved (lb/yr)	Final Load (lb/yr)	Areal Load (lb/yr)
			Impervious	Pervious				
Existing								
Stormwater Wetland 1	Stormwater Wetland	87%	4.4	11.2	14.0	12.2	1.8	0.12
Stormwater Wetland 2	Stormwater Wetland	78%	3.8	9.4	11.9	9.4	2.6	0.19
Stormwater Wetland 3	Stormwater Wetland	64%	3.8	9.5	12.0	7.7	4.3	0.32
Stormwater Wetland 4	Stormwater Wetland	40%	2.0	1.1	3.9	1.6	2.3	0.77
Recommended								
BMP 1 - Outfall 10390	Infiltration Basin	93%	1.5	3.0	4.3	4.0	0.3	0.07
BMP 2 - Outfall 10391	Infiltration Basin	93%	1.5	1.9	3.7	3.4	0.3	0.07
BMP 3 - Outfalls 10392 & 10392.1	Infiltration Basin	93%	0.4	1.6	1.6	1.5	0.1	0.06
BMP 4 - Outfall 10394	Infiltration Basin	93%	0.3	0.0	0.5	0.5	0.0	0.11
BMP 5 - Outfall 10395	Infiltration Basin	93%	0.3	0.0	0.5	0.5	0.0	0.12
BMP 6 - Outfall 13633.4	Infiltration Basin	93%	0.8	0.0	1.4	1.3	0.1	0.12
BMP 7 - Outfalls 10393 & 10513	WQ Swale & Infiltration Basin	94%	1.2	2.4	3.4	3.2	0.2	0.06
BMP 8 - Outfall 10396	WQ Swale & Infiltration Basin	94%	0.4	1.1	1.3	1.2	0.1	0.05
BMP 9 - Outfall 10512	Infiltration Basin	93%	0.3	0.1	0.6	0.6	0.0	0.10
BMP 10 - Outfall 13579	Infiltration Basin	97%	1.0	0.8	2.1	2.0	0.1	0.04
BMP 11 - Outfall 13582	Vegetated Filter Strip	75%	0.7	2.4	2.5	1.9	0.6	0.21
BMP 12 - Outfalls 13583, 13584, 13585	Vegetated Filter Strip	75%	1.4	0.8	2.8	2.1	0.7	0.32
BMP 13 - Outfalls 13590 & 13591	Infiltration Basin	97%	0.5	0.0	0.7	0.7	0.0	0.05
BMP 14 - Outfall 13587	WQ Swale	21%	0.9	1.6	2.4	0.5	1.9	0.77
BMP 15 - Outfall 13631.4	WQ Swale	21%	0.3	0.0	0.4	0.1	0.4	1.30
Total	-	77%	25	47	70	54	16	0.22

Notes:

- Reduction Effectivness is derived from EPA (March 2010) and MassDEP (*Massachusetts Stormwater Handbook*, 2008).
- Values listed for Reduction Effectiveness assume highway surfaces are equivalent to the "commercial land use" used in EPA's report "Stormwater Best Management Practices (BMP) Performance Study" (Revised March 2010) and assume a Water Quality Volume of 1.0 inches. TP Reduction Effectiveness for infiltration BMPs is based on estimated soil infiltration rates corresponding to each of the four soil groups defined by the Soil Conservation Service (SCS).

BMP 1 - Outfall 10390

Outfall 10390 is an 18 inch concrete outlet receiving storm water from approximately 5 acres of roadway. It discharges to the shoulder along the southbound side of I-395. Storm water has eroded a small pool where MassDOT observed standing water under dry-weather conditions (shown in the photograph below). It appears that under storm conditions, runoff entering this pool flows into an adjacent 36 inch culvert that flows into the median and then to the opposite side of the highway. MassDOT proposes to install an infiltration basin at this outfall. MassDOT will direct overflow from the infiltration basin into the adjacent culvert during high flow conditions. Refer to Figure 2 for the exact location of this culvert.

BMP 2 - Outfall 10391

Outfall 10391 is a 24 inch concrete outlet and receives storm water from approximately 3 acres of MassDOT property, mostly roadway. It discharges to the shoulder along the northbound side of I-395 into a heavily-eroded ditch through which MassDOT observed some dry-weather flow, as shown in the photograph below. This dry-weather flow appeared clean and is likely due to groundwater inflow. MassDOT proposes to install an infiltration basin to capture and infiltrate flow from this outlet. MassDOT also proposes to armor the existing ditch with erosion control fabric or riprap stone and utilize it for overflow from the infiltration basin during high flow conditions.

BMP 3 - Outfalls 10392 and 10392.1

Outfall10392 is a 12 inch concrete outlet and receives storm water from approximately 0.5 acre of roadway. Outfall 10392.1 is the outlet from a 36 inch concrete culvert directing storm water from approximately 1.5 acres in the median to the northbound shoulder. MassDOT proposes to install an infiltration basin to infiltrate storm water discharges from these two outlets.

Additionally, flow from these two outlets currently discharges into a heavily eroded ditch as shown in the photograph below. MassDOT proposes to armor the existing ditch with erosion control fabric or riprap stone and utilize it for overflow from the infiltration basin during high flow conditions.

BMP 4 - Outfall 10394

Outfall 10394 is a 12 inch concrete outlet and receives storm water from approximately 0.3 acres of roadway. It discharges into a heavily eroded ditch on the northbound shoulder approximately 400 feet north of Hugenot Road. MassDOT proposes to install an infiltration basin at this outlet to infiltrate storm water discharges. In addition, MassDOT proposes to armor the existing ditch with erosion control fabric or riprap stone and utilize it for overflow from the infiltration basin during high flow conditions.

BMP 5 - Outfall 10395

Outfall 10395 is another 12 inch concrete outlet and also receives storm water from approximately 0.3 acres of roadway. It discharges to a 4 foot wide grassed ditch along the shoulder of the northbound shoulder of I-395 approximately 700 feet north of Hugenot Road. MassDOT proposes to install an infiltration basin at this outlet to infiltrate storm water discharges. In addition, MassDOT will utilize the existing grassed ditch for overflow from the infiltration basin during high flow conditions.

BMP 6 - Outfall 13633.4

Outfall 13633.4 is a 12 inch concrete outlet receiving storm water from approximately one acre of roadway. It discharges to a heavily eroded ditch flowing directly to Lowes Pond as shown in the photograph below. MassDOT proposes to install an infiltration basin at this outlet to capture and infiltrate storm water. MassDOT will also armor the existing ditch with erosion control fabric or riprap stone and utilize it for overflow from the infiltration basin during high flow conditions.

BMP 7 - Outfalls 10393 and 10513

Outlet 10393 is a 12 inch concrete outlet receiving storm water from approximately 0.35 acres of roadway. Outlet 10513 is a 24 inch concrete outlet receiving storm water runoff from approximately 3.65 acres of both roadway and median drainage. The outlets currently discharge to the median area and flow overland into a 30 inch culvert which directs the storm water to the northbound shoulder. MassDOT proposes to install a water quality swale to collect discharge from these two outlets and direct the storm water into an infiltration basin in the median. The overflow from the infiltration basin will be directed into the existing 30 inch culvert and flow to the northbound shoulder.

The following photograph shows the current condition of the median.

Construction of a water quality swale and infiltration basin here may require the removal of some light brush and other vegetation.

BMP 8 - Outfall 10396

Outfall 10396 is a 12 inch concrete outlet collecting storm water from approximately one acre of roadway. The outlet currently discharges to the median where storm water flows overland into the same 30 inch culvert collecting storm water from Outfalls 10393 and 10513. MassDOT proposes to install a water quality swale and infiltration basin in the median to capture, convey, and treat storm

water from this outlet. The overflow from this infiltration basin during high flow conditions will be directed towards the existing 30 inch culvert where it will flow to the northbound shoulder.

The median in this area is lightly vegetated, similar to the median in the vicinity of Outfalls 10393 and 10513, described above. Installation of a water quality swale and infiltration basin in this location may require some brush removal.

BMP 9 - Outfall 10512

Outfall 10512 is a 12 inch concrete outlet receiving storm water from approximately 0.5 acres of roadway. The outfall currently discharges to the southbound shoulder where storm water then flows overland into a 30 inch culvert. This 30 inch culvert conveys the storm water from the southbound shoulder to the northbound shoulder, and daylights in the median to collect additional runoff. MassDOT proposes to install an infiltration basin to capture and infiltrate storm water runoff from Outfall 10512. MassDOT also proposes to install a ditch stabilized with erosion control fabric or riprap stone to convey overflow from the infiltration basin to the 30 inch culvert during high flow conditions. Refer to Figure 2 for exact location of this culvert.

BMP 10 - Outfall 13579

Outfall 13579 is a 12 inch concrete outlet receiving storm water from approximately 2 acres of roadway. The outfall discharges to a heavily eroded ditch approximately 50 to 75 feet from Lowes Pond. As shown in the photograph below, the ditch flows directly towards the water body. MassDOT proposes to construct an infiltration basin to capture and infiltrate storm water from this outlet. In addition, MassDOT proposes to armor the existing ditch with erosion control fabric or riprap stone and utilize it for overflow from the infiltration basin during high flow conditions.

BMP 11 - Outfall 13582

Outfall 13582 is a 12 inch concrete outlet receiving flow from two catch basins that collect storm water from approximately 0.3 acres of roadway. The outfall discharges directly to Lowes Pond along the northbound shoulder of I-395 approximately 100 feet south of the pond's culvert. The shoulder of the road in this location slopes down towards the pond at approximately two horizontal to one vertical. As shown in the photograph below, there is not adequate space here for the construction of a water quality BMP. MassDOT instead proposes to reroute this outfall to discharge to the median.

Original construction plans for this portion of I-395 from 1972 show that the median directly across from this outlet has been mildly graded to channel approximately 2.7 acres of storm water northward towards Lowes Pond. In addition, the median in this location is relatively vegetation-free. MassDOT will construct a vegetated filter strip in the median by reestablishing vegetation to slow runoff velocities and promote infiltration of storm water from the median and from the rerouted outlet before entering Lowes Pond.

BMP 12 - Outfalls 13583, 13584, and 13585

Outfalls 13583, 13584, and 13585 are all 12 inch concrete outlets discharging directly to Lowes Pond. Outfall 13584 discharges along the northbound shoulder of I-395 approximately 200 feet north of the pond's culvert. Outfalls 13583 and 13585 discharge along the southbound shoulder of I-395 approximately 50 and 400 feet north of the pond's culvert, respectively. The shoulder of the road in each of these locations angles down towards the pond at an approximate slope of two horizontal to one vertical. Each outfall receives flow from two catch basins, which collect storm water from a total of approximately 1.2 acres. MassDOT proposes to reroute all three outfalls to the median area.

As with Outfall 13582, MassDOT will use the median as a vegetated filter strip to provide treatment for storm water runoff from both the median area and each of the three rerouted outfalls. The median in this area is vegetated with dense brush and small trees, which may require removal. Installation of a vegetated filter strip will involve planting of additional vegetation and mild regrading to flatten slopes and direct runoff towards Lowes Pond.

BMP 13 - Outfall 13590 and 13591

Outfalls 13590 and 13591 are both 12 inch concrete outlets receiving storm water from a total of approximately 0.5 acre of roadway. The outfalls discharge to the shoulder of the southbound on-ramp at the interchange of I-395 with Sutton Avenue. Storm water discharges from these two outfalls are within 300 feet of Lowes Pond. MassDOT proposes to construct an infiltration basin to capture and infiltrate storm water from these two outlets.

BMP 14 - Outfall 13587

Outfall 13587 is a 12 inch concrete outlet receiving storm water runoff from approximately 1.3 acres of median and 0.7 acres of roadway. The outfall discharges to the shoulder of the southbound on-ramp at the interchange of I-395 with Sutton Avenue. Original I-395 construction plans from 1972

show that the outfall was designed to discharge into a 4 foot wide ditch graded towards Lowes Pond.

MassDOT observed that this ditch was partially filled and overgrown with vegetation, as shown in the photograph below. MassDOT proposes to convert this ditch into a water quality swale to provide treatment before storm water from this outlet enters Lowes Pond. This will be achieved by removing accumulated sediment and debris, reestablishing grass cover, and adding stone check dams to provide some detention of storm water flows.

BMP 15 - Outfall13631.4

Outfall 13631.4 is a 12” corrugated metal outlet discharging to a heavily eroded ditch that flows into a small finger along the northwestern edge of Lowes Pond. The outfall receives storm water runoff from approximately 0.3 acres of roadway. MassDOT proposes to convert the heavily eroded ditch into a water quality swale to provide treatment before discharge from this outlet enters the water body upstream of Lowes Pond.

Conclusions

As shown in Table 2, the existing and recommended BMPs provide a total reduction in TP loading of 54 lb/yr, providing 77% removal of TP from the directly contributing urban areas and thus meeting the 77% reduction required by the TMDL.

If possible given site constraints, MassDOT will construct the recommended BMPs in accordance with the design characteristics outlined in the "Storm water Best Management Practices (BMP) Performance Analysis" (EPA, 2010) and MassDEP's Massachusetts Stormwater Handbook (2008) in order to obtain the specified TP removal efficiencies. Specifically, infiltration BMPs that require pre-treatment to remove large particles that can lead to clogging will be designed with pre-treatment BMPs.

The locations and sizes of the recommended BMPs are approximate based on inspection of the watershed during site visits. Designers may find that some BMPs can be combined or relocated based on additional analysis and survey. BMP designers will likely perform site-specific soil analysis before constructing any infiltration BMPs. These BMPs rely upon the ability of the soil to infiltrate water, and without proper soil, will be less effective. If site-specific soil testing reveals that any of the recommended BMPs are not feasible, MassDOT will consider alternative designs to address the requirements of the TMDL.

A number of the recommended BMPs are also in close proximity to wetlands, streams, and Lowes Pond. Although these BMPs will ultimately be installed to improve the water quality of the receiving water body, there may be permitting requirements associated with construction in these areas. MassDOT will work with the local permitting agencies during the design and construction of these BMP structures.

References

EPA 2002. *National Recommended Water Quality Criteria: 2002*. EPA 822R-02-047.

EPA 2010a. *Revisions to the November 22, 2002 Memorandum "Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLA) for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs*."

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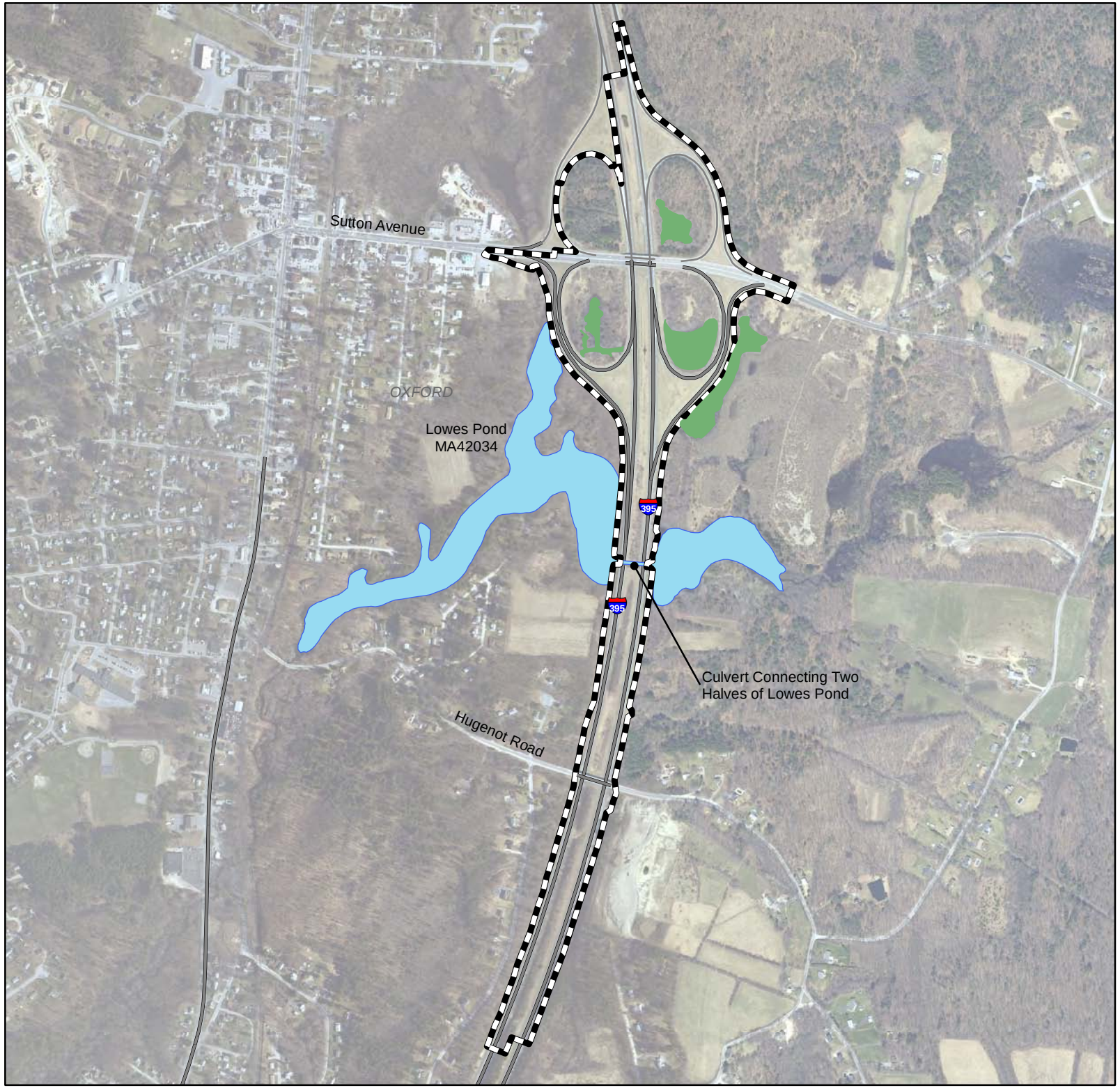

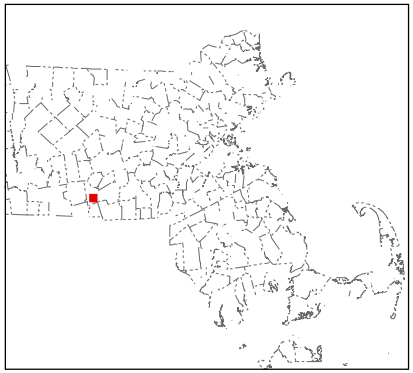

Town Boundaries

Impaired Stream Segments

Impaired Water Bodies

MA DOT Roads in Urban Areas

MA DOT Roads

Existing Stormwater Wetlands

Direct Lowes Pond Watershed

N

790 395 0 790

Feet

Figure 1
Lowes Pond

I-395
Oxford, MA

March 2011

massDOT

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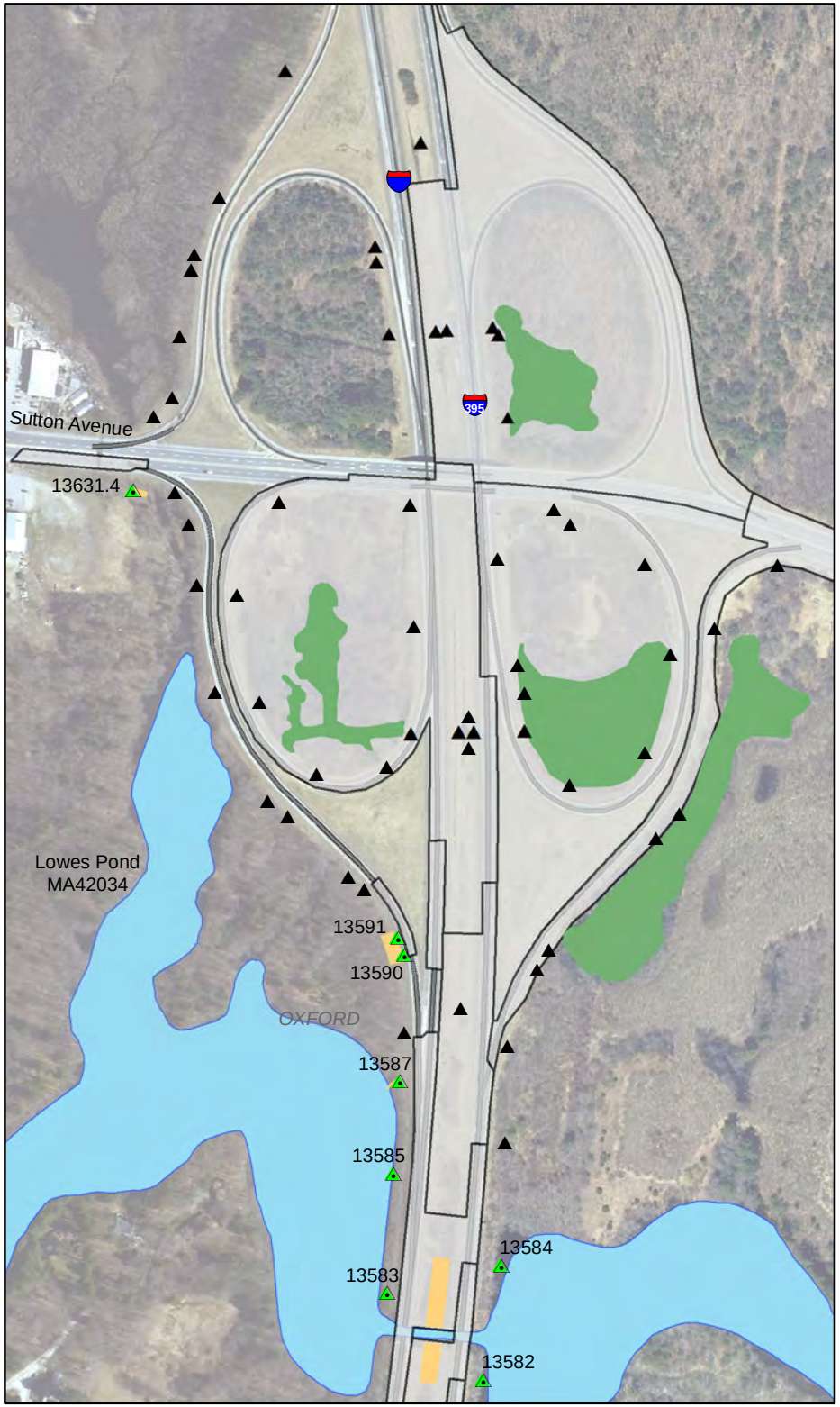

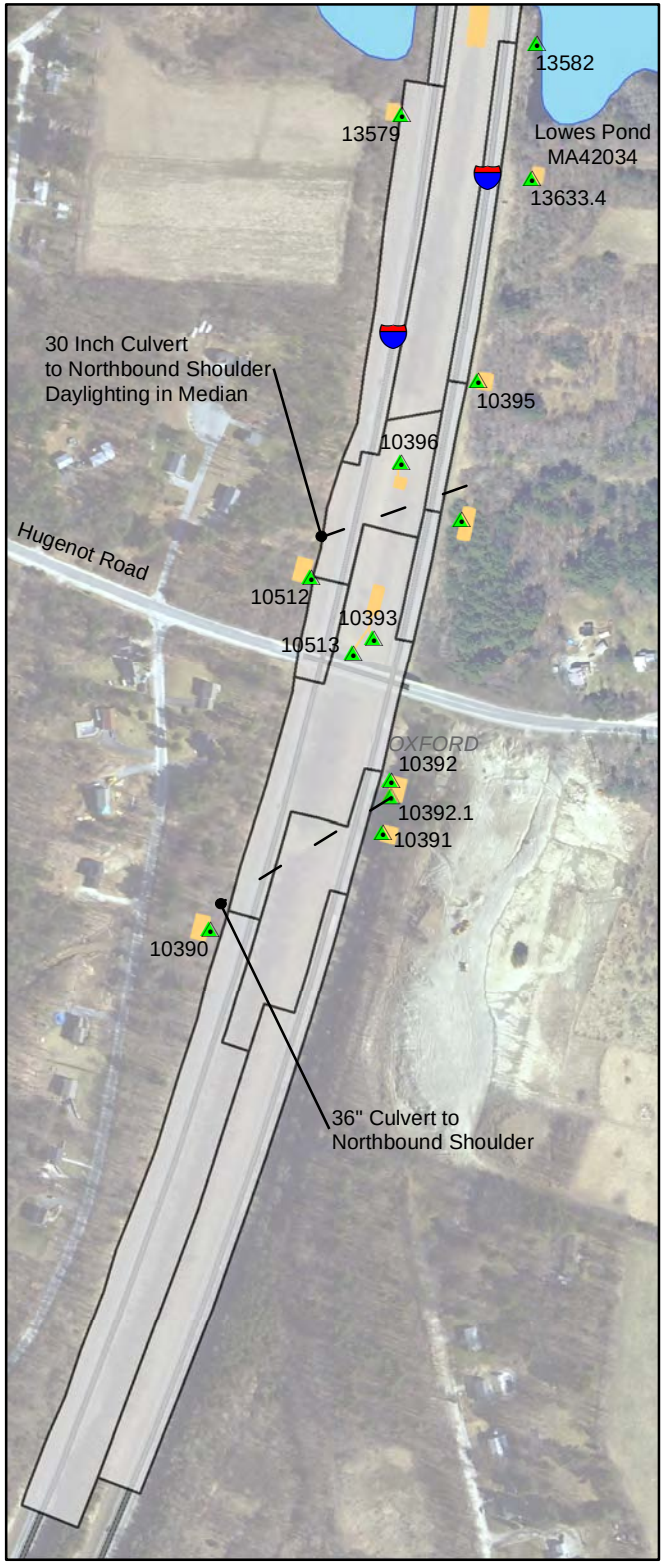

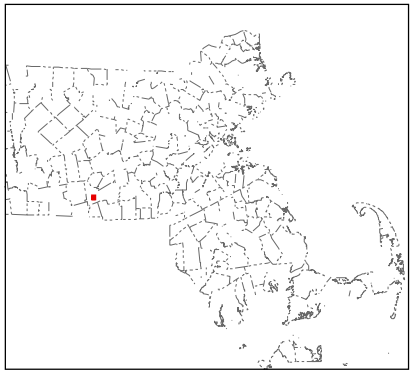

Town Boundaries

MassDOT Outfalls

Proposed BMP Outfalls

Impaired Stream Segments

Impaired Water Bodies

Existing Stormwater Wetlands

ProposedBMPs

BMP Watersheds

MA DOT Roads in Urban Areas

MA DOT Roads

N

450 225 0 450

Feet

Figure 2
Lowes Pond

I-395
Oxford, MA

March 2011

massDOT

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Attachment 2:
Impaired Segments Assessments with <9% Impervious Cover Watersheds

Impaired Waters Assessment for Impaired Waters with <9% Impervious Cover in Contributing Watershed

Impaired Water Bodies

The list of impaired water bodies covered by this assessment is included in Table 1.

Impairments

Impairments included under this assessment methodology include those typically associated with storm water runoff from impervious cover. Impairments for specific water bodies are listed in MassDEP's 303d List included in the Final 2008 and Proposed 2010 Integrated List of Waters.

Relevant Water Quality Standards

Relevant Water Quality Standards can be found on EPA's website: http://www.mass.gov/dep/service/regulations/314cmr04.pdf.

Site Description

This assessment applies to the water bodies listed in Table 1. These water bodies are located across the state and have various impairments that could potentially be storm water related. They potentially receive discharge from MassDOT urban roadways.

Assessment under BMP 7U

The impairments for the water bodies listed in Table 1 have not been addressed by a Total Maximum Daily Load (TMDL) and therefore MassDOT assessed its contribution to these impairments using the approach described under BMP 7U. To facilitate this approach, MassDOT has developed a protocol to use EPA's Impervious Cover (IC) Method to identify areas where stormwater runoff is potentially contributing to water body impairments. The IC Method uses the percent of impervious cover within a receiving water body's watershed as an indicator that stormwater runoff is likely contributing to its impairment(s). This method is summarized below.

Using the IC Method, MassDOT concluded that stormwater runoff from its property is not contributing to the impairment(s) of the water bodies in Table 1.

Impervious Cover Analysis

The IC Method relates an aquatic system's health (i.e., state of impairment) to the percentage of impervious cover in its contributing watershed. This method is largely based on the work of the Center for Watershed Protection, which has compiled and evaluated extensive data relating watershed impervious cover to the hydrologic, physical, water quality, and biological conditions of aquatic systems (Schueler, 2003). Water quality in tributary streams, rivers, lakes and ponds is a direct reflection of loading from the watershed (Wetzel 2001); therefore the IC method can be used

as a surrogate for pollutant loading from storm water when evaluating water quality impairments and their causes.

EPA recommends a target of 9% impervious cover in a watershed (ENSR, 2006). When more than 9% of the watershed is impervious cover, storm water is likely to be a significant contributor to water quality concerns. When less than 9% of the watershed is impervious cover, water quality impairments are likely to be caused by other factors. Based on this principle, MassDOT assessed whether storm water from its property is potentially contributing to the impairment of receiving water bodies and stream segments.

MassDOT's Application of the Impervious Cover Method - Assessment

MassDOT recently completed a round of assessments using the IC Method for water bodies on the MA 303d list receiving stormwater discharges from MassDOT-owned properties. The water bodies included under this assessment are those for which the directly contributing subwatershed had less than 9% IC.

As mentioned previously, the research supporting EPA's IC Method demonstrates that storm water runoff to an impaired water body having a watershed having less than 9% IC does not contribute to the impairments of the water body. Accordingly, MassDOT has concluded that because the watersheds to the water bodies included herein contain less than 9% IC, storm water discharges from MassDOT-owned property do not contribute to the impairments of the water bodies. As a result, MassDOT plans to take no further action to specifically address the impairments of the water bodies included under this assessment.

Conclusions

MassDOT has concluded, using the IC Method, that the impairment is not due to storm water discharges for the water bodies listed in Table 1. Therefore, since stormwater BMPs are not warranted MassDOT does not propose any further action.

However, during any future project work or reconstruction efforts that impact the drainage to these water bodies, MassDOT will consider incorporating additional stormwater mitigation practices specifically aimed at addressing impairments associated with IC as part of MassDOT's new Impaired Water Body Program for Programmed Projects.

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Table 1. Impaired Waters Addressed by IC Method with <9% IC in Watershed

Waterbody ID	Waterbody Name	Pollutants of Concern (2008)	% IC in Subwatershed
MA92057_2008	Salem Pond	Turbidity	2.1%
MA91-05_2008	Rowley River	Pathogens	2.6%
MA93-11_2008	Essex River	Fecal Coliform	2.7%
MA21-11_2008	Wahconah Falls Brook	Fecal Coliform	2.7%
MA11018_2008	Cheshire Reservoir	(Eurasian Water Milfoil, Myriophyllum spicatum*), Non-native aquatic plants, aquatic plants (Macrophytes)	3.0%
MA72-20_2008	Powissett Brook	Combined Biota/habitat Bioassessments	3.6%
MA32-05_2008	Westfield River	Cause Unknown, Taste, odor and color, Noxious aquatic plants, Turbidity	3.7%
MA95-72_2008	Aucoot Creek	Nitrogen (Total), Oxygen, Dissolved, Nutrient/Eutrophication Biological Indicators, Fecal Coliform	3.8%
MA81-30_2008	East Wachusett Brook	Pathogens	4.1%
MA91-02_2008	Parker River	Pathogens	4.2%
MA34-07_2008	Bachelor Brook	Nutrient/Eutrophication Biological Indicators	4.3%
MA93-16_2008	Essex Bay	Fecal Coliform	4.5%
MA36-16_2008	Quaboag River	Pathogens, Taste, odor and color	4.6%
MA62-42_2008	Unnamed Tributary	Cause Unknown	4.6%
MA41-03_2008	Quinebaug River	Nutrients, Organic enrichment/Low DO, (Other habitat alterations*), Pathogens, Taste, odor and color, (Objectionable deposits*)	4.7%
MA94179_2008	Lily Pond	(Flow alteration*), Turbidity, (Exotic species*)	4.8%
MA62124_2008	Muddy Cove Brook Pond	Noxious aquatic plants, Turbidity	4.9%
MA41-01_2008	Quinebaug River	Metals, Pathogens	5.0%
MA21-01_2008	East Branch Housatonic River	Fecal Coliform, PCB in Fish Tissue	5.1%

Attachment 3:
Assessments which Identified no Discharges from MassDOT Outfalls to Impaired Segments under Review

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.

This quarterly review also includes assessment of outfalls located in the Cape Cod watershed. EPA included an assumption in the TDMLs[2] created for the Cape, that runoff from impervious cover located more than 200 ft from the water body is unlikely to reach the water body due to the soils and geology of the Cape. Instead, runoff is likely to infiltrate into groundwater. Based on this, MassDOT assumed that water bodies on the Cape that were more than 200 ft from any MassDOT urban storm water outfalls do not receive discharge from MassDOT urban roads. This

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[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.

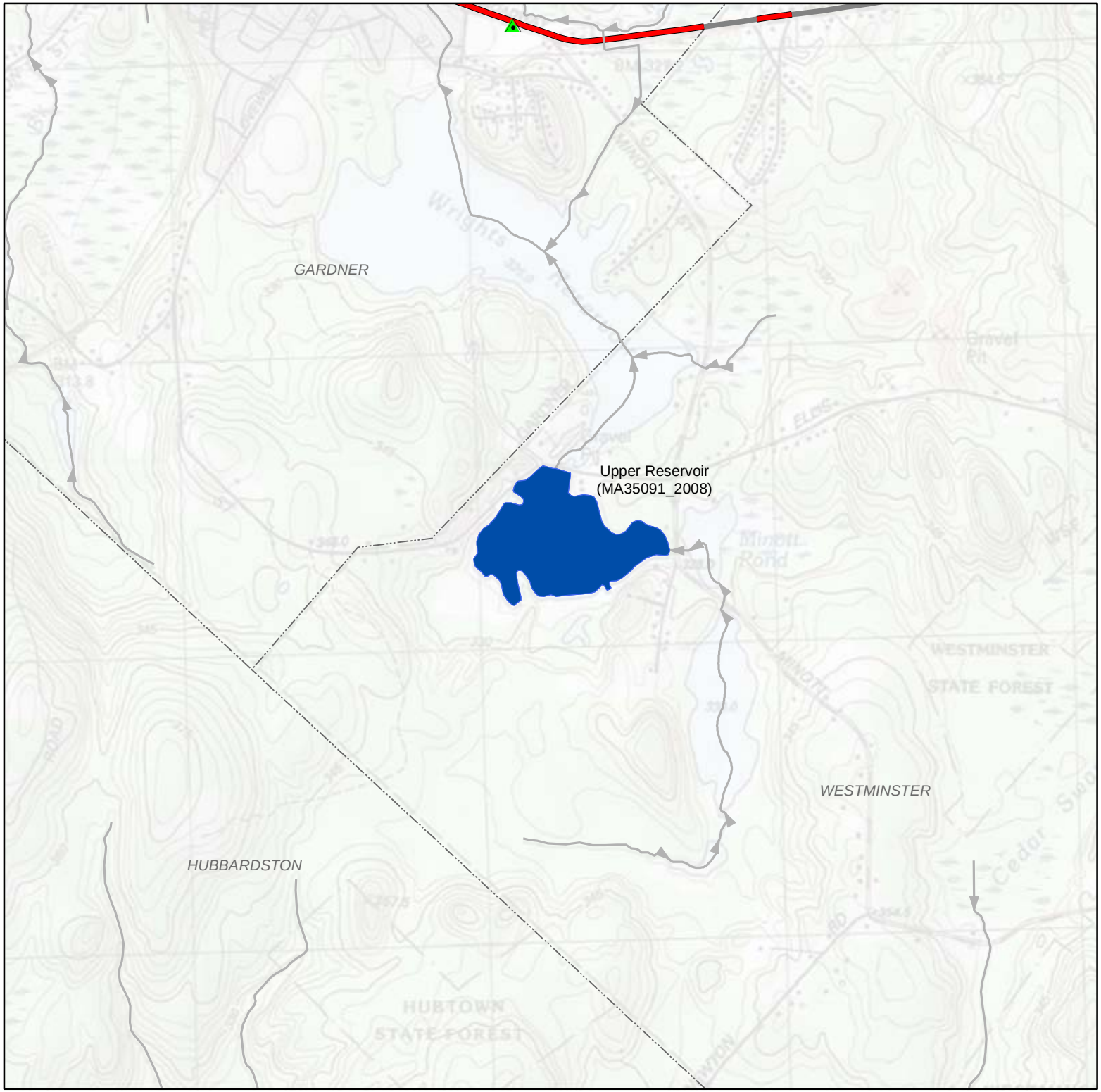
[2] EPA made this assumption in multiple TMDLs on the cape, including the "Final Pathogen TMDL for the Cape Cod Watershed," The Final Nutrient TMDL for Centerville River/East Bay," " and the "Final Nitrogen TMLD for West Falmouth Harbor." These and other Cap Code TMDLs are available at: http://www.mass.gov/dep/water/resources/tmdls.htm#cape

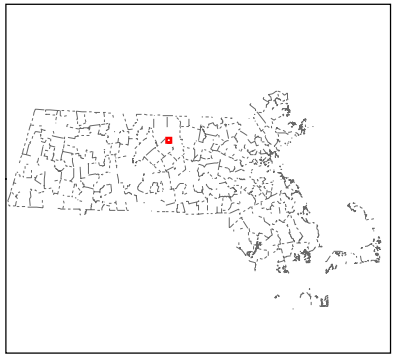
approach is more conservative from the TMDLs impervious cover assumption, as outfalls can be located a significant distance from the impervious area they serve. Impervious surface more than 200 ft from the impaired water body is retained for further assessment as part of the program if an outfall is located within 200 ft of the impaired segment. In addition, topography and surface waters were reviewed to confirm that discharges from MassDOT roads greater than 200 feet away are not being conveyed to the impaired waters via surface conveyances.

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.

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
MA35091_2008	Upper Reservoir	Millers	12/20/2007-NEHgTMDL
MA36025_2008	Browning Pond	Chicopee	4/12/2002-CN118.0
MA36083_2008	Long Pond	Chicopee	4/12/2002-CN118.0
MA42009_2008	Cedar Meadow Pond	French	7/12/2002-CN110.0
MA42023_2008	Greenville Pond	French	7/12/2002-CN110.0
MA42029_2008	Hudson Pond	French	7/12/2002-CN110.0
MA42030_2008	Jones Pond	French	7/12/2002-CN110.0
MA42048_2008	Rochdale Pond	French	7/12/2002-CN110.0
MA96-47_2008	Crows Pond	Cape Cod	10/24/2007-CN244.0
MA96-58_2008	Hamblin Pond	Cape Cod	11/7/2007-CN218.0
MA96004_2008	Ashumet Pond	Cape Cod	12/20/2007-NEHgTMDL
MA96-11_2008	Stage Harbor	Cape Cod	6/21/2006-CN206.0
MA96-52_2008	Mill Pond	Cape Cod	6/21/2006-CN206.0
MA96-59_2008	Jehu Pond	Cape Cod	9/23/2004-CN201.0
MA96-60_2008	Great River	Cape Cod	9/23/2004-CN201.0
MA96-61_2008	Little River	Cape Cod	9/23/2004-CN201.0
MA96-71_2008	Namequoit River	Cape Cod	9/23/2004-CN201.0
MA96-72_2008	Paw Wah Pond	Cape Cod	9/23/2004-CN201.0
MA96-73_2008	Pochet Neck	Cape Cod	9/23/2004-CN201.0
MA96-74_2008	Quanset Pond	Cape Cod	9/23/2004-CN201.0





Impaired Water Body Being Assessed

Impaired Water Body

Impaired Stream Being Assessed

Impaired Stream Segment

Non-Impaired Stream Segments

MA DOT Roads

MA DOT Urban Area Roads

Town Boundaries

Stormwater Outfalls

1,000 500 0 1,000 Feet

N

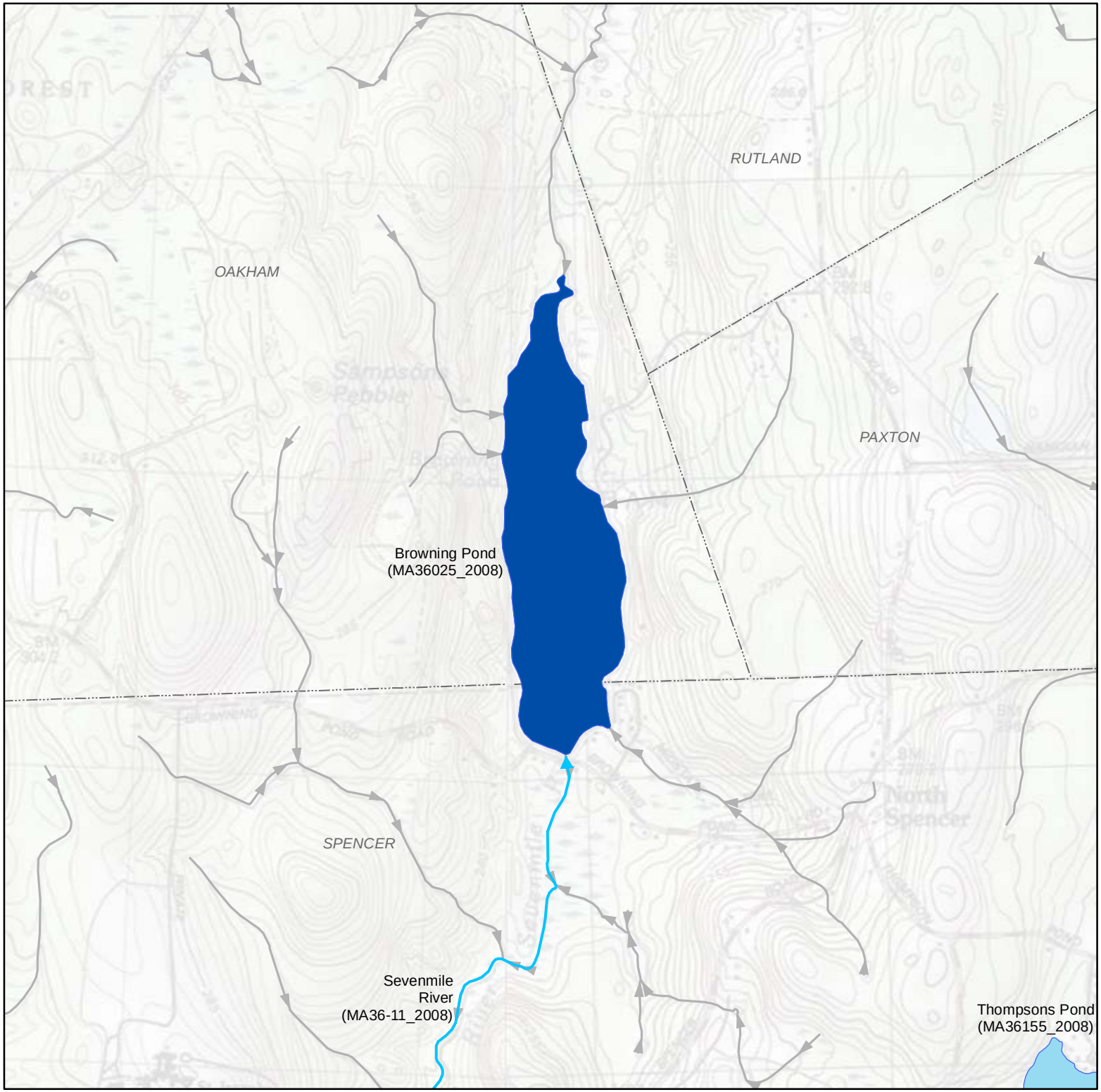
MA35091_2008

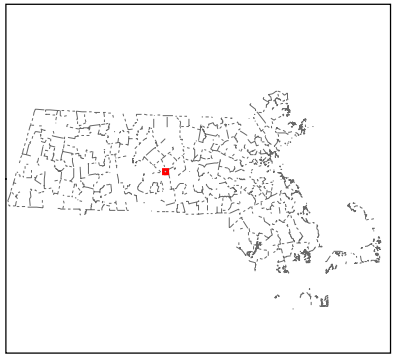
Upper Reservoir

Millers

March 2011

massDOT





Impaired Water Body Being Assessed

Impaired Water Body

Impaired Stream Being Assessed

Impaired Stream Segment

Non-Impaired Stream Segments

MA DOT Roads

MA DOT Urban Area Roads

Town Boundaries

Stormwater Outfalls

1,000 500 0 1,000 Feet

N

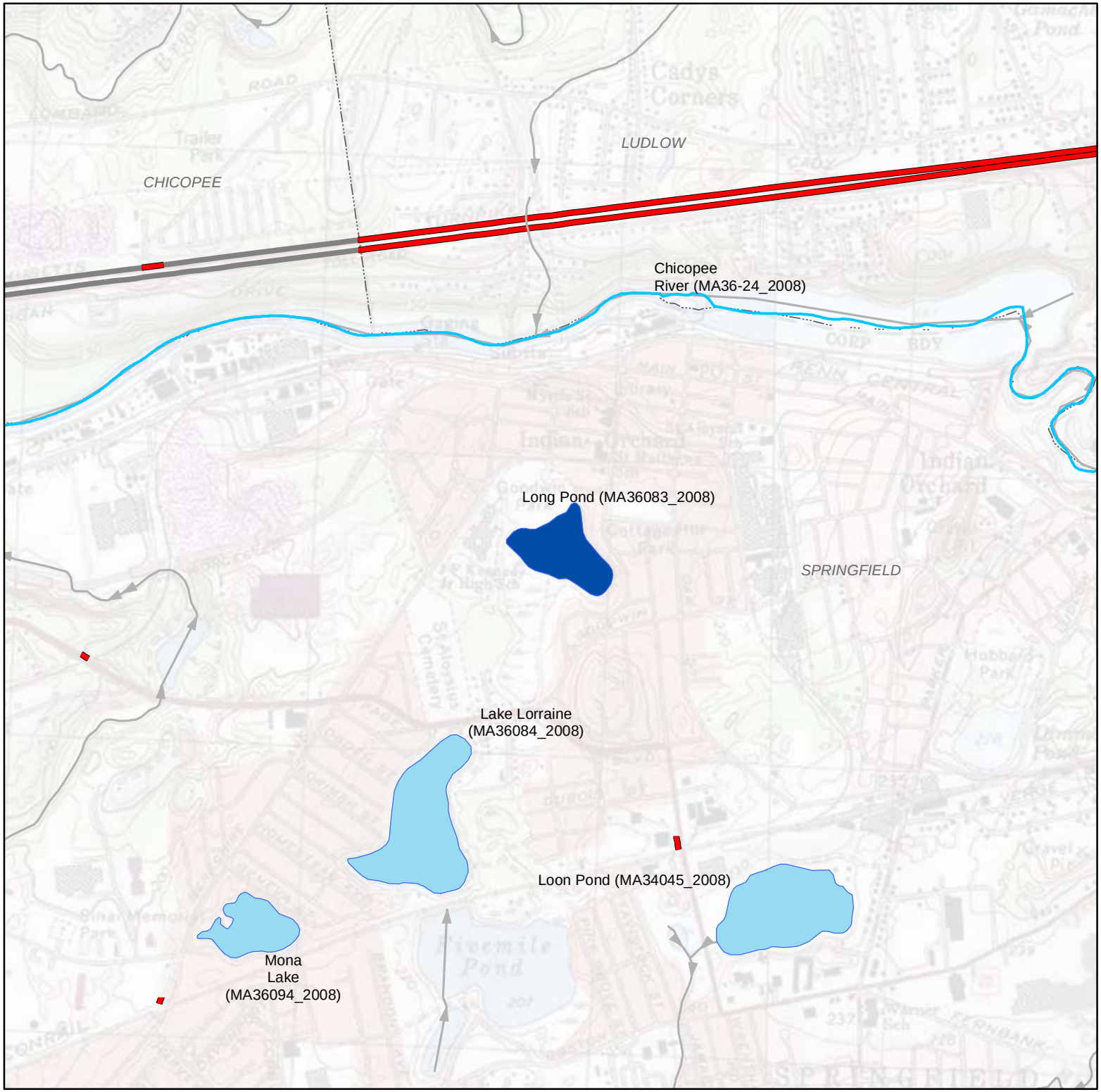
MA36025_2008

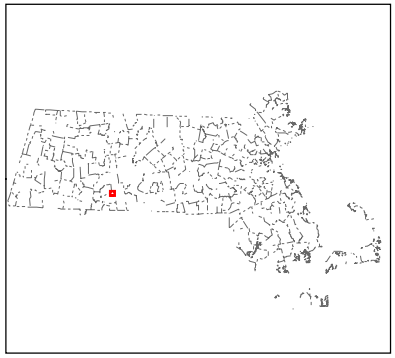
Browning Pond

Chicopee

March 2011

Moving Massachusetts Forward. massDOT





Impaired Water Body Being Assessed

Impaired Water Body

Impaired Stream Being Assessed

Impaired Stream Segment

Non-Impaired Stream Segments

MA DOT Roads

MA DOT Urban Area Roads

Town Boundaries

Stormwater Outfalls

1,000 500 0 1,000 Feet

N

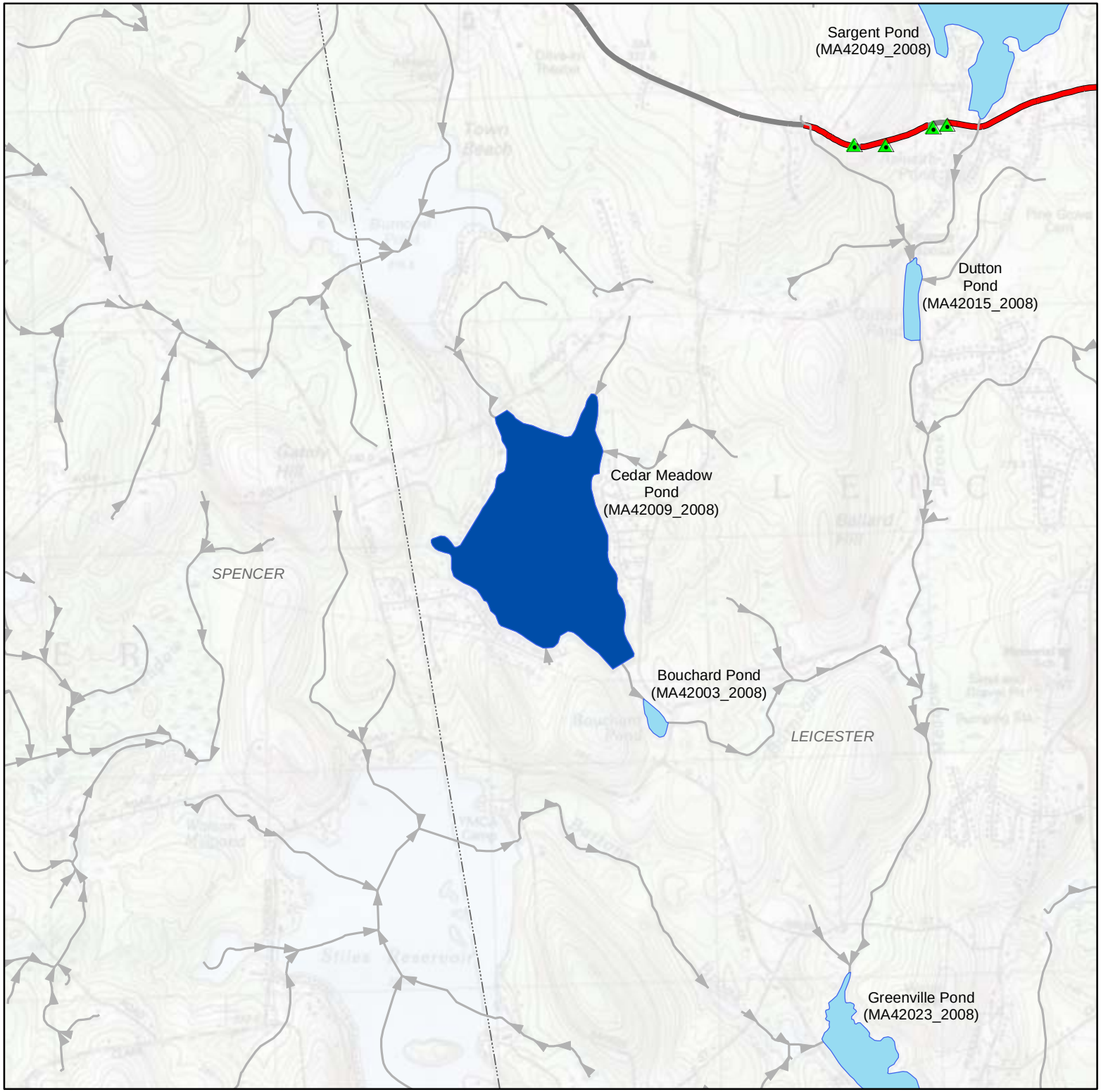
MA36083_2008

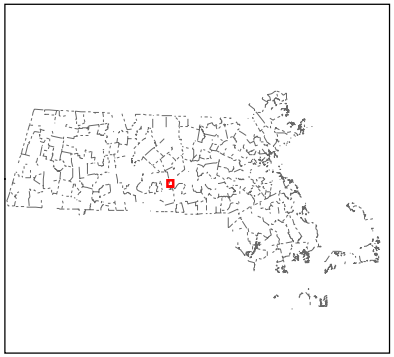
Long Pond

Chicopee

March 2011

Moving Massachusetts Forward. massDOT





Impaired Water Body Being Assessed

Impaired Water Body

Impaired Stream Being Assessed

Impaired Stream Segment

Non-Impaired Stream Segments

MA DOT Roads

MA DOT Urban Area Roads

Town Boundaries

Stormwater Outfalls

1,500 750 0 1,500 Feet

N

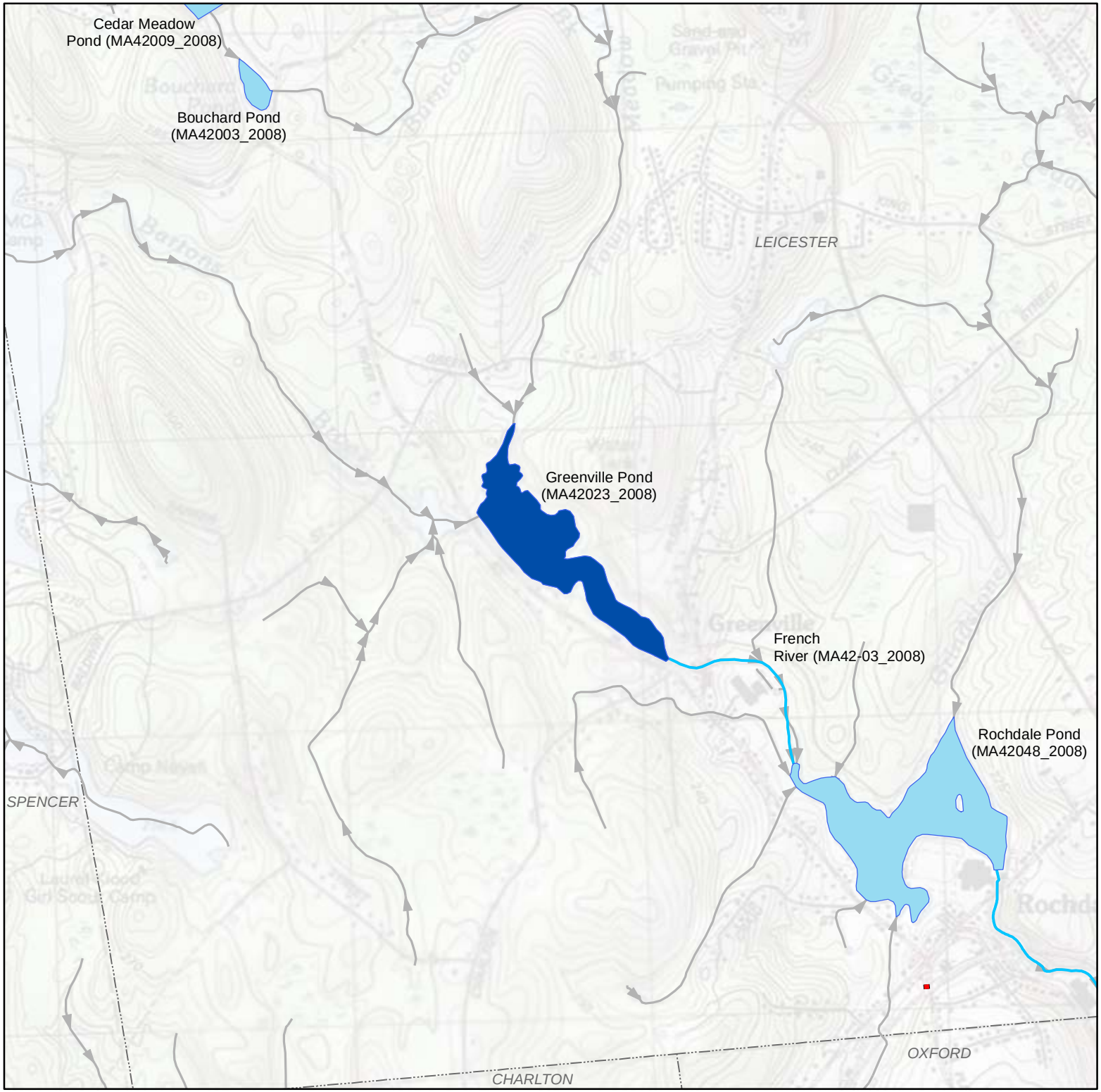
MA42009_2008

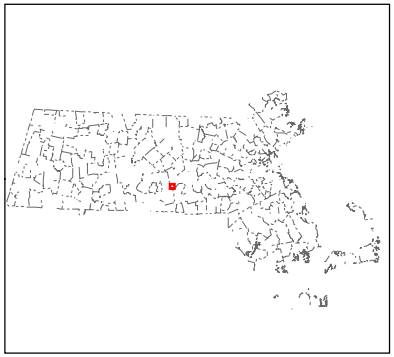
Cedar Meadow Pond

French

March 2011

Moving Massachusetts Forward. massDOT





Impaired Water Body Being Assessed

Impaired Water Body

Impaired Stream Being Assessed

Impaired Stream Segment

Non-Impaired Stream Segments

MA DOT Roads

MA DOT Urban Area Roads

Town Boundaries

Stormwater Outfalls

1,000 500 0 1,000 Feet

N

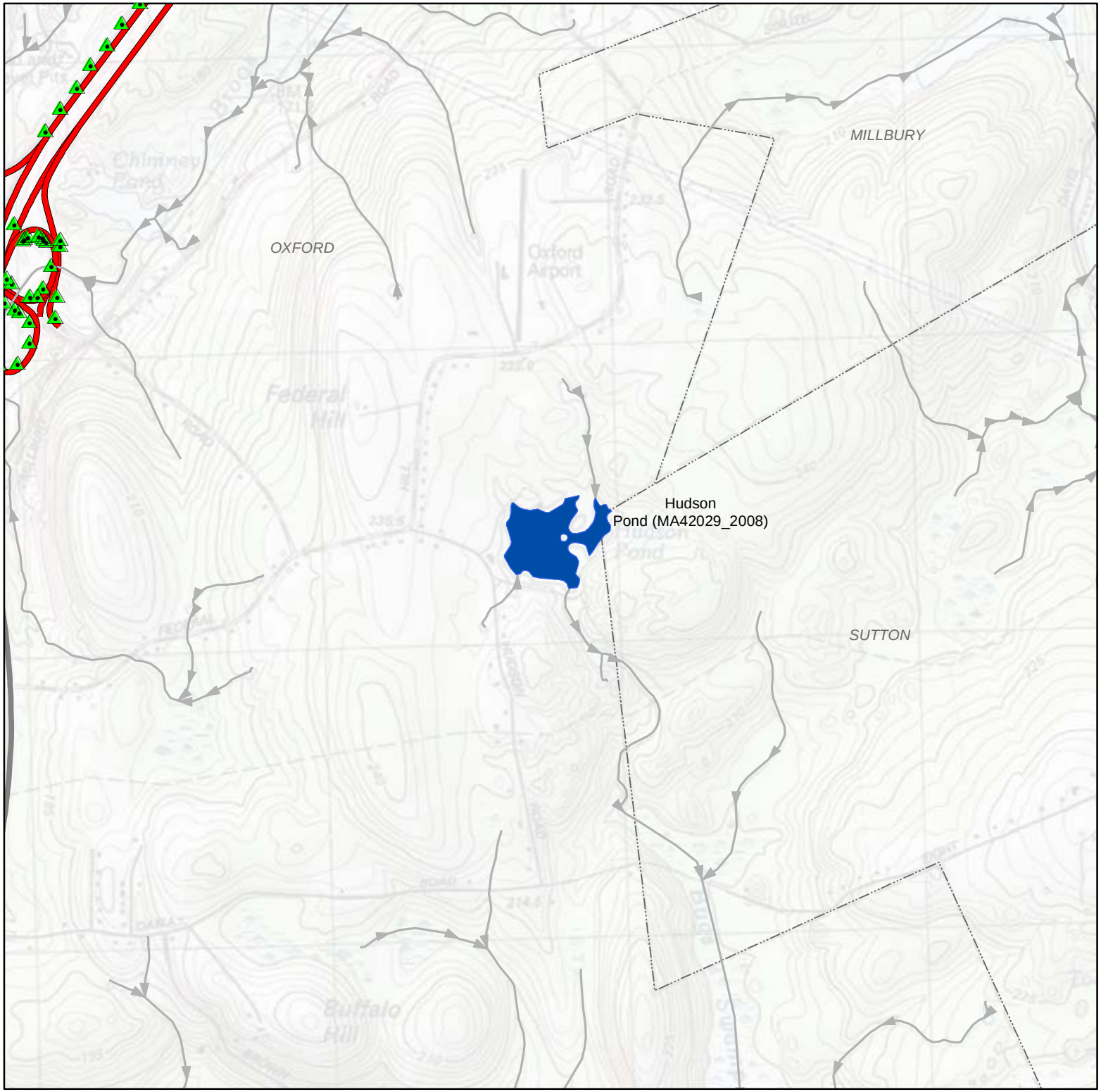
MA42023_2008

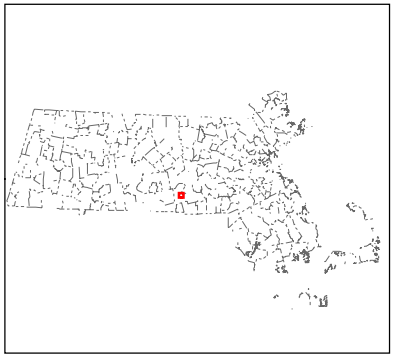
Greenville Pond

French

March 2011

Moving Massachusetts Forward. massDOT





Impaired Water Body Being Assessed

Impaired Water Body

Impaired Stream Being Assessed

Impaired Stream Segment

Non-Impaired Stream Segments

MA DOT Roads

MA DOT Urban Area Roads

Town Boundaries

Stormwater Outfalls

1,000 500 0 1,000 Feet

N

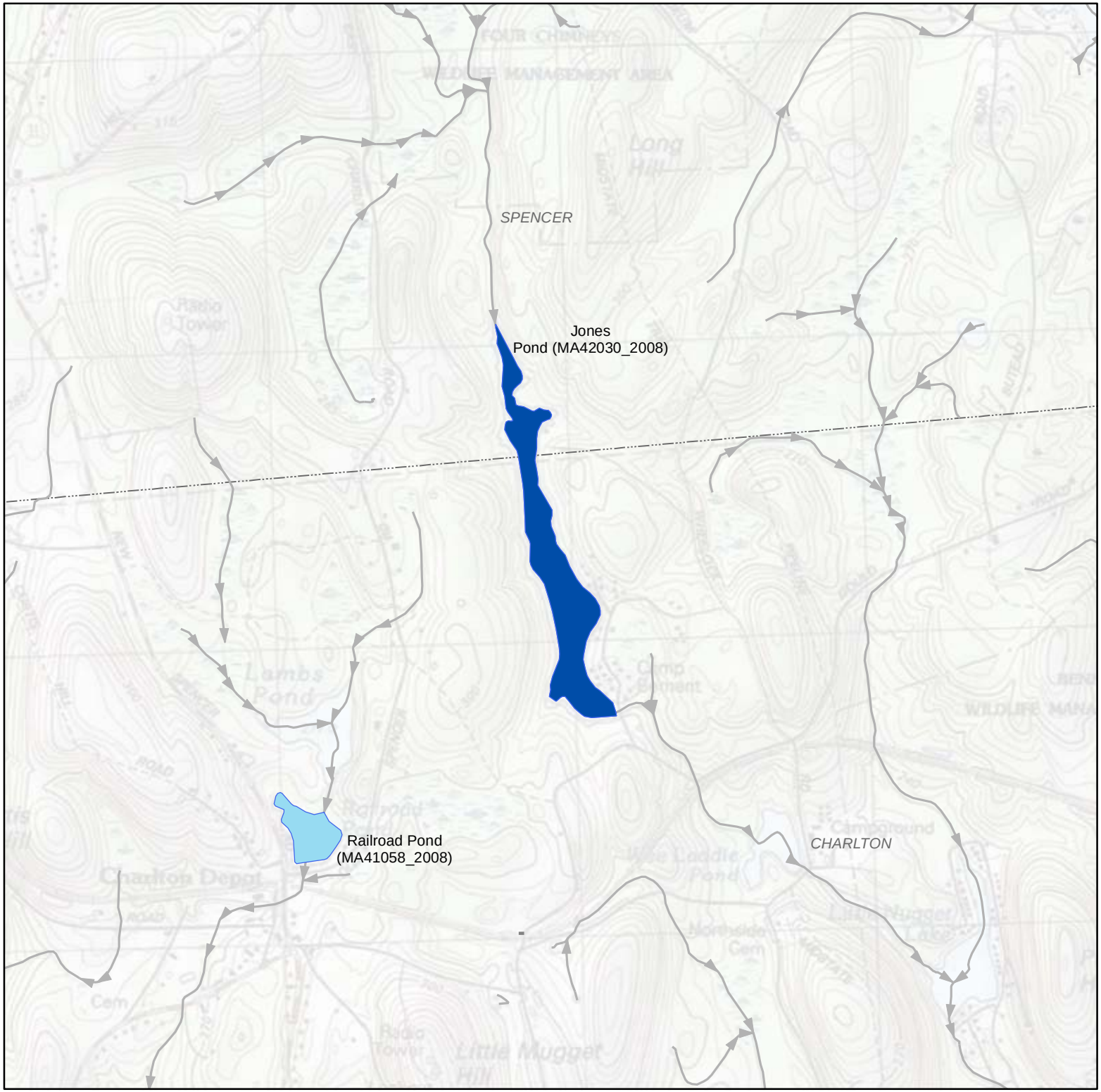
MA42029_2008

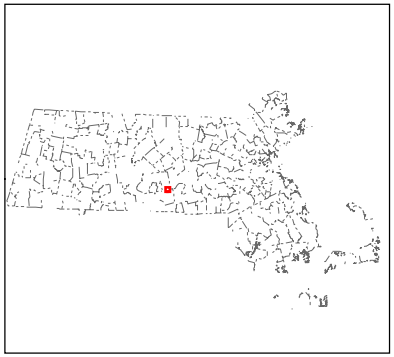
Hudson Pond

French

March 2011

massDOT





Impaired Water Body Being Assessed

Impaired Water Body

Impaired Stream Being Assessed

Impaired Stream Segment

Non-Impaired Stream Segments

MA DOT Roads

MA DOT Urban Area Roads

Town Boundaries

Stormwater Outfalls

1,000 500 0 1,000 Feet

N

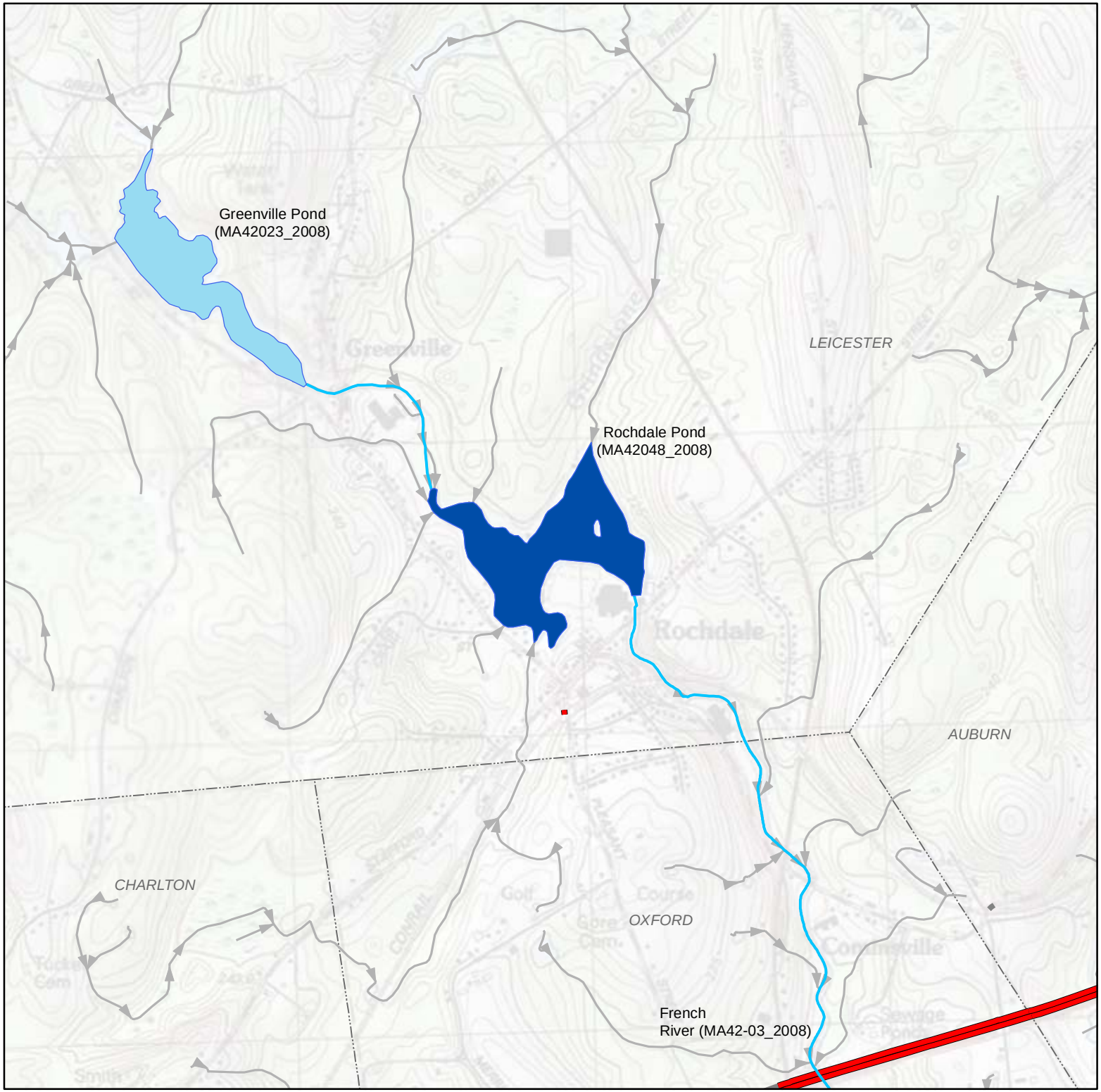
MA42030_2008

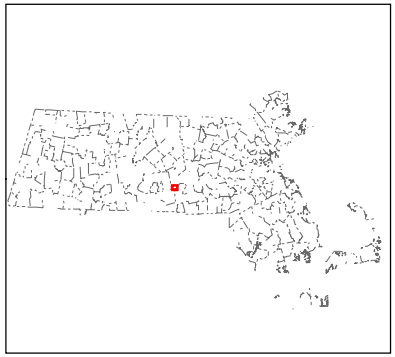
Jones Pond

French

March 2011

massDOT





Impaired Water Body Being Assessed

Impaired Water Body

Impaired Stream Being Assessed

Impaired Stream Segment

Non-Impaired Stream Segments

MA DOT Roads

MA DOT Urban Area Roads

Town Boundaries

Stormwater Outfalls

1,000 500 0 1,000 Feet

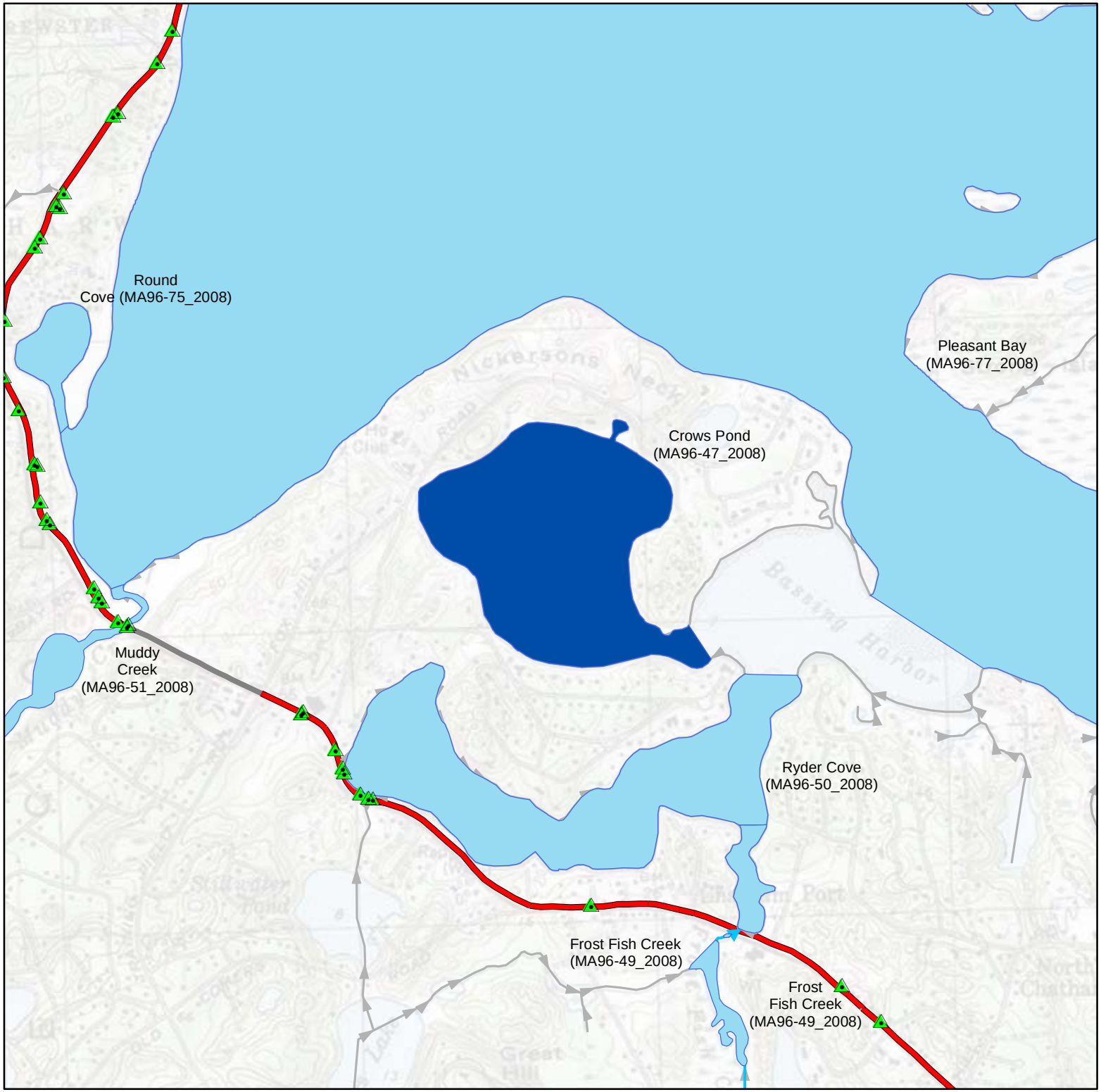
N

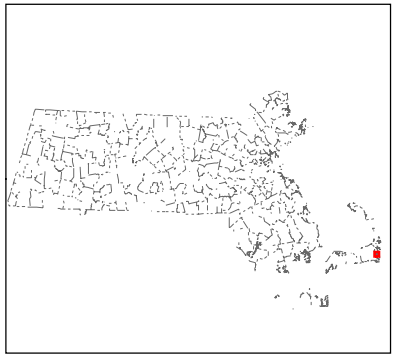
MA42048_2008

Rochdale Pond

French

March 2011





Impaired Water Body Being Assessed

Impaired Water Body

Impaired Stream Being Assessed

Impaired Stream Segment

Non-Impaired Stream Segments

MA DOT Roads

MA DOT Urban Area Roads

Town Boundaries

Stormwater Outfalls

1,000 500 0 1,000 Feet

N

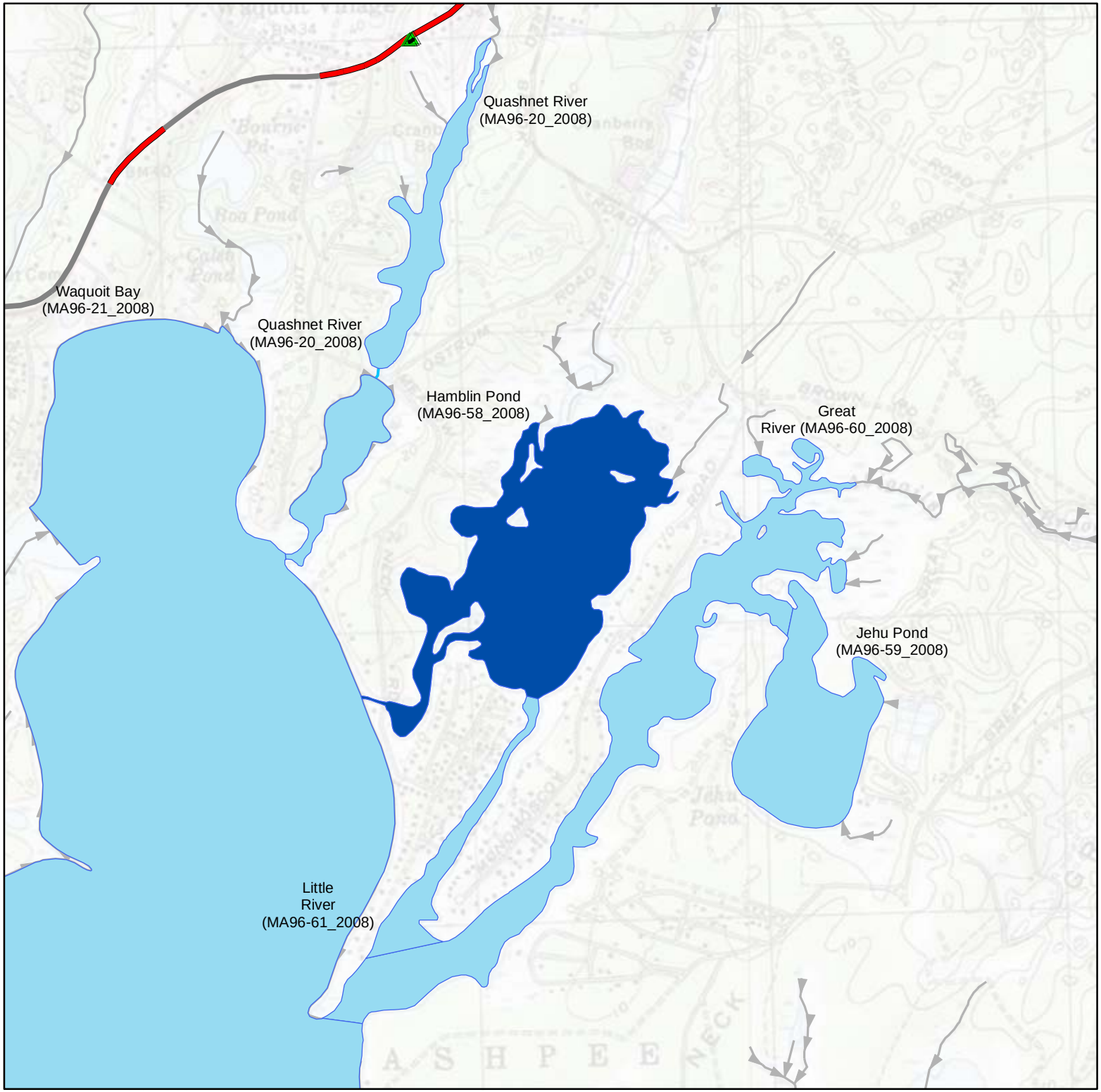
MA96-47_2008

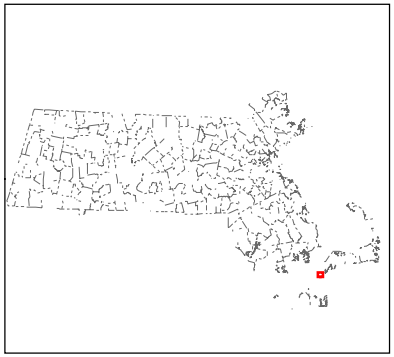
Crows Pond

Cape Cod

March 2011

massDOT





Impaired Water Body Being Assessed

Impaired Water Body

Impaired Stream Being Assessed

Impaired Stream Segment

Non-Impaired Stream Segments

MA DOT Roads

MA DOT Urban Area Roads

Town Boundaries

Stormwater Outfalls

1,000 500 0 1,000 Feet

N

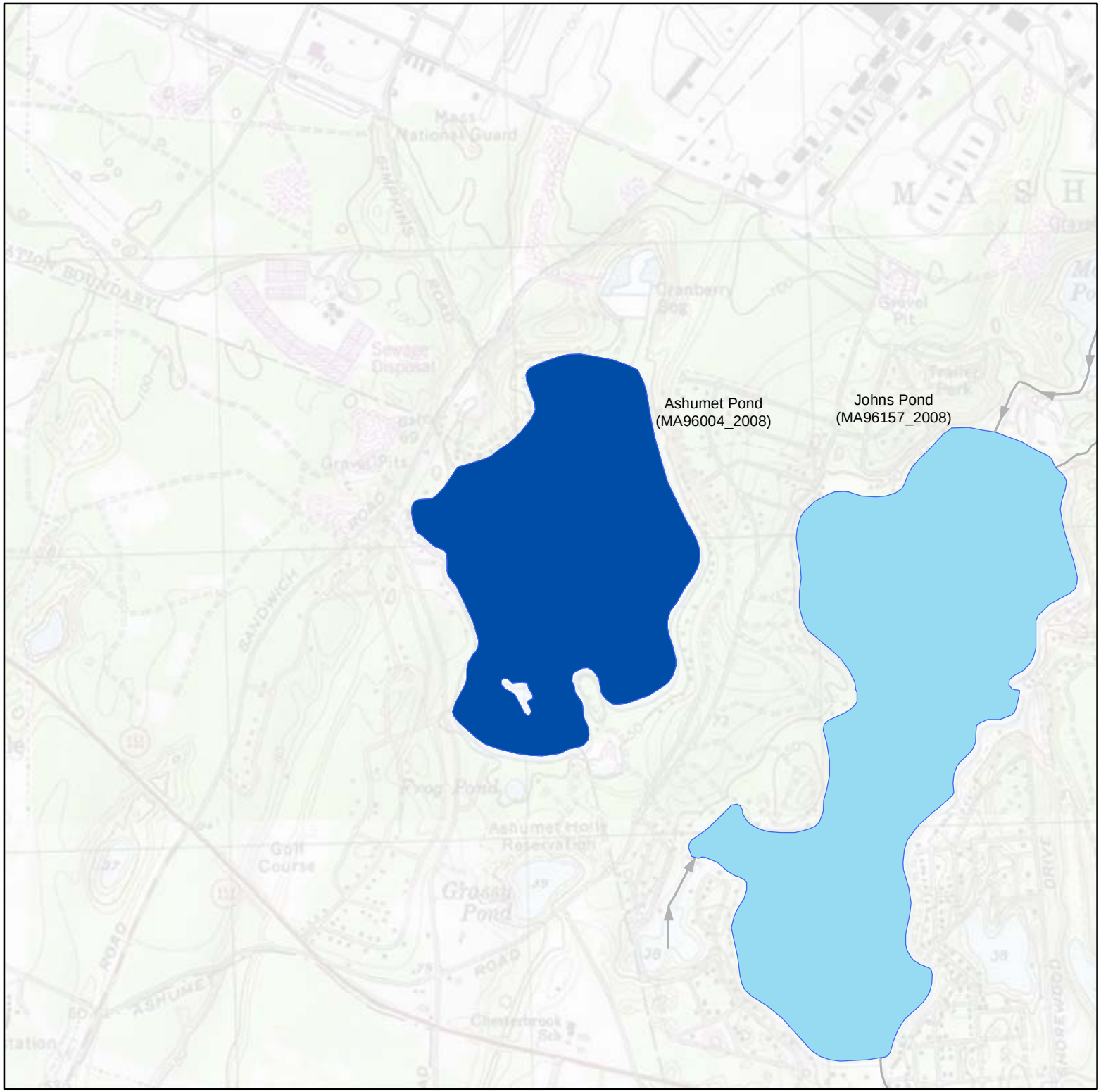
MA96-58_2008

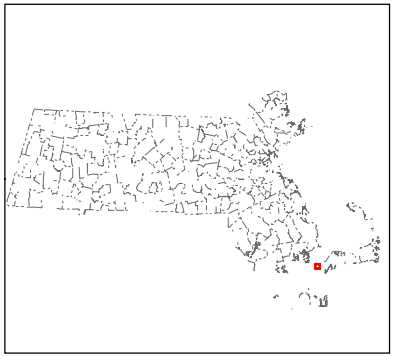
Hamblin Pond

Cape Cod

March 2011

massDOT





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

1,000 500 0 1,000 Feet

N

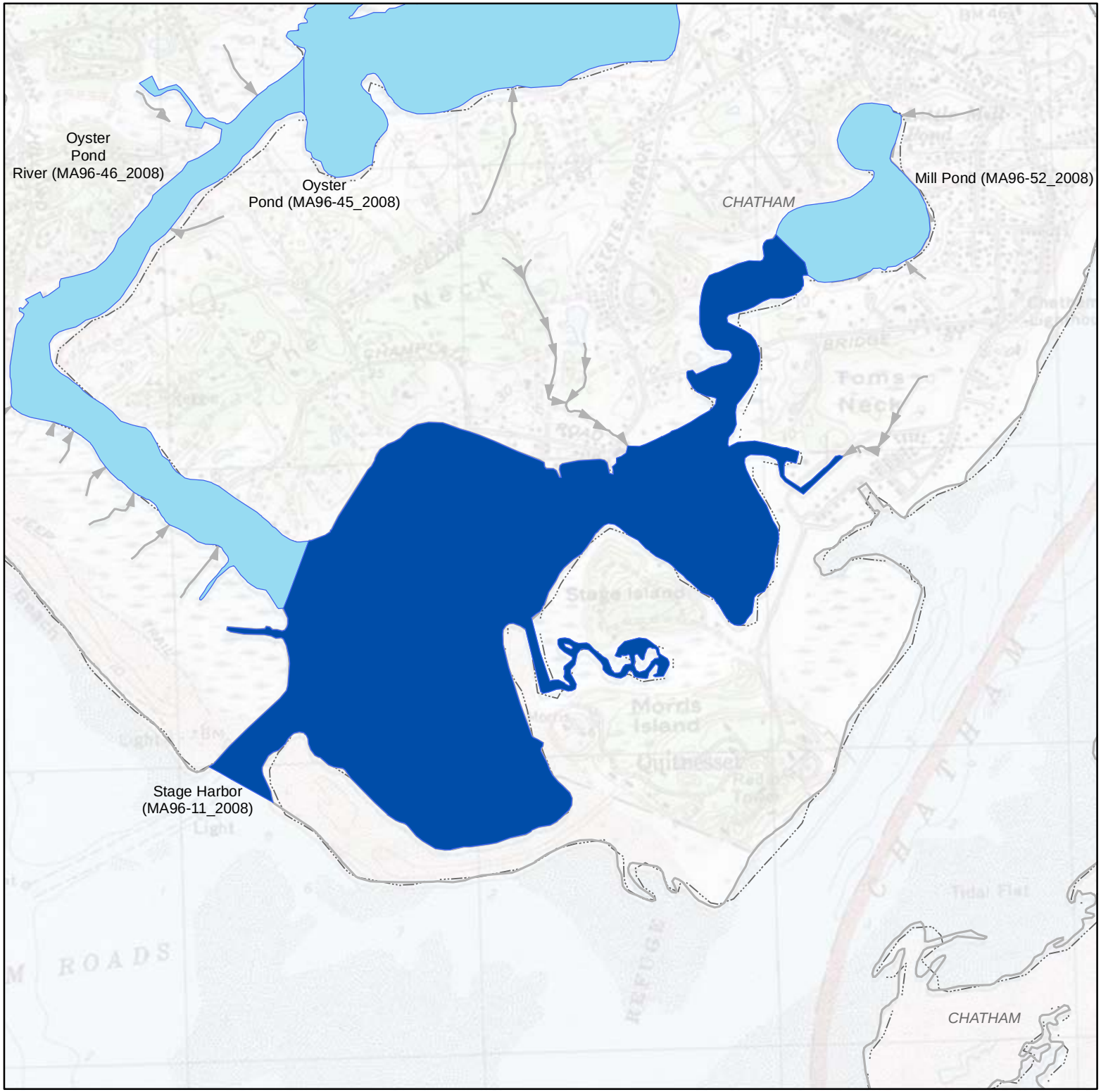
MA96004_2008

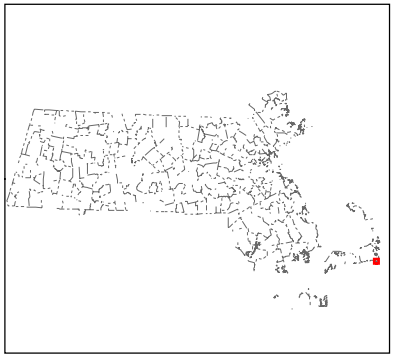
Ashumet Pond

Cape Cod

March 2011

massDOT
Moving Massachusetts Forward





Impaired Water Body Being Assessed

Impaired Water Body

Impaired Stream Being Assessed

Impaired Stream Segment

Non-Impaired Stream Segments

MA DOT Roads

MA DOT Urban Area Roads

Town Boundaries

Stormwater Outfalls

1,000 500 0 1,000 Feet

N

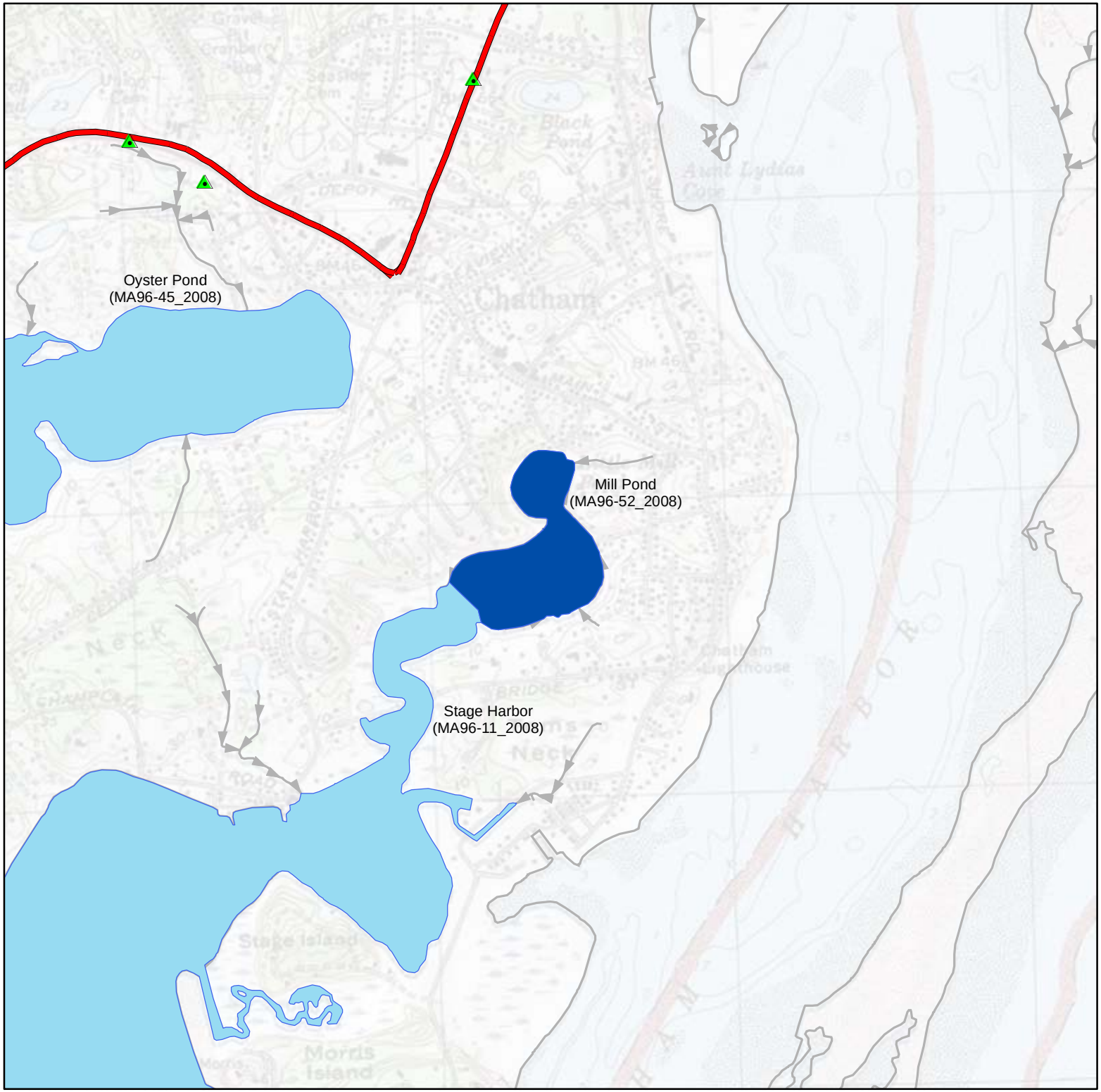
MA96-11_2008

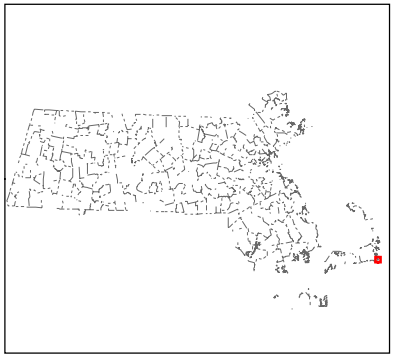
Stage Harbor

Cape Cod

March 2011

Moving Massachusetts Forward. massDOT





Impaired Water Body Being Assessed

Impaired Water Body

Impaired Stream Being Assessed

Impaired Stream Segment

Non-Impaired Stream Segments

MA DOT Roads

MA DOT Urban Area Roads

Town Boundaries

Stormwater Outfalls

1,000 500 0 1,000 Feet

N

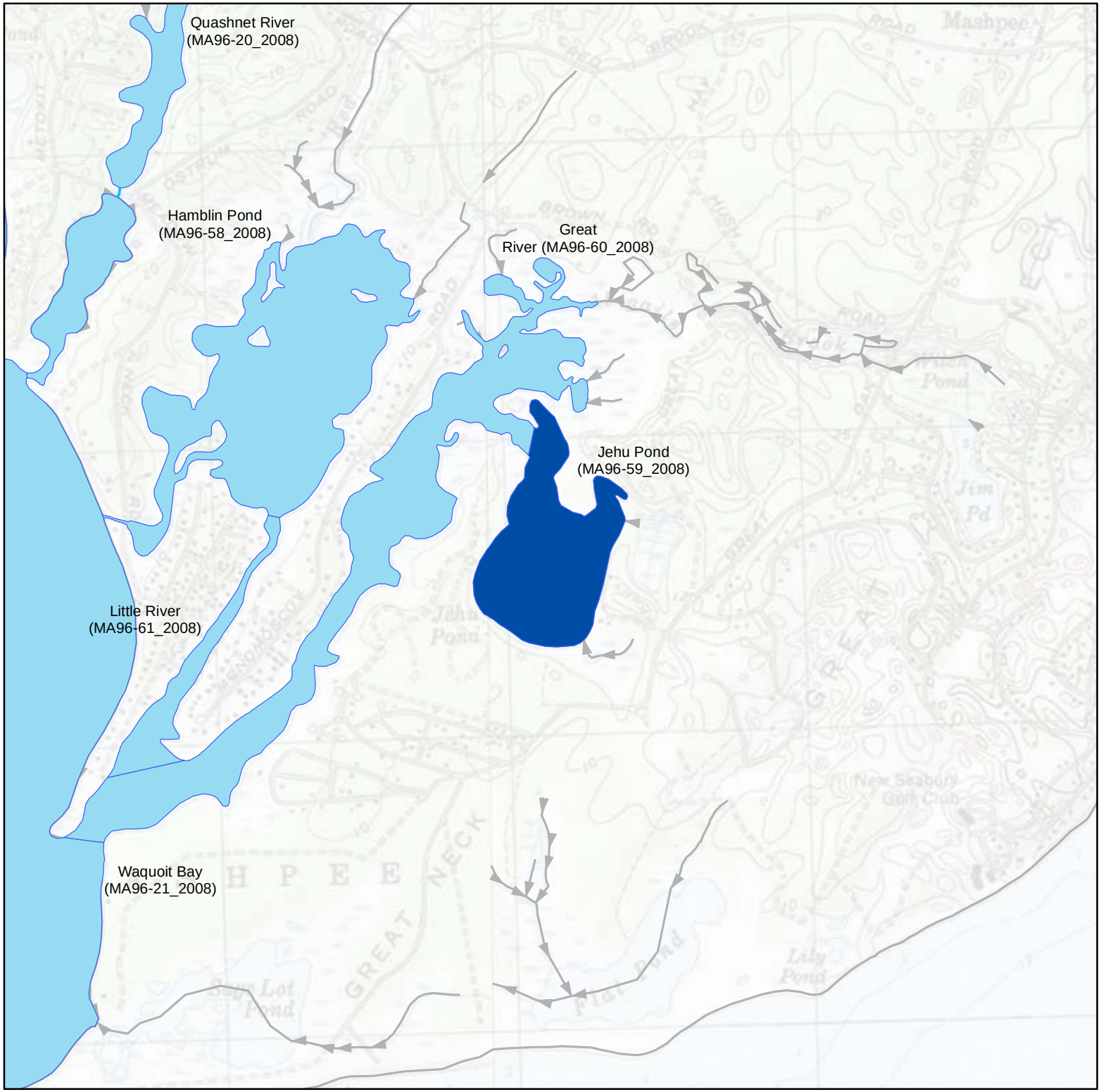
MA96-52_2008

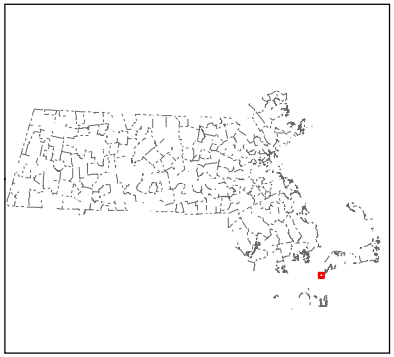
Mill Pond

Cape Cod

March 2011

Moving Massachusetts Forward. massDOT





Impaired Water Body Being Assessed

Impaired Water Body

Impaired Stream Being Assessed

Impaired Stream Segment

Non-Impaired Stream Segments

MA DOT Roads

MA DOT Urban Area Roads

Town Boundaries

Stormwater Outfalls

1,000 500 0 1,000 Feet

N

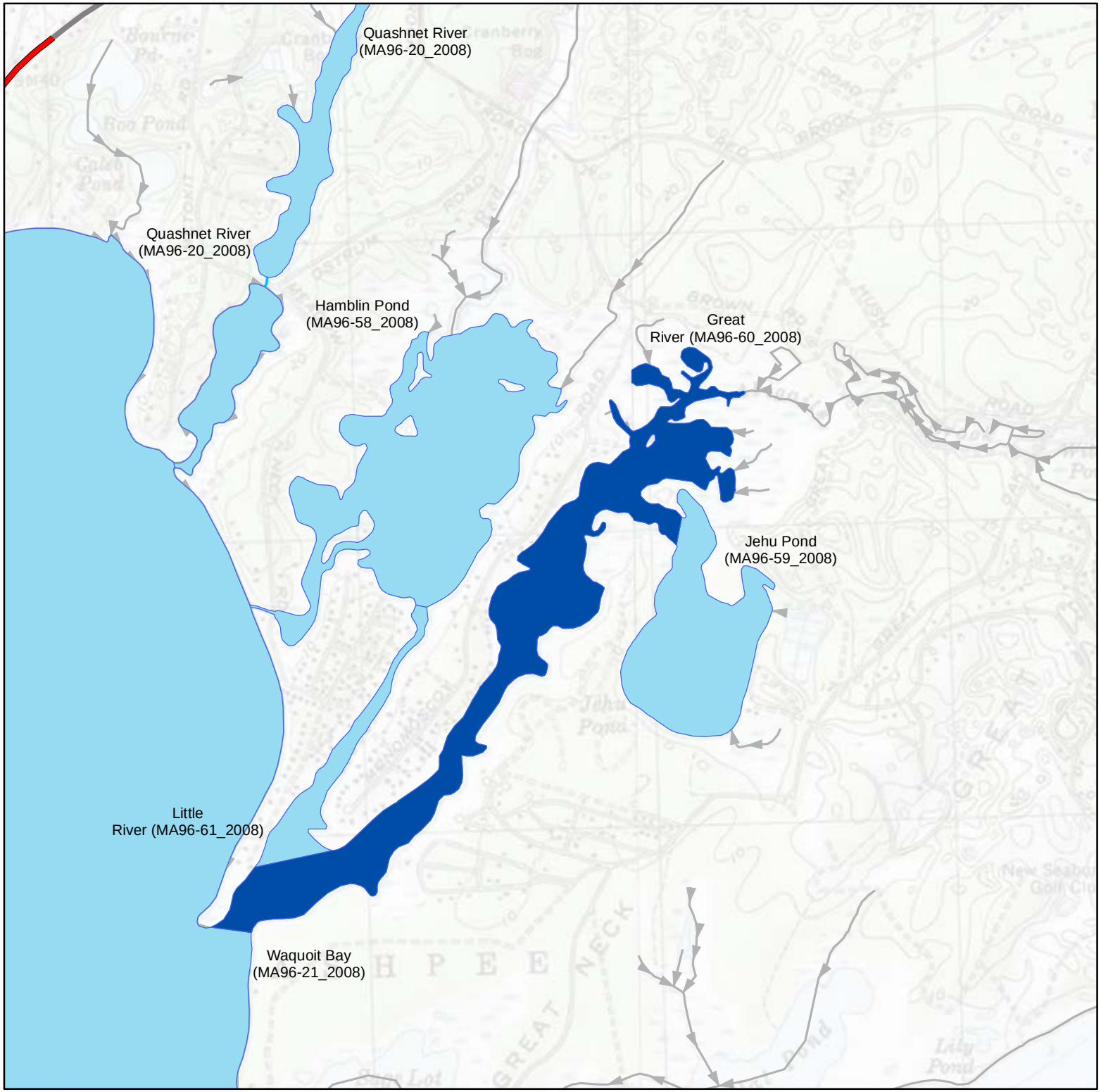
MA96-59_2008

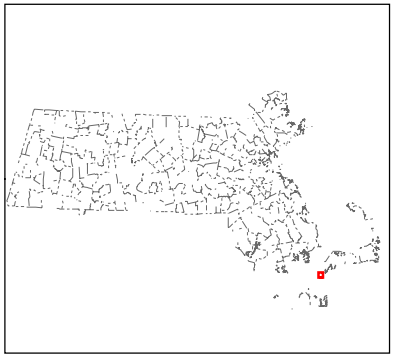
Jehu Pond

Cape Cod

March 2011

massDOT





Impaired Water Body Being Assessed

Impaired Water Body

Impaired Stream Being Assessed

Impaired Stream Segment

Non-Impaired Stream Segments

MA DOT Roads

MA DOT Urban Area Roads

Town Boundaries

Stormwater Outfalls

1,000 500 0 1,000 Feet

N

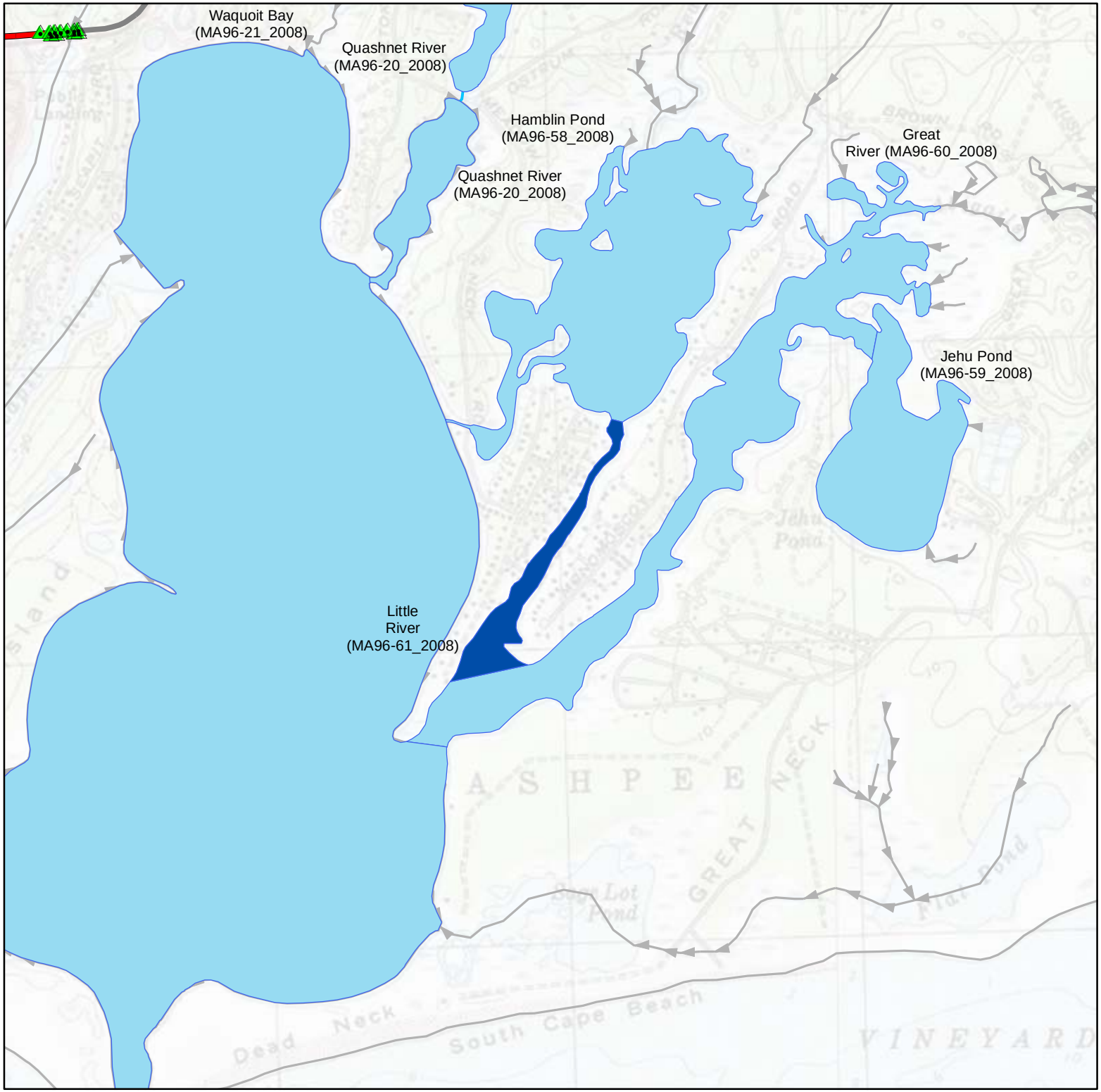
MA96-60_2008

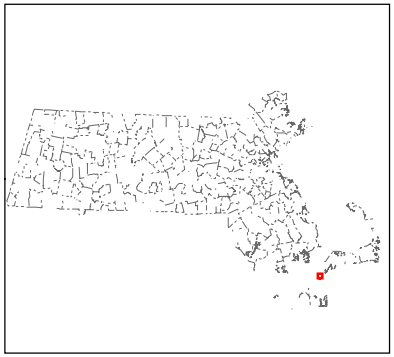
Great River

Cape Cod

March 2011

massDOT





Impaired Water Body Being Assessed

Impaired Water Body

Impaired Stream Being Assessed

Impaired Stream Segment

Non-Impaired Stream Segments

MA DOT Roads

MA DOT Urban Area Roads

Town Boundaries

Stormwater Outfalls

1,000 500 0 1,000 Feet

N

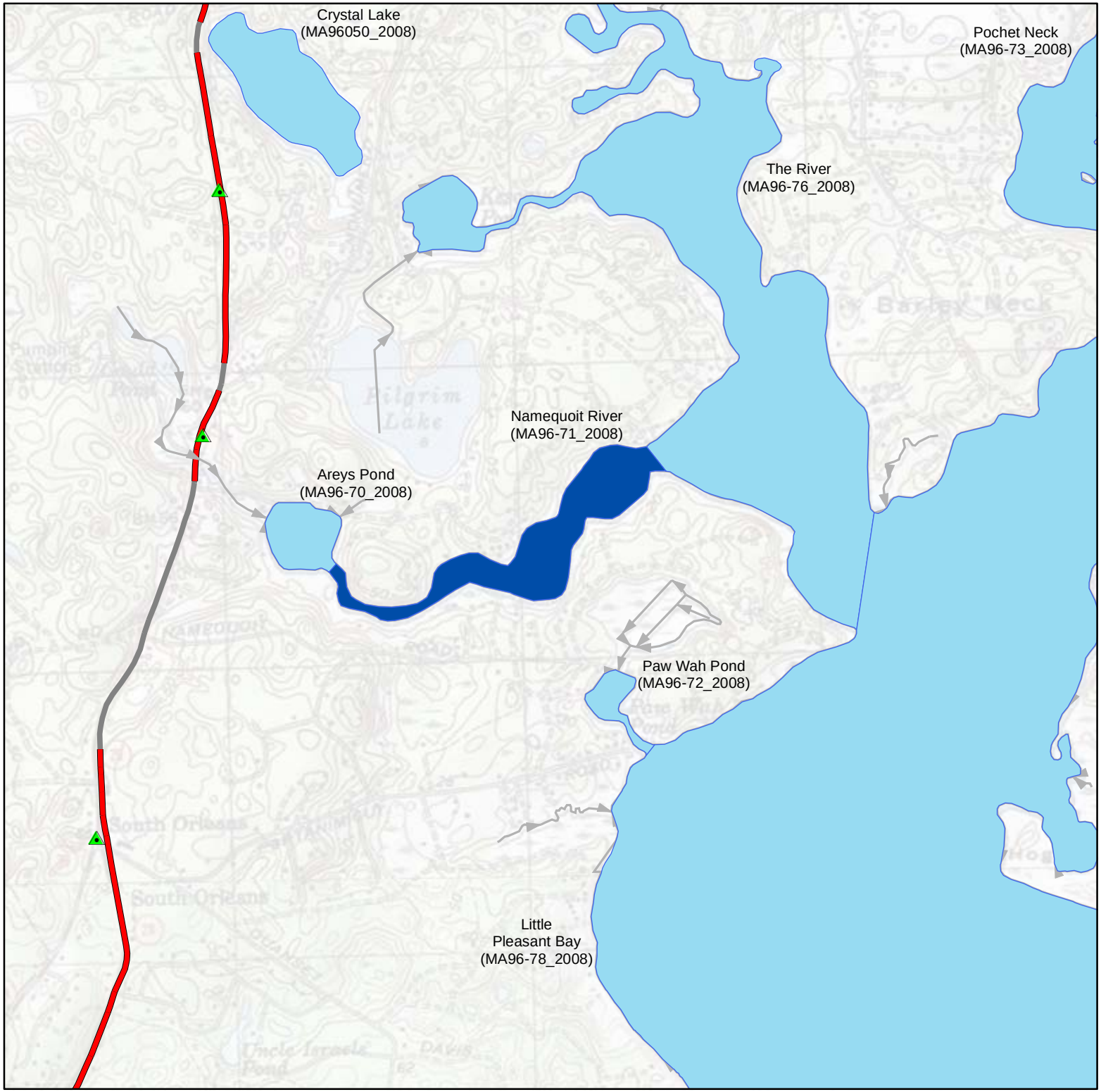
MA96-61_2008

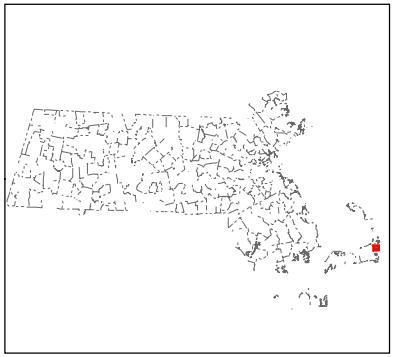
Little River

Cape Cod

March 2011

Moving Massachusetts Forward. massDOT





Impaired Water Body Being Assessed

Impaired Water Body

Impaired Stream Being Assessed

Impaired Stream Segment

Non-Impaired Stream Segments

MA DOT Roads

MA DOT Urban Area Roads

Town Boundaries

Stormwater Outfalls

1,000 500 0 1,000 Feet

N

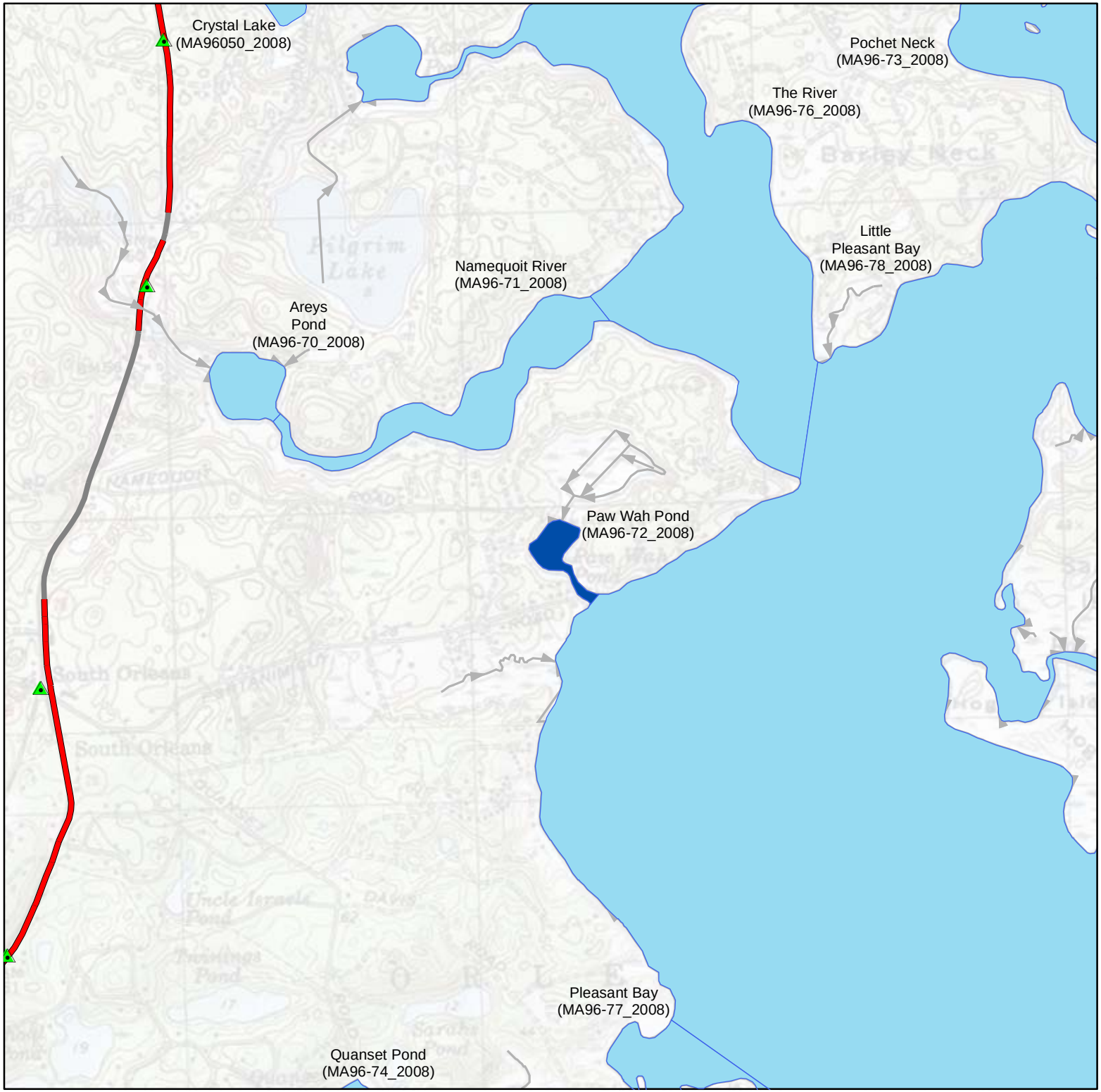
MA96-71_2008

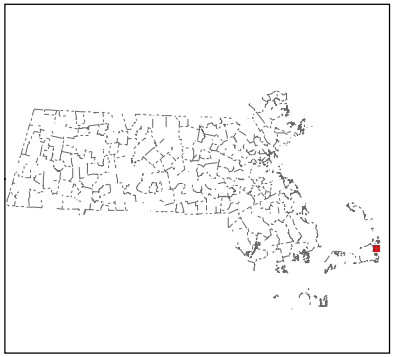
Namequoit River

Cape Cod

March 2011

massDOT





Impaired Water Body Being Assessed

Impaired Water Body

Impaired Stream Being Assessed

Impaired Stream Segment

Non-Impaired Stream Segments

MA DOT Roads

MA DOT Urban Area Roads

Town Boundaries

Stormwater Outfalls

1,000 500 0 1,000 Feet

N

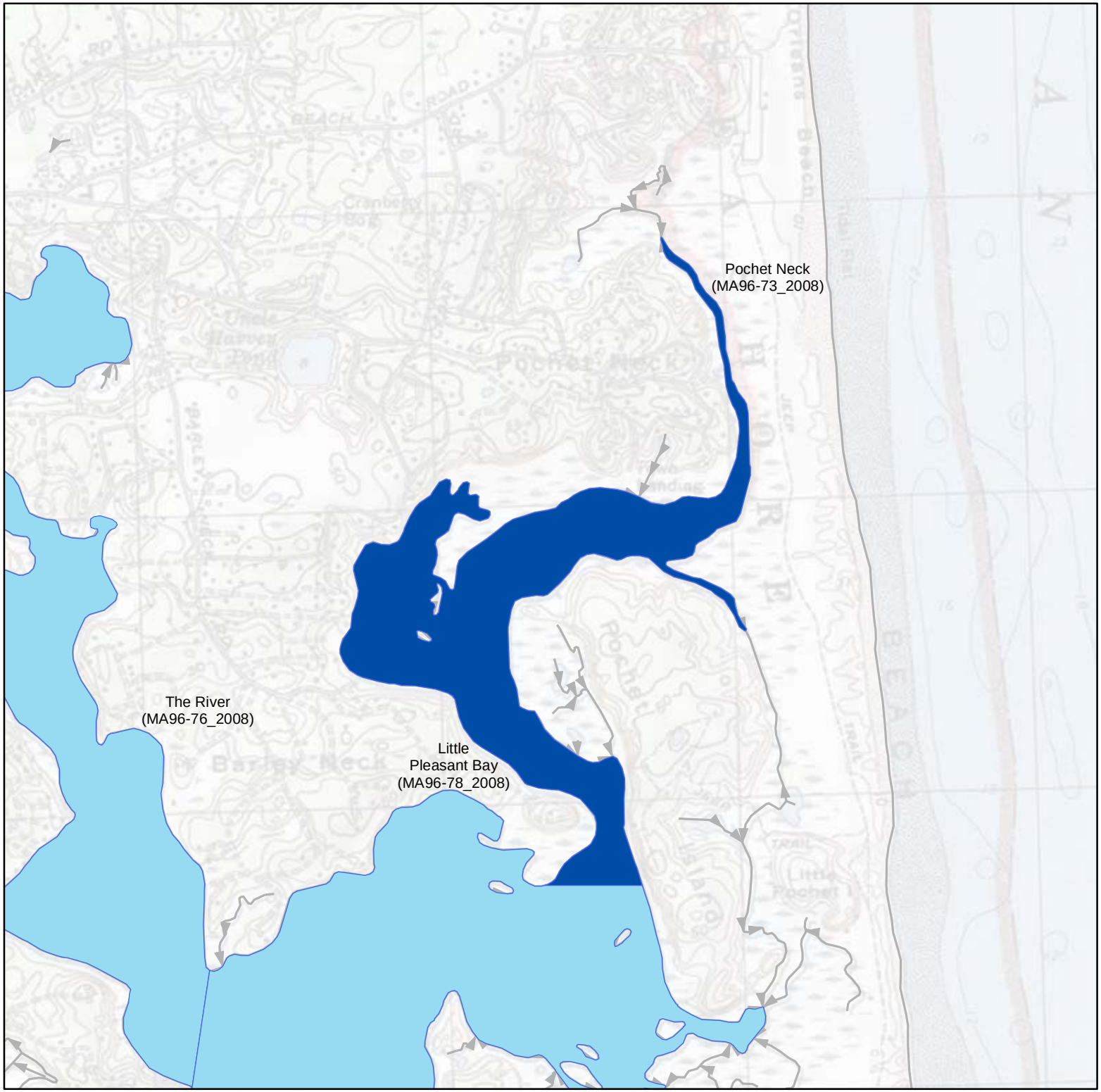
MA96-72_2008

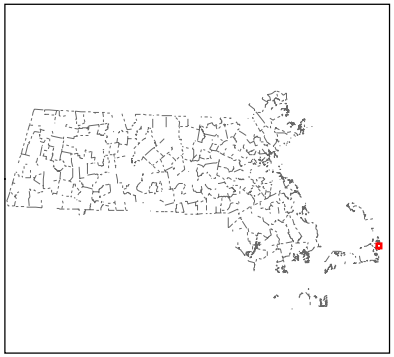
Paw Wah Pond

Cape Cod

March 2011

massDOT
Moving Massachusetts Forward





Impaired Water Body Being Assessed

Impaired Water Body

Impaired Stream Being Assessed

Impaired Stream Segment

Non-Impaired Stream Segments

MA DOT Roads

MA DOT Urban Area Roads

Town Boundaries

Stormwater Outfalls

1,000 500 0 1,000 Feet

N

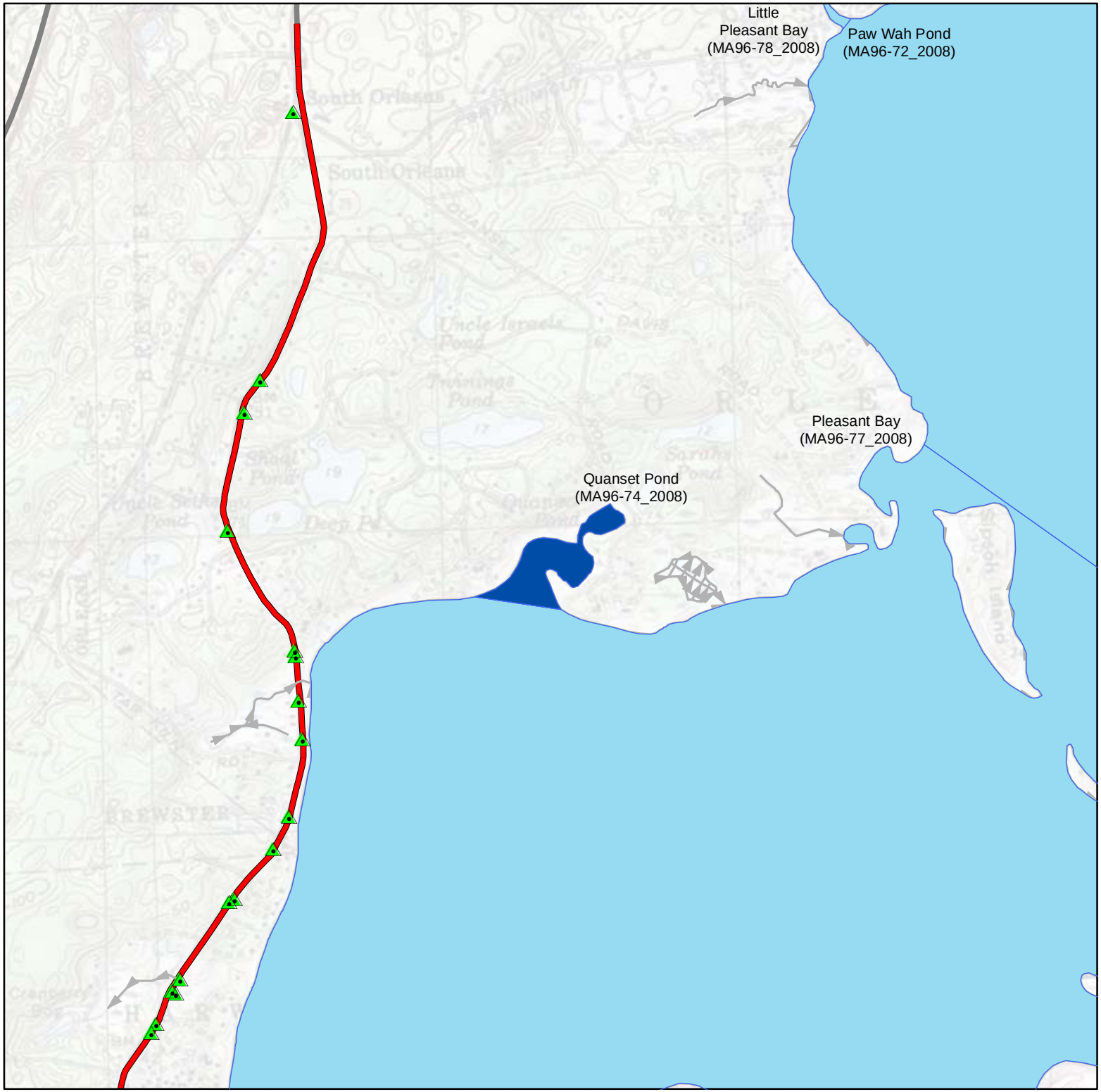
MA96-73_2008

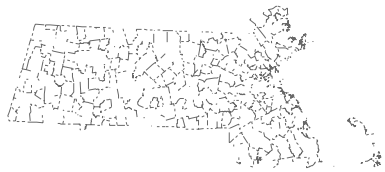
Pochet Neck

Cape Cod

March 2011

massDOT





Impaired Water Body Being Assessed

Impaired Water Body

Impaired Stream Being Assessed

Impaired Stream Segment

Non-Impaired Stream Segments

MA DOT Roads

MA DOT Urban Area Roads

Town Boundaries

Stormwater Outfalls

1,000 500 0 1,000 Feet

N

Quanset Pond

Cape Cod

March 2011