Attachment 2:

Impaired Waters Assessments – Other

List of Impaired Water Bodies

Waterbody ID	Waterbody Name
MA21-02	East Branch Housatonic River
MA34-04	Connecticut River
MA73062	Willet Pond
MA73-13	Unnamed Tributary (7341595)
MA82A-10	River Meadow Brook
MA83-15	Unnamed Tributary
MA83-20	Unnamed Tributary*
MA84A-01	Merrimack River
MA84A-05	Merrimack River
MA84A-06	Merrimack River
MA84A-09	Little River
MA84A-40	Fish Brook*
MA92-26	Unnamed Tributary (Martin's Brook)*
MA94-05	North River
MA96-34	Wellfleet Harbor
MA96-69	Coonamessett River

*Not on original L-1 List.

06/08/2014

Impaired Waters Assessment for East Branch Housatonic River (MA21-02)

Impaired Water Body

Name: East Branch Housatonic River

Location: Dalton and Pittsfield, MA

Water Body ID: MA21-02

Impairments

East Branch Housatonic River (MA21-02) is listed under Category 5, "Waters requiring a TMDL", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). The East Branch Housatonic River is impaired for the following:

- Fecal Coliform
- PCB in Fish Tissue

According to MassDEP's *Housatonic River Watershed 2002 Water Quality Assessment Report* (MassDEP, 2007), the East Branch Housatonic River (MA21-02) is impaired for fish consumption due to PCBs and is impaired for primary contact due to elevated total fecal coliform bacteria. The source of fecal coliform is unknown; however, stormwater runoff is a suspected source. The aquatic life use is supported in the upper six miles of the river segment and is not assessed in the lower two miles. A Total Maximum Daily Load (TMDL) report has not been prepared for pathogens in the East Branch Housatonic River.

MassDOT has identified a subset of water body impairments in the East Branch Housatonic River watershed which are not related to stormwater runoff. Specific impairments unrelated to stormwater for the East Branch Housatonic River (MA21-02) include PCB in Fish Tissue. In accordance with MassDOT's Impaired Waters Assessment for Impaired Waters with Impairments Unrelated to Stormwater in the December 8, 2012 EPA submittal, the non-stormwater related impairments are not specifically addressed as part of the Impaired Waters Program (MassDEP, 2012).

Polychlorinated Biphenyls (PCBs) refer to a range of man-made organic chemicals that were manufactured in the United States between 1929 and 1979. They had a variety of industrial applications and are extremely persistent in the environment. MassDOT concluded that the impairment for PCB in fish tissue is unrelated to storm water runoff. The Nationwide Urban Runoff Program (NURP) conducted by the EPA found that PCB was detected in less than 1% of stormwater samples collected (EPA, 1983). Therefore, MassDOT concluded that stormwater runoff from its roadways does not contribute to the impairments of PCB in fish tissue.

Relevant Water Quality Standards

Water Body Classification: Class B

Applicable State Regulations:

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

- 314 CMR 4.05 (3)(b) 4 Bacteria.
  - a. At bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: where E. coli is the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 126 colonies per 100 ml and no single sample taken during the bathing season shall exceed 235 colonies per 100 ml; alternatively, where enterococci are the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 33 colonies per 100 ml and no single sample taken during the bathing season shall exceed 61 colonies per 100 ml;
  - b. for other waters and, during the non bathing season, for waters at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: the geometric mean of all E. coli samples taken within the most recent six months shall not exceed 126 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 235 colonies per 100 ml; alternatively, the geometric mean of all enterococci samples taken within the most recent six months shall not exceed 33 colonies per 100 ml typically based on a minimum of five samples and no single sample shall exceed 61 colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

Site Description

Segment MA21-02 of the East Branch Housatonic River flows west and southwest from the outlet of Center Pond in Dalton approximately 8.0 miles to its confluence with the Housatonic River in Pittsfield. The East Branch Housatonic River is separated into two segments in the final *Massachusetts Year 2012 Integrated List of Waters.* Segment MA21-01 of the East Branch Housatonic River begins at the outlet of Muddy Pond in Washington, and flows north and west to the outlet of Center Pond in Dalton where it becomes Segment MA21-02.

The total watershed for Segment MA21-02 of the East Branch Housatonic River extends approximately 70.8 square miles in the Towns of Hinsdale, Windsor, Washington, and Peru. The majority of the land in the total watershed is undeveloped forest. The subwatershed for Segment

MA21-02 of East Branch Housatonic River is an approximately 17.7 square mile area that consists of forest and a mix of residential and commercial development along Route 8 and densely developed areas in Pittsfield in the western portion of the subwatershed. Segment MA21-02 of the East Branch Housatonic River is located in the western and central portions of its watershed. Refer to Figure 1 for the total and subwatershed of Segment MA21-02 of the East Branch Housatonic River.

MassDOT's property with the potential to directly contribute stormwater runoff to Segment MA21-02 of East Branch Housatonic River is comprised of portions of Route 8 and Route 9. Refer to Figure 1 for the location of these roadways within the subwatershed of Segment MA21-02 of the East Branch Housatonic River.

BMP 7U for Pathogen Impairment

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7U of MassDOT's Storm Water Management Plan (SWMP), which applies to impairments that have been assigned to a water body prior to completion of a TMDL. Segment MA21-02 of East Branch Housatonic River is not covered by a TMDL.

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

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

Pathogens in MassDOT Discharge

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

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

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

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

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

Assessment

In general, pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations (US EPA, 2010a; US EPA, 2010b, US EPA, 2013).

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

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (MassDEP, 2009a)

- "The NPDES permit does not, however, establish numeric effluent limitations for stormwater discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated

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

- "Although the TMDL presents quantified WLAs for stormwater that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs." (MassDEP, 2002).

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

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contain specific requirements for compliance with pathogen TMDLs (in Appendix G) (US EPA, 2010a; US EPA, 2010b). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing stormwater discharges to pathogen-impaired waters. Section 2.2.1(c) of the permit states "For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA." Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

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

Mitigation Plan

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

- BMP 3C-1: Drainage Connection Policy
- BMP 3C-2: Drainage Tie-In Standard Operating Procedure
- BMP 3D: Illicit Discharge Detection Review

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

MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens. As part of its pet waste management program, MassDOT has determined that no targeted MassDOT rest stops are located within the subwatershed of this water body. At rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired water body, and pet waste removal bags and disposal cans will be provided.

Furthermore, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. Any illicit discharges to MassDOT's system could contribute pathogens to impaired waters, however, MassDOT's existing Illicit Discharge Detection and Elimination (IDDE) program is aimed at identifying and addressing these contributions. District maintenance staff are trained to conduct regular inspections of MassDOT infrastructure and note any signs of potential illicit discharges, such as dry weather flow and notable odors or sheens. Similarly, resident engineers overseeing construction projects also receive training to note any suspicious connections or flows, and report these for follow-up investigation and action as appropriate. MassDOT will continue to implement this Illicit Discharge Detection and Elimination (IDDE) training, and District staff will continue to report any suspicious flows requiring further investigation. MassDOT investigates any suspicious flows noted, and will work with owners of confirmed illicit discharges to remove these flows, and thereby minimize the possibility of pathogen contributions to receiving waters. At present, there are no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the subwatershed of this water body that could be contributing pathogens to the impaired water body.

Conclusions

MassDOT has concluded based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, pathogen TMDLs for Massachusetts waters, that the BMPs outlined in the stormwater management plan are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit and the applicable pathogen TMDLs. As stated previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from DOT roadways to be a contributing source, it is unlikely to warrant action relative to other sources of pathogens in the watershed. In addition, MassDOT has concluded that runoff from its roadways does not contribute to the impairments that are unrelated to stormwater.

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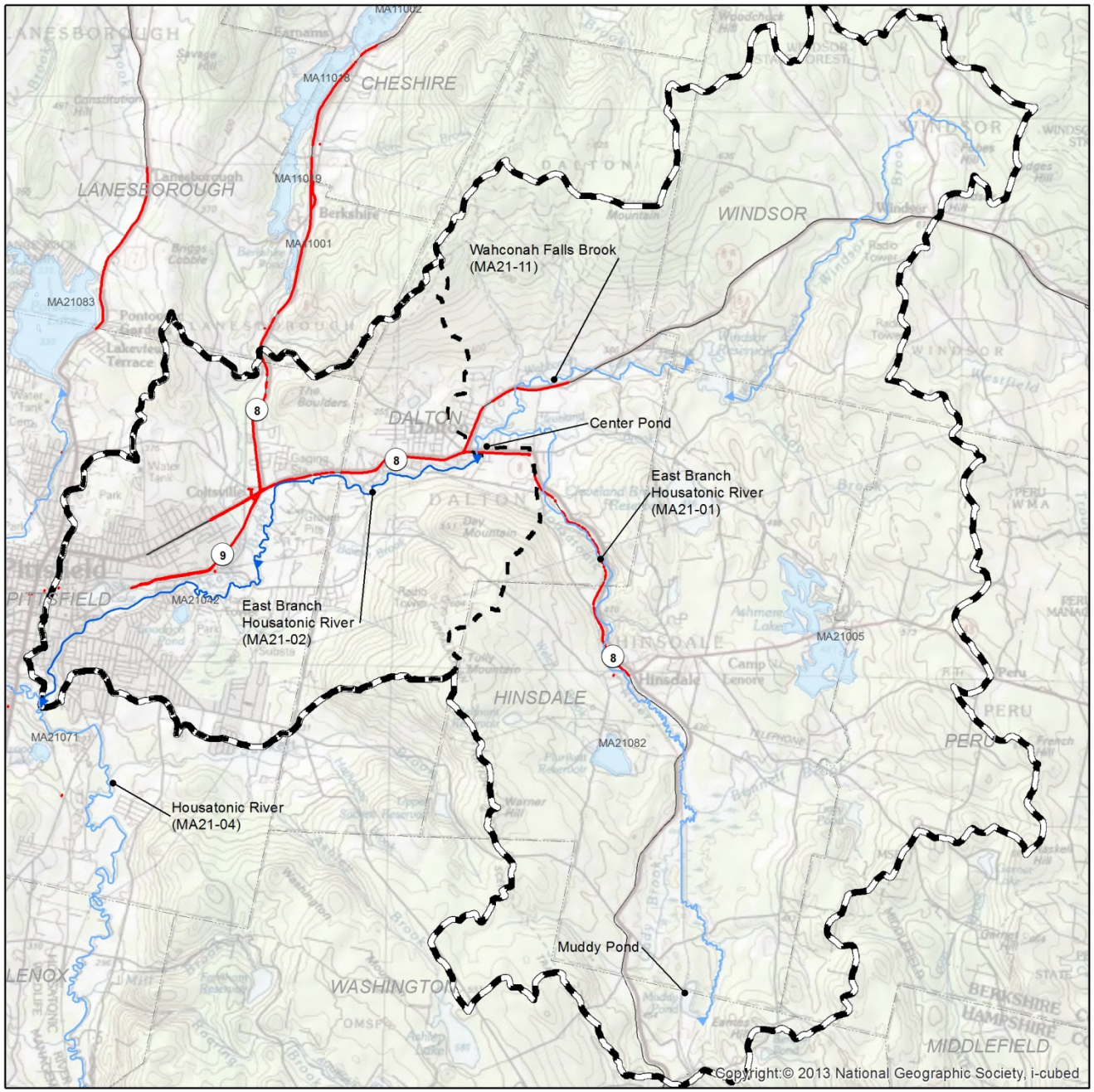

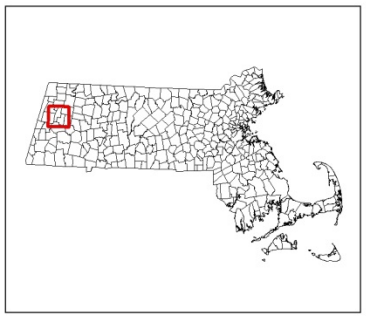

East Branch Housatonic River

Impaired Stream Segments

Impaired Water Bodies

Subwatershed

Total Watershed

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

N

0 1 2 3 4 Miles

Figure 1

East Branch Housatonic River (MA21-02) Total and Subwatershed

June 2014

massDOT
Massachusetts Department of Transportation
Highway Division

Impaired Waters Assessment for Connecticut River (MA34-04)

Impaired Water Body

Name: Connecticut River

Location: Greenfield, Montague, Deerfield, Holyoke, South Hadley, MA

Water Body ID: MA34-04

Impairments

The Connecticut River (MA34-04) is listed under Category 5, "Waters Requiring a TMDL", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Segment MA34-04 of the Connecticut River is impaired for the following:

- PCB in fish tissue
- Escherichia coli

According to MassDEP's *Connecticut River Watershed 2003 Water Quality Assessment Report* (MassDEP, 2008), Connecticut River (MA34-04) is impaired for fish consumption due to PCB in fish tissue; however, the source is unknown. Connecticut River is not covered by a final Total Maximum Daily Load (TMDL).

MassDOT has identified a subset of water body impairments in the Connecticut River (MA34-04) watershed which are not related to stormwater runoff. Specific impairments unrelated to stormwater for the Connecticut River (MA34-04) include PCB in Fish Tissue. In accordance with MassDOT's Impaired Waters Assessment for Impaired Waters with Impairments Unrelated to stormwater in the December 8, 2012 EPA submittal, the non-pollutant impairments are not specifically addressed as part of the Impaired Waters Program (MassDEP, 2012).

Polychlorinated Biphenyls (PCBs) refer to a range of man-made organic chemicals that were manufactured in the United States between 1929 and 1979. They had a variety of industrial applications and are extremely persistent in the environment. MassDOT concluded that the impairment for PCB in fish tissue is unrelated to storm water runoff. The *Nationwide Urban Runoff Program* (NURP) conducted by the EPA found that PCB was detected in less than 1% of stormwater samples collected (EPA, 1983). Therefore, MassDOT concluded that stormwater runoff from its roadways does not contribute to the impairments of PCB in fish tissue.

Relevant Water Quality Standards

Water Body Classification: Class B

Applicable State Regulations:

- *314 CMR 4.05 (5)(e) Toxic Pollutants*. All surface waters shall be free from pollutants in concentrations or combinations that are toxic to humans, aquatic life or wildlife. For pollutants not otherwise listed in 314 CMR 4.00, the National Recommended Water Quality Criteria: 2002, EPA 822R-02-047, November 2002 published by EPA pursuant to Section 304(a) of the Federal Water Pollution Control Act, are the allowable receiving water concentrations for the affected waters, unless the Department either establishes a site specific criterion or determines that naturally occurring background concentrations are higher. Where the Department determines that naturally occurring background concentrations are higher, those concentrations shall be the allowable receiving water concentrations. The Department shall use the water quality criteria for the protection of aquatic life expressed in terms of the dissolved fraction of metals when EPA's 304(a) recommended criteria provide for use of the dissolved fraction. The EPA recommended criteria based on total recoverable metals shall be converted to dissolved metals using EPA's published conversion factors. Permit limits will be written in terms of total recoverable metals. Translation from dissolved metals criteria to total recoverable metals permit limits will be based on EPA's conversion factors or other methods approved by the Department. The Department may establish site specific criteria for toxic pollutants based on site specific considerations.
- *314 CMR 4.05 (3)(b) 4 Bacteria.*
  - 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
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Site Description

Segment MA34-04 of the Connecticut River flows for 34.4 miles, from the confluence with Deerfield River, to the Holyoke Dam in South Hadley. The segment is the subject of many Water Management Act (WMA) withdrawals and discharges, as well as NPDES permits (27 total). The Holyoke Dam Hydroelectric Project is also an operating Federal Energy Regulatory Commission (FERC) facility at the end of the segment. Refer to Figure 1 for the subwatershed to Segment MA34-04 of Connecticut River.

MassDOT's property with the potential to directly contribute stormwater runoff to Segment MA34-04 of the Connecticut River is comprised of portions of Routes 9, 5, 116, 202, and Interstate 91. Refer to Figure 1 for the location of these roadways within the subwatershed to Segment MA34-04 of the Connecticut River.

BMP 7U for Pathogen Impairment

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7U of MassDOT's Storm Water Management Plan (SWMP), which applies to impairments that have been assigned to a water body prior to completion of a TMDL. Segment MA34-04 of the Connecticut River is not covered by a TMDL (MassDOT, 2011).

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

In addition, while there is a positive relationship between IC and pathogen loading, the relationship is not as direct as other impairments. According to the Center for Watershed Protection "…Other studies show that concentrations of bacteria are typically higher in urban areas than rural areas (USGS, 1999), but they are not always directly related to IC (CWP, 2003)." Therefore, DOT did not rely solely on the IC method to assess pathogen impairments. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations (US EPA, 2010a, US EPA, 2010b, US EPA, 2013).

Pathogens in MassDOT Discharge

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

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

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

thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the stormwater system.

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

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

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

Assessment

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

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

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (MassDEP, 2009a)

- "The NPDES permit does not, however, establish numeric effluent limitations for stormwater discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals."(MassDEP, 2009b)

- "Although the TMDL presents quantified WLAs for stormwater that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based

> Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs." (MassDEP, 2002).

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

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contain specific requirements for compliance with pathogen TMDLs (in Appendix G) (US EPA, 2010a, US EPA, 2010b). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing stormwater discharges to pathogen-impaired waters. Section 2.2.1(c) of the permit states "For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA." Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

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

Mitigation Plan

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

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

MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens. In addition, as part of its pet waste management program, MassDOT has determined that one MassDOT targeted rest stop is located within the subwatershed of this water body. The MassDOT facility ID is 502 and it is located on the northbound side of I-91 in Holyoke. At rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired water body, and pet waste removal bags and disposal cans will be provided.

Furthermore, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. Any illicit discharges to MassDOT's system could contribute pathogens to impaired waters, however, MassDOT's existing Illicit Discharge Detection and Elimination (IDDE) program is aimed at identifying and addressing these contributions. District maintenance staff are trained to conduct regular inspections of MassDOT infrastructure and note any signs of potential illicit discharges, such as dry weather flow and notable odors or sheens. Similarly, resident engineers overseeing construction projects also receive training to note any suspicious connections or flows, and report these for follow-up investigation and action as appropriate. MassDOT will continue to implement this Illicit Discharge Detection and Elimination (IDDE) training, and District staff will continue to report any suspicious flows requiring further investigation. MassDOT investigates any suspicious flows noted, and will work with owners of confirmed illicit discharges to remove these flows, and thereby minimize the possibility of pathogen contributions to receiving waters. At present, there are no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the subwatershed of this water body that could be contributing pathogens to the impaired water body.

Conclusions

MassDOT has concluded based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, and pathogen TMDLs for Massachusetts waters that the BMPs outlined in the stormwater management plan are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit and the applicable Pathogen TMDLs. As stated previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from DOT roadways to be a contributing source it is unlikely to be warrant action relative to other sources of pathogens in the watershed. In addition, MassDOT has concluded that runoff from its roadways does not contribute to the impairments that are unrelated to stormwater.

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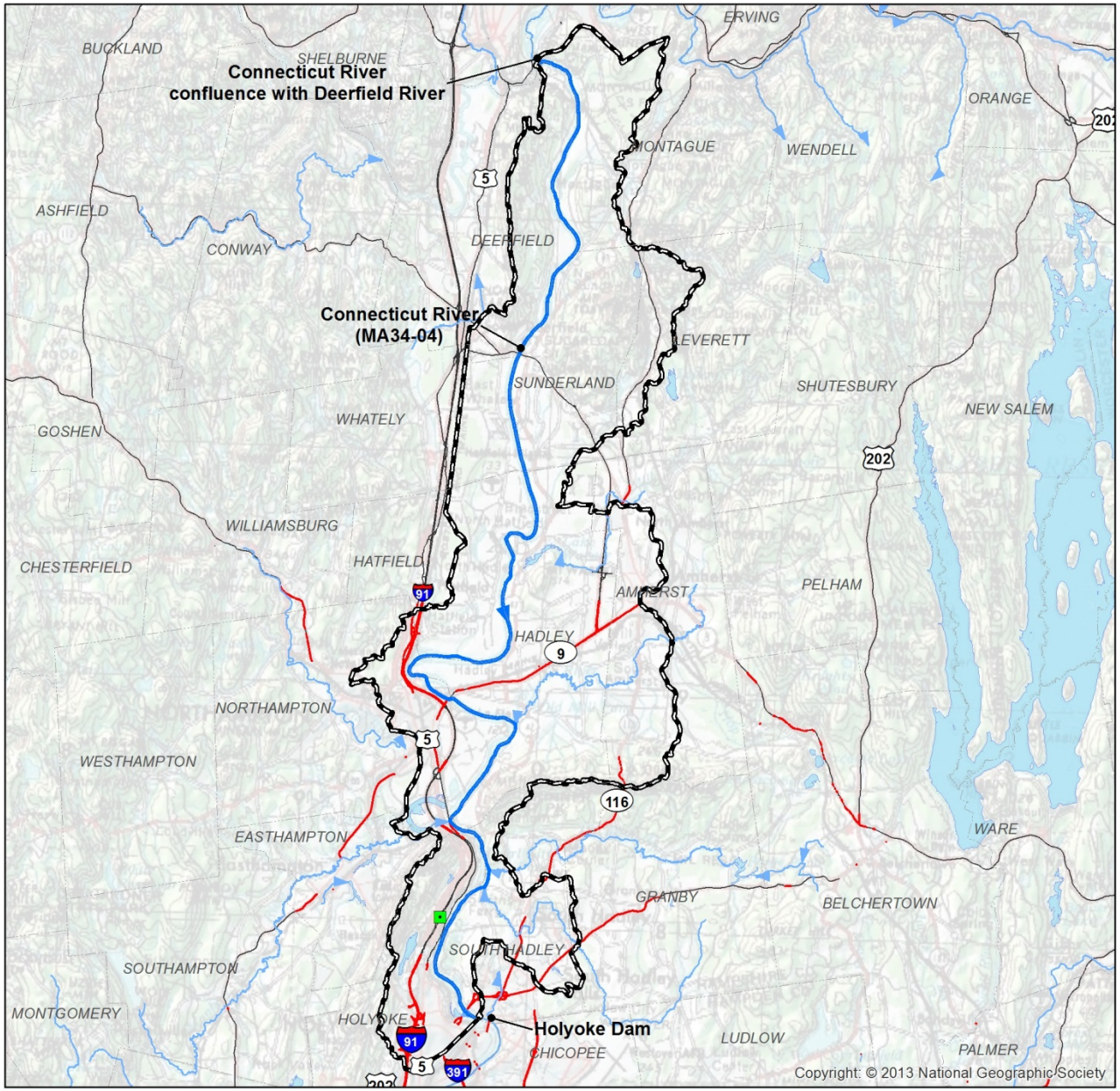

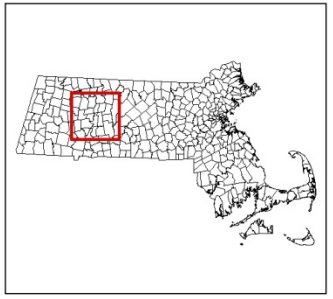

MassDOT Targeted Rest Stops
Subwatershed
Connecticut River (MA34-04)
Impaired Stream Segments
Impaired Water Bodies
MassDOT Roads in Urban Areas
MassDOT Roadways
Town Boundaries

N

0 1.5 3 6
Miles

Figure 1
Connecticut River (MA34-04) Subwatershed

June 2014

MassDOT Massachusetts Department of Transportation Highway Division

Impaired Waters Assessment for Impaired Waters with Impairments Unrelated to Stormwater

Impaired Water Bodies

As part of the Impaired Waters Program, MassDOT has been reviewing those impaired water bodies identified as potentially receiving MassDOT property runoff in urban areas (Appendix L-1 list) to determine the appropriate assessment methodology. MassDEP updates the Integrated List of Waters ("303(d) list") every two years to reflect changes to the water quality of Massachusetts' streams and lakes. The *Final Massachusetts 2012 Integrated List of Waters* (MassDEP, 2013) was finalized in March 2013 and replaces the *Final Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2011). During our review of the updated 2012 "303(d) list", it was determined that two water bodies that were included in the Appendix L-1 list have impairments unrelated to stormwater. This assessment completes the assessment for these water bodies (Table 1).

Impairments

This assessment addresses the impairments listed below.

- Mercury in Fish Tissue

Table 1 includes the receiving water impairment as listed on the 2012 "303(d) List". Other water bodies may include these impairments but are also listed for pollutants that are potentially related to stormwater. Those receiving waters will be addressed in specific assessments for the water bodies to which they apply.

Table 1. Appendix L-1 Impaired Waters with Impairments that are Unrelated to Stormwater

Water Body ID	Water Body Name	Impairments of Concern (According to the 2012 303d List)	TMDL Impairment on Appendix L1*
MA73-13	Unnamed Tributary	As of the 2012 List, this segment became part of MA73062 Willet Pond which is impaired for Mercury in Fish Tissue	-Pathogens [6/21/2002-CN121.0]
MA73062	Willet Pond	Mercury in Fish Tissue	-Metals [12/20/2007-NEHgTMDL]

* TMDL impairment listed on Appendix L-1 based on 2008 "303(d) List". Some water bodies may have Total Maximum Daily Loads (TMDLs) finalized on the 2012 list.

Assessment under BMP 7R

A Total Maximum Daily Load (TMDL) has been developed for mercury in fish tissue which covers MA73062 Willet Pond. Therefore, MassDOT began to assess these impairments using the TMDL

method, described in BMP 7R of MassDOT's Storm Water Management Plan (MassDOT, 2012). In reviewing the water bodies addressed by the *Northeast Regional Mercury TMDL (*NEIWPCC, 2007)*,* the TMDL indicated that this impairment is not stormwater related. According to the TMDL, regulated stormwater is considered to be a *de minimis* contributor to the waste load allocation for mercury. Additionally, the primary source of mercury in stormwater in Massachusetts is atmospheric deposition, which must be controlled by targeting sources that emit into the air. Based on the TMDL, the impairment for mercury in fish tissue has been excluded from the TMDL Method and deemed "unrelated to stormwater," so no further action is necessary for this pollutant.

Conclusions

MassDOT has concluded, in accordance with the TMDL method, that there is no required reduction in pollutant loading for the water bodies listed in Table 1 because the impairments are not related to stormwater runoff from MassDOT property. As such, further assessment of these water bodies is not warranted under the Impaired Waters Program.

References

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Impaired Waters Assessment for River Meadow Brook (MA82A-10)

Impaired Water body

Name: River Meadow Brook

Location: Chelmsford and Lowell, MA

Water Body ID: MA82A-10

Impairments

River Meadow Brook (MA82A-10) is listed under Category 5, "Waters Requiring a TMDL", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). River Meadow Brook is impaired for the following:

- Debris/Floatables/Trash
- Non-Native Aquatic Plants
- Fecal Coliform.

MassDOT has identified a subset of water body impairments in the River Meadow Brook watershed which are not related to stormwater runoff. Specific impairments unrelated to stormwater for River Meadow Brook include non-native aquatic plants and Debris/Floatables/Trash. In accordance with MassDOT's Impaired Waters Assessment for Impaired Waters with Impairments Unrelated to Stormwater in the December 8, 2012 EPA submittal, the non-stormwater related impairments are not specifically addressed as part of the Impaired Waters Program.

According to MassDEP's *SuAsCo Watershed Year 2001 Water Quality Assessment Report* (MassDEP, 2001), River Meadow Brook (MA82A-10) is impaired for trash and debris due to the surrounding dense municipal urban area. The aquatic life and fish consumption uses have not been assessed.

Relevant Water Quality Standards

Water Body Classification: Class B

Applicable State Regulations:

- 314 CMR 4.05 (3)(b) 4 Bacteria.
  - a. At bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010: where E. coli is the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 126 colonies per 100 ml and no single sample taken during the bathing season shall exceed 235 colonies per 100 ml; alternatively, where enterococci are the chosen indicator, the geometric mean of the five most recent samples taken during the same bathing season shall not exceed 33 colonies per 100 ml and no

single sample taken during the bathing season shall exceed 61 colonies per 100 ml;

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

Site Description

River Meadow Brook (MA82A-10) flows south to north through the towns of Chelmsford and Lowell, Massachusetts from its headwaters of Russell Millpond (MA82096) to its confluence with the Concord River (MA82A-08). The total watershed of River Meadow Brook extends into Carlisle, Westford, Chelmsford, Billerica, and Lowell. The sub watershed extends into Carlisle, Billerica, Chelmsford, and Lowell. Both the total and sub watersheds are shown on Figure 1.

Land uses within the sub watershed are largely residential, industrial, and commercial. River Meadow Brook crosses under Interstate 495 (I-495), Route 3 and Route 4 (the Lowell Connector) in a highly urbanized area which includes the Chelmsford Mall and other large commercial areas.

MassDOT's property with the potential to directly contribute stormwater runoff to River Meadow Brook is comprised of portions I-495, Route 3, and the Lowell Connector.

Assessment of Pathogen Impairment under BMP 7U

MassDOT assessed the pathogen impairment using the approach described in BMP 7U of MassDOT's Storm Water Management Plan (*Water Quality Assessment and Mitigation Plan*), which applies to impairments that have been assigned to a water body prior to completion of a TMDL. Pathogen concentrations in stormwater vary widely temporally and spatially; concentrations can vary by an order of magnitude within a given storm event at a single location (MassDEP, 2009b). Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. Due to this difficulty, MassDOT generally will not conduct site specific assessments of loading at each location impaired for pathogens. Instead these sites are assessed based on available information on pathogen loading from highways, MassDOT actions, and information available from EPA and DEP. Based on this information MassDOT developed an approach to be consistent with relevant TMDL and permit condition requirements and an iterative adaptive management approach to stormwater management.

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

Pathogens in MassDOT Discharge

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

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

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

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

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

Assessment

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

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

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (MassDEP, 2009a)
- "The NPDES permit does not, however, establish numeric effluent limitations for stormwater discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals."(MassDEP, 2009b)
- "Although the TMDL presents quantified WLAs for stormwater that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs." (MassDEP, 2002).

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

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

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

Mitigation Plan

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit

connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

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

MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens. MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program, MassDOT has determined that no MassDOT rest stops are located within the sub-watershed of this water body. At rest stops that have been identified as being within sub-watersheds of waterbodies impaired for pathogens, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired water body, and pet waste removal bags and disposal cans will be provided.

Furthermore, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. Any illicit discharges to MassDOT's system could contribute pathogens to impaired waters, however, MassDOT's existing Illicit Discharge Detection and Elimination (IDDE) program is aimed at identifying and addressing these contributions. District maintenance staff are trained to conduct regular inspections of MassDOT infrastructure and note any signs of potential illicit discharges, such as dry weather flow and notable odors or sheens. Similarly, resident engineers overseeing construction projects also receive training to note any suspicious connections or flows, and report these for follow-up investigation and action as appropriate. MassDOT will continue to implement this Illicit Discharge Detection and Elimination (IDDE) training, and District staff will continue to report any suspicious flows requiring further investigation. MassDOT investigates any suspicious flows noted, and will work with owners of confirmed illicit discharges to remove these flows, and thereby minimize the possibility of pathogen contributions to receiving waters. At present, there are no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the sub-watershed of this water body that could be contributing pathogens to the impaired water body.

Conclusions

MassDOT has concluded, based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, and pathogen TMDLs for Massachusetts waters, that the BMPs outlined in the stormwater management plan are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit and the applicable Pathogen TMDLs. As stated previously, pathogen loadings are highly variable and although there is potential for stormwater

runoff from DOT roadways to be a contributing source it is unlikely to be warrant action relative to other sources of pathogens in the watershed.

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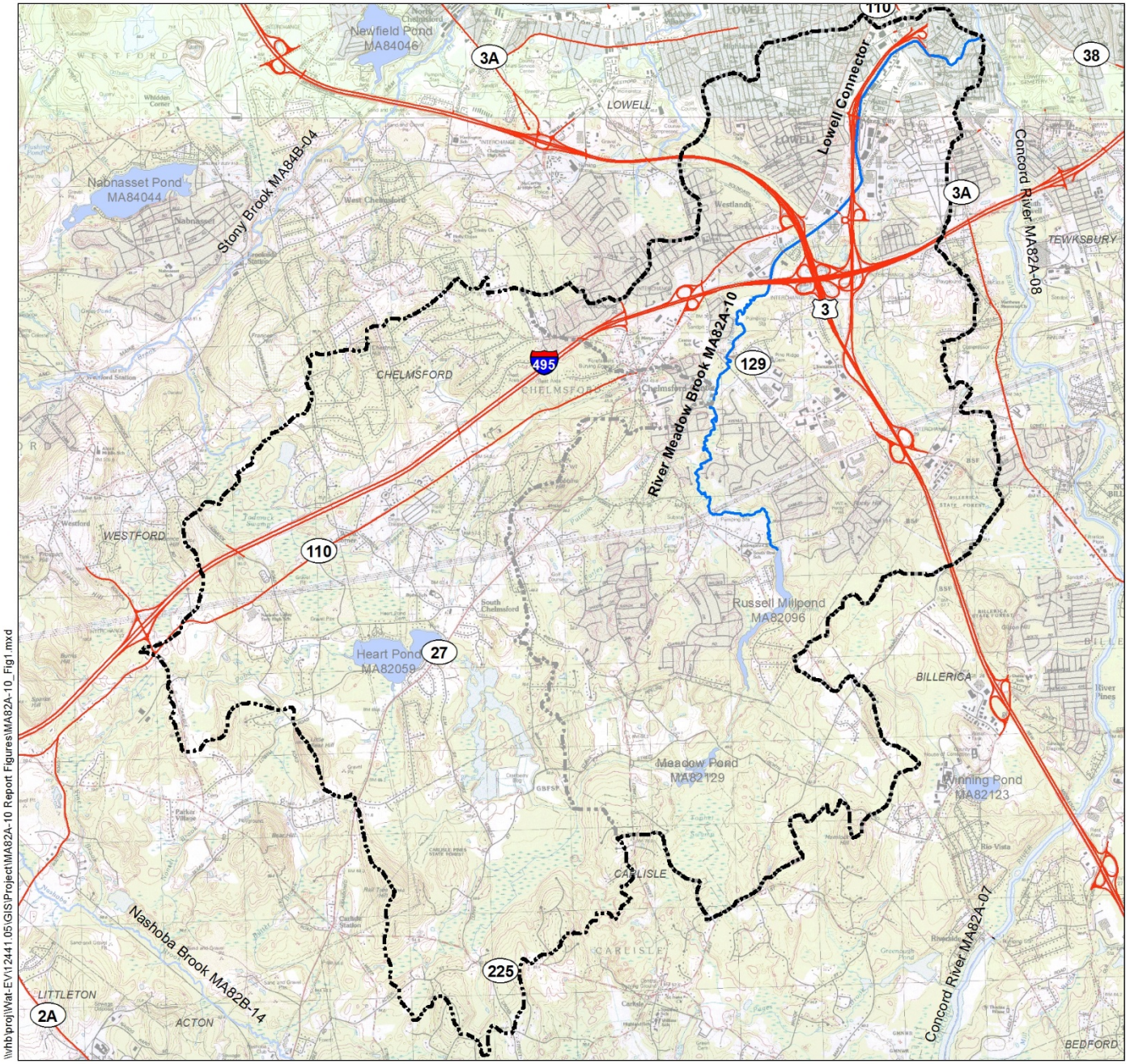

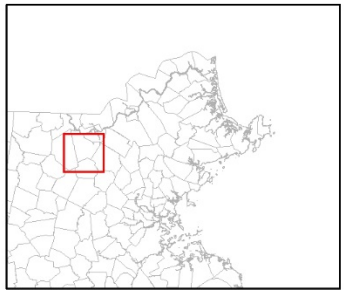

MassDOT Roadways in Urban Area

Assessed Segment

Impaired Lakes

Impaired Streams

Total Watershed

Sub Watershed

N

0 0.5 1 Miles

Figure 1

River Meadow Brook (MA82A-10) Watersheds

June 2014

massDOT Massachusetts Department of Transportation Highway Division

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massDOT Massachusetts Department of Transportation Highway Division

06/08/2014

Impaired Waters Assessment for Unnamed Tributary (MA83-15)

Summary

Impaired Waters[1]		**Stormwater**
	Impairments	Chloride, fecal coliform
	Category	5 (Waters requiring a TMDL)
	Final TMDLs	Bacteria TMDL for the Shawsheen River Basin CN 122.0[2]
	WQ Assessment	Shawsheen River Watershed 2000 Water Quality Assessment Report CN 86.0[3]
Location	**Towns:**	Andover and Tewksbury
	MassDOT Roads:	Interstate 93
Assessment Methods(s)	**7R (TMDL Method)**	☒
	7U (IC Method)	☒
BMPs	**Existing:**	None

1 MassDEP, 2013. Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. Massachusetts. Available at: http://www.mass.gov/eea/docs/dep/water/resources/07v5/12list2.pdf

[2] MassDEP, 2002. Bacteria TMDL for the Shawsheen River Basin, Report MA83-01-2002-24. Available at http://www.mass.gov/eea/docs/dep/water/resources/n-thru-y/shawshee.pdf.

[3] MassDEP, 2003. Shawsheen River Watershed 2000 Water Quality Assessment Report. Available at http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/83wqar.pdf.

Site Description

Unnamed Tributary (MA83-15), locally known as Pinnacle Brook, is a small stream that flows east to west from just east of Interstate 93 (I-93) in Andover to the confluence with Meadow Brook(MA83-12) in Tewksbury. As shown on Figure 1, the watershed to MA83-20 is approximately 2 square miles and includes a portion of the I-93/Lowell Street interchange in Andover. Land uses within the watershed are mostly open space and residential with a large industrial facility west of the I-93 southbound interchange. MassDOT owns I-93 within the receiving water body's watershed.

BMP 7R for Pathogen TMDL (CN 122.0)

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7U of MassDOT's Storm Water Management Plan (SWMP).[4] The Shawsheen River (MA83-18) is covered by the Bacteria TMDL for the Shawsheen River Basin.[5] The TMDL states that sources of indicator bacteria include illicit sewer connections, sewer line leaks, septic systems, and urban stormwater runoff. Recommended TMDL implementation measures include controlling point sources, septic tank contributions, and urban runoff. The TMDL also emphasizes the need for additional monitoring of wet weather sources and in-stream conditions.

Pathogen concentrations in stormwater vary widely temporally and spatially; concentrations can vary by an order of magnitude within a given storm event at a single location.[6] Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT's Southeast Expressway study measured bacterial concentration in stormwater runoff[7] and data indicate that highway's pathogen loading may be lower than urban areas. Considering that the potential sources of pathogens (e.g., illicit discharges, sewer utilities, pet waste, and wildlife) are likely to be less prevalent in the highway environment than along urban roads, this finding is not surprising.

MassDOT does not conduct site specific assessments of loading at each location impaired for pathogens. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and pathogen TMDL requirements. Language in the documents clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters and recommends implementation of programmatic BMPs such as residential educational programs, illicit connection identification, tracking and removal and pet waste management. MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing SWMP including educational programs, illicit connection review, and source control.

MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. Any illicit discharges to MassDOT's system could contribute pathogens to impaired waters, however, MassDOT's existing Illicit Discharge Detection and Elimination (IDDE) program is aimed at identifying and addressing these contributions. District maintenance staff notes signs of potential illicit discharges, such as dry weather flow and notable odors or sheens. Similarly, Resident Engineers overseeing construction

[4] Massachusetts Department of Transportation (MassDOT), July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.mhd.state.ma.us/downloads/projDev/BMP_7R_TMDL_WatershedReview.pdf

[5] MassDEP, 2002. Bacteria TMDL for the Shawsheen River Basin, Report MA83-01-2002-24. Available at http://www.mass.gov/eea/docs/dep/water/resources/n-thru-y/shawshee.pdf.

[6] ibid.

[7] Smith. (2002). Effectiveness of Three Best Management Practices for Highway Runoff Quality along the Southeast Expressway. USGS Water Resources Investigations Report 02-4059. Boston, Massachusetts.

projects also note any suspicious connections or flows, and report these for follow-up investigation and action as appropriate. MassDOT will continue to implement this IDDE training, and District staff will continue to report any suspicious flows requiring further investigation. MassDOT investigates any suspicious flows noted, and proceeds to work with owners of confirmed illicit discharges to remove these flows, and thereby minimize pathogen contributions to receiving waters.

MassDOT is in the process of developing a pet waste management program for MassDOT rest stops located within the sub-watershed of a pathogen impaired waterbody. At these prioritized rest stops, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired waterbody and will be providing pet waste removal bags and disposal cans.

MassDOT's existing efforts are consistent with the current and draft MS4 permit's requirements and TMDL recommendations.

Assessment of Chloride Impairment under BMP 7U

MassDOT assessed the chloride impairment 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. TMDL studies have not been initiated for chloride impaired streams in Massachusetts.

The water quality impairments for these water bodies are based on water quality data that was collected by EPA-Region 1 in 2009 and 2010 and was included in a Preliminary Data Report, Baseline Assessment of Stream Water Quality in the I-93 Tri-town Project Area from December 1, 2009 to April 7, 2010.[8] The water quality results indicated that chloride levels occasionally exceeded the EPA recommended chronic aquatic life criteria both upstream and downstream of the surrounding major roadways.

MassDOT does not conduct site specific assessments of loading at each location impaired for chloride. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements. MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing SWMP including educational programs, good housekeeping, and source control.

MassDOT's roadway deicing practices are a source of chloride to surrounding waterbodies. As discussed in MassDOT Environmental Status and Planning Report (ESPR),[9] MassDOT constantly reviews the methods employed to meet the safety needs of its traveling public and the potential impact to the environment. These reviews include conducting research on alternate methods for roadway deicing. MassDOT has identified alternative deicing methods, such as acetate based deicers, but determined that they are not appropriate for use in Massachusetts. Acetate based deicers are 10 to 20 times more expensive than traditional deicers, are slow acting and less effective in cold temperatures, and have higher corrosion impacts on infrastructure. Acetate deicers

[8] EPA, Baseline Assessment of Stream Water Quality in the I-93 Tri-Town Project Areas from December 1, 2009 to April 7, 2010. http://cfpub.epa.gov/si/si_public_record_Report.cfm?dirEntryId=239143&CFID=744254&CFTOKEN=43647609&jsessionid=383040727181ab9a550a609435846661f3e2

[9] MassDOT (2012) MassDOT Snow and Ice Control Program. Environmental Status and Planning Report. Public Review Draft. February 2012. http://www.mhd.state.ma.us/downloads/projDev/ESPR_2012/EnvironStatus_PlanningRpt_0212.pdf

have also been shown to increase the nutrient loading in stormwater runoff from treated surfaces. Due to these factors, MassDOT has decided to continue use of traditional chloride based deicers.

Accident rates following snowfall are proven to increase due to slippery and unsafe roadway conditions. MassDOT's primary focus is safety for all motorists including in the winter months. MassDOT has found that traditional road salt with strategic use of pre-treatment and pre-wetting (using salt brine or liquid $MgCl_2$) is the most effective and economical roadway deicer method available to maintain safe driving conditions.

Traditional stormwater treatment BMPs are not effective in treating or reducing chloride levels in stormwater since chloride, once dissolved, remains dissolved in the water. Therefore, source control is the primary means to reduce the amount of chloride released to the environment. MassDOT has recently implemented numerous statewide measures and policies to reduce its road salt usage and become more effective and efficient with deicing practices.

Mitigation Plan

In regards to pathogens, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. Any illicit discharges to MassDOT's system could contribute pathogens to impaired waters, however, MassDOT's existing Illicit Discharge Detection and Elimination (IDDE) program is aimed at identifying and addressing these contributions. District maintenance staff notes signs of potential illicit discharges, such as dry weather flow and notable odors or sheens. Similarly, Resident Engineers overseeing construction projects also note any suspicious connections or flows, and report these for follow-up investigation and action as appropriate. MassDOT will continue to implement this IDDE training, and District staff will continue to report any suspicious flows requiring further investigation. MassDOT investigates any suspicious flows noted, and proceeds to work with owners of confirmed illicit discharges to remove these flows, and thereby minimize pathogen contributions to receiving waters.

MassDOT is in the process of developing a pet waste management program for MassDOT rest stops located within the sub-watershed of a pathogen impaired waterbody. At these prioritized rest stops, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired waterbody and will be providing pet waste removal bags and disposal cans. No MassDOT targeted rest areas are located within the subwatershed of this waterbody.

MassDOT believes the existing pathogen mitigation efforts are consistent with the current and draft MS4 permit's requirements and TMDL recommendations.

In regards to chloride, MassDOT implements a variety of source control measures to reduce the application of road salt. While eliminating salt application in the winter months is not a feasible alternative due to safety concerns, source control can reduce the salt application and in turn reduce the amount of chloride introduced to surrounding waterbodies.

MassDOT stores road salt in covered sheds at maintenance depots across the state. These sheds are located away from streams and watersheds to the extent possible. When located in environmentally sensitive areas, the sheds have been rebuilt or retrofitted with high roofs and access doorways that allow loading and offloading material inside the building.

MassDOT has implemented pre-treatment and pre-wetting practices to increase the effectiveness and efficiency of road salt use. Pre-treatment relies on the use of liquid deicers such as liquid calcium chloride to pre-wet dry road salt and pretreat roadways prior to or in the early part of the

storm event. Pre-treatment of roadways using liquid brines helps to prevent the bonding of snow and ice to the pavement, which greatly reduces the potential need to apply heavier amounts to break up these bonds later in the snow event. Pre-wetting dry road salt reduces bounce and scatter so the material adheres to the road surface more readily and can prevent as much as 20 to 30 percent of applied salt from being cast off the pavement (which ultimately reduces the frequency of re-application).

MassDOT requires all contractors to equip their trucks with pre-wetting equipment. Additionally, MassDOT offers a higher reimbursement rate if contractors equip their spreader trucks with electronic ground speed controllers and wing plows. Electronic controllers have proven to be highly effective in using less salt by adjusting salt applications by truck and auger speed. The percentage of contractors using electronic controllers has grown to approximately 80 to 90 percent in 2014. MassDOT has also increased the number of pre-season training sessions for both MassDOT personnel and its contractors.

Closed loop controllers, electronic devices that provide a more consistent rate of material application, are also used in MassDOT's deicing operations. Closed loop controllers result in greater efficiencies and less deicing material usage. MassDOT reimburses contractors at higher rates if their trucks are equip with closed loop controllers. More than 80 percent of hired contractors in each district had trucks outfitted with closed loop controllers in the winter of 2013.

MassDOT District 4 has been experimenting with the use of a pavement friction meter as means to provide more detailed and real-time information on pavement conditions during snow events to help decide when applications are needed. The friction meter measures the relative "slipperiness" of the pavement surface. The friction meter is still being tested, but use of the meter has preliminarily enhanced the level of understanding as to what type of pavement conditions warrant deicing material applications. If friction meters are determined to reduce salt use, MassDOT will expand their use to other districts.

To evaluate the effect of these various mitigation measures, MassDOT has begun using a winter severity index (WSI) to compare year-to-year differences in annual salt use to historical annual salt use amounts.[10] The WSI value is used to reflect the relative severity of winter weather conditions and the demand for deicing applications. The WSI is based on a number of factors including daily snowfall and daily maximum and minimum temperatures and has enabled MassDOT to correlate annual salt usage to winter weather conditions. This allows MassDOT to assess how salt usage in more recent years with source control measures in place compares to the historical annual salt usage without these measures in place. The historical annual salt usage is based on a 13-year period from 2001 to 2013.

Based on the procedure described in the ESPR, compared to the average annual historical salt usage in the years 2001 to 2013 adjusted for winter severity, MassDOT used approximately 23 percent less road salt on a per-lane basis statewide and 35 percent less road salt in District 4 in the last three years. These reductions are attributed to the combined effect of the measures and policies implemented beginning in 2011. The most recent winters of 2010/11 and 2012/13 were also the third and fifth most severe winters according to their WSI values and MassDOT still used less salt compared to years of similar winter severity values in the previous 13 years.

[10] MassDOT Snow and Ice Program, Second Annual Report for the 2012/13 Winter.

Conclusions

MassDOT did not assess this stream using the IC Method but instead focused on the source control measures implemented by MassDOT for both pathogens and the chloride impairment. In regards to the chloride impairment, MassDOT must provide the motoring public with safe road conditions even during the winter months. Given the solubility and conservative nature in which chloride travels in the environment, traditional stormwater BMPs are not effective in retaining chloride or reducing concentrations in contrast to other pollutants. MassDOT has adopted a number of source control and preventative measures on a statewide basis and will continue to expand upon these measures to gain greater efficiencies and reduce its annual salt usage. As discussed above, these measures have shown success in reducing annual salt use amounts compared to that used historically. It is MassDOT's intent to continue to refine and adopt new measures as cost-effective technologies become available and work with snow removal contractors in the adoption of any new policies or equipment upgrades. These source control measures, to achieve sodium chloride reductions to the maximum extent practicable, are consistent with the intent of the existing stormwater permit.

For the pathogen impairment, MassDOT has concluded, based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, and pathogen TMDLs for Massachusetts waters that the BMPs outlined in the stormwater management plan are consistent with its existing permit requirements. These measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit and the applicable Pathogen TMDLs. As stated previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from DOT roadways to be a contributing source it is unlikely to be warrant action relative to other sources of pathogens in the watershed.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed of Unnamed Tributary (MA83-15), including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education.

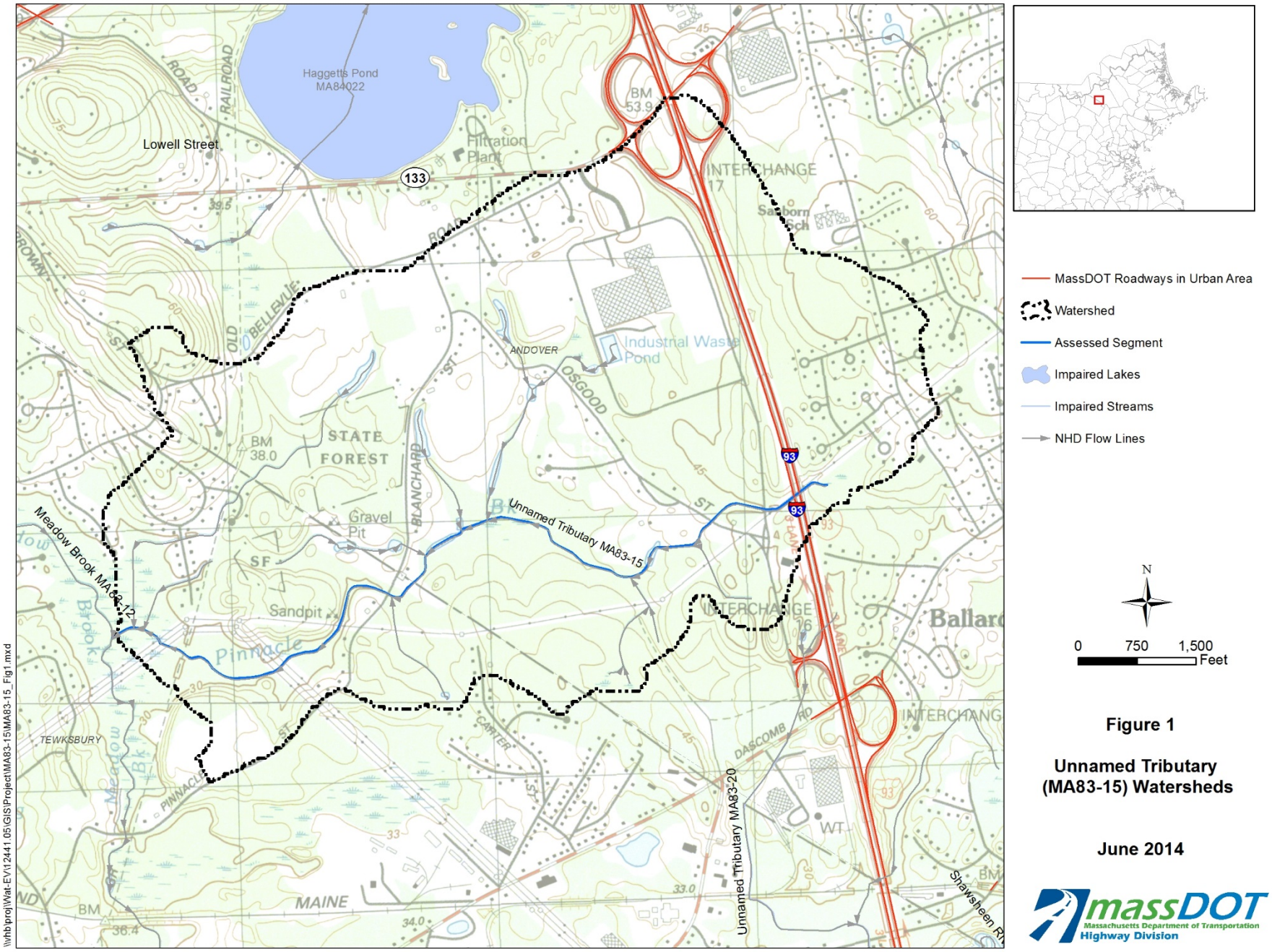

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Figure 1

Unnamed Tributary (MA83-15) Watersheds

June 2014

MassDOT Massachusetts Department of Transportation Highway Division

massDOT Massachusetts Department of Transportation Highway Division

06/08/2014

Impaired Waters Assessment for Unnamed Tributary (MA83-20)

Summary

		Stormwater
Impaired Waters[1]	**Impairments**	Chloride
	Category:	5 (Waters requiring a TMDL)
	Final TMDLs	None
	WQ Assessment	Shawsheen River Watershed 2000 Water Quality Assessment Report CN 86.0[2]
Location	**Towns:**	Andover and Tewksbury
	MassDOT Roads:	Interstate 93
Assessment Methods(s)	**7R (TMDL Method)**	☐
	7U (IC Method)	☒
BMPs	**Existing:**	None

Site Description

Unnamed Tributary (MA83-20) is a small stream that flows north to south from Dascomb Road in Andover to the confluence with the Shawsheen River (MA83-18) in Tewksbury. As shown on Figure 1, the watershed to MA83-20 is approximately 0.75 square miles and includes the I-93/Dascomb Road interchange in Andover. Land uses within the watershed are mostly residential and open space with a few large industrial and commercial facilities located along Dascomb Road. MassDOT owns I-93 and a small portion of Dascomb Road within the receiving water body's watershed.

Assessment of Chloride Impairment under BMP 7U

MassDOT assessed the chloride impairment 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

1 MassDEP, 2013. Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. Massachusetts. Available at: http://www.mass.gov/eea/docs/dep/water/resources/07v5/12list2.pdf

[2] MassDEP, 2003. Shawsheen River Watershed 2000 Water Quality Assessment Report. Available at http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/83wqar.pdf.

completion of a TMDL. TMDL studies have not been initiated for chloride impaired streams in Massachusetts.

The water quality impairments for these water bodies are based on water quality data that was collected by EPA-Region 1 in 2009 and 2010 and was included in a Preliminary Data Report, Baseline Assessment of Stream Water Quality in the I-93 Tri-town Project Area from December 1, 2009 to April 7, 2010.[3] The water quality results indicated that chloride levels occasionally exceeded the EPA recommended chronic aquatic life criteria both upstream and downstream of the surrounding major roadways.

MassDOT does not conduct site specific assessments of loading at each location impaired for chloride. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements. MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing SWMP including educational programs, good housekeeping, and source control.

MassDOT's roadway deicing practices are a source of chloride to surrounding waterbodies. As discussed in MassDOT Environmental Status and Planning Report (ESPR),[4] MassDOT constantly reviews the methods employed to meet the safety needs of its traveling public and the potential impact to the environment. These reviews include conducting research on alternate methods for roadway deicing. MassDOT has identified alternative deicing methods, such as acetate based deicers, but determined that they are not appropriate for use in Massachusetts. Acetate based deicers are 10 to 20 times more expensive than traditional deicers, are slow acting and less effective in cold temperatures, and have higher corrosion impacts on infrastructure. Acetate deicers have also been shown to increase the nutrient loading in stormwater runoff from treated surfaces. Due to these factors, MassDOT has decided to continue use of traditional chloride based deicers.

Accident rates following snowfall are proven to increase due to slippery and unsafe roadway conditions. MassDOT's primary focus is safety for all motorists including in winter months. MassDOT has found that traditional road salt with strategic use of pre-treatment and pre-wetting (using salt brine or liquid $MgCl_2$) is the most effective and economical roadway deicer method available to maintain safe driving conditions.

Traditional stormwater treatment BMPs are not effective in treating or reducing chloride levels in stormwater since chloride, once dissolved, remains dissolved in the water. Therefore, source control is the primary means to reduce the amount of chloride released to the environment. MassDOT has recently implemented numerous statewide measures and policies to reduce its road salt usage and become more effective and efficient with deicing practices.

Mitigation Plan

MassDOT implements a variety of source control measures to reduce the application of road salt. While eliminating salt application in the winter months is not a feasible alternative due to safety

[3] EPA, Baseline Assessment of Stream Water Quality in the I-93 Tri-Town Project Areas from December 1, 2009 to April 7, 2010. http://cfpub.epa.gov/si/si_public_record_Report.cfm?dirEntryId=239143&CFID=744254&CFTOKEN=43647609&jsessionid=383040727181ab9a550a609435846661f3e2

4 MassDOT (2012) MassDOT Snow and Ice Control Program. Environmental Status and Planning Report. Public Review Draft. February 2012. http://www.mhd.state.ma.us/downloads/projDev/ESPR_2012/EnvironStatus_PlanningRpt_0212.pdf

concerns, source control can reduce the salt application and in turn reduce the amount of chloride introduced to surrounding waterbodies.

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Closed loop controllers, electronic devices that provide a more consistent rate of material application, are also used in MassDOT's deicing operations. Closed loop controllers result in greater efficiencies and less deicing material usage. MassDOT reimburses contractors at higher rates if their trucks are equip with closed loop controllers. More than 80 percent of hired contractors in each district had trucks outfitted with closed loop controllers in the winter of 2013.

MassDOT District 4 has been experimenting with the use of a pavement friction meter as means to provide more detailed and real-time information on pavement conditions during snow events to help decide when applications are needed. The friction meter measures the relative "slipperiness" of the pavement surface. The friction meter is still being tested, but use of the meter has preliminarily enhanced the level of understanding as to what type of pavement conditions warrant deicing material applications. If friction meters are determined to reduce salt use, MassDOT will expand their use to other districts.

To evaluate the effect of these various mitigation measures, MassDOT has begun using a winter severity index (WSI) to compare year-to-year differences in annual salt use to historical annual salt use amounts.[5] The WSI value is used to reflect the relative severity of winter weather conditions and the demand for deicing applications. The WSI is based on a number of factors including daily snowfall and daily maximum and minimum temperatures and has enabled MassDOT to correlate annual salt usage to winter weather conditions. This allows MassDOT to assess how salt usage in more recent years with source control measures in place compares to the historical annual salt usage without these measures in place. The historical annual salt usage is based on a 13-year period from 2001 to 2013.

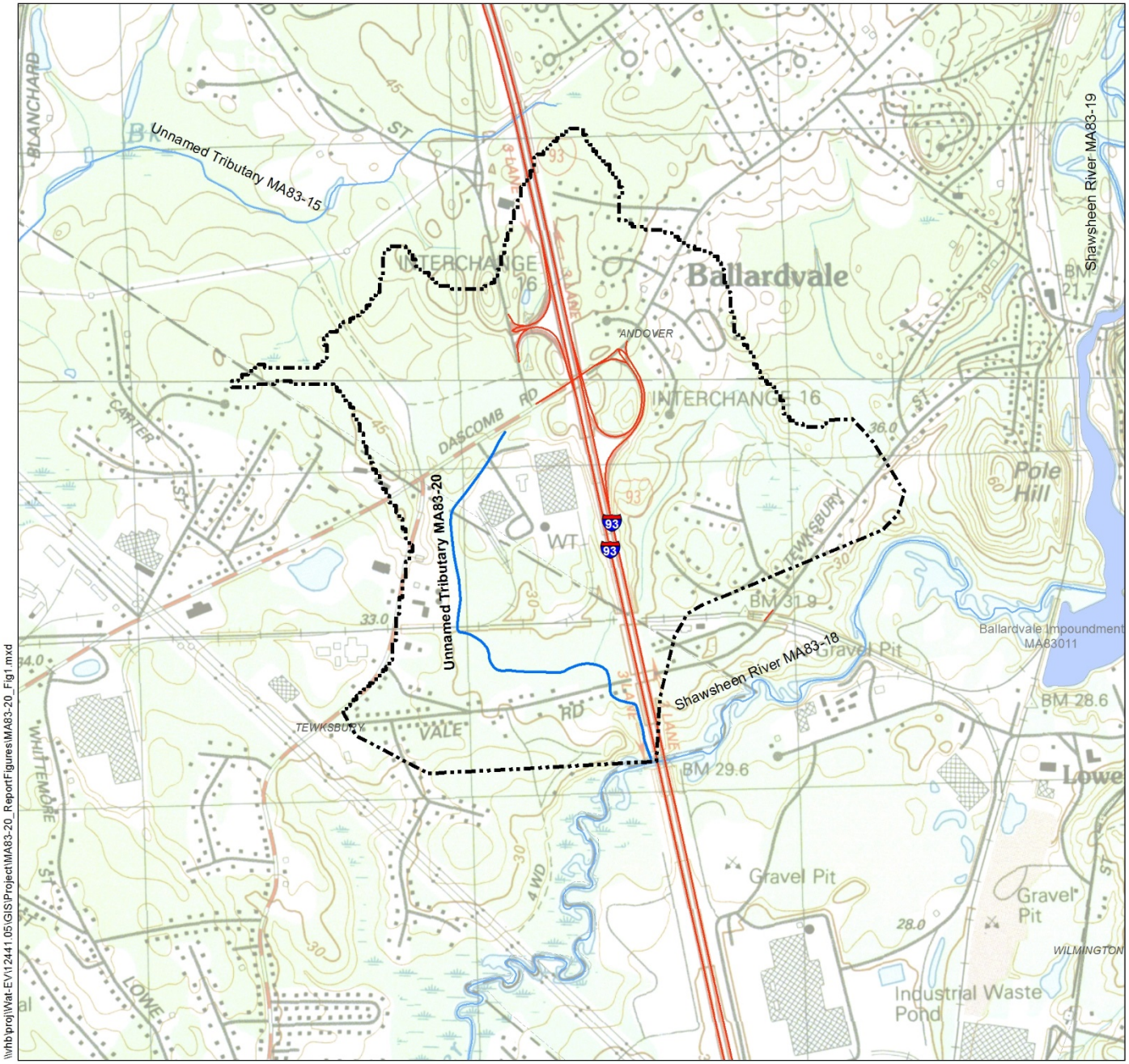
[5] MassDOT Snow and Ice Program, Second Annual Report for the 2012/13 Winter.

Based on the procedure described in the ESPR, compared to the average annual historical salt usage in the years 2001 to 2013 adjusted for winter severity, MassDOT used approximately 23 percent less road salt on a per-lane basis statewide and 35 percent less road salt in District 4 in the last three years. These reductions are attributed to the combined effect of the measures and policies implemented beginning in 2011. The most recent winters of 2010/11 and 2012/13 were also the third and fifth most severe winters according to their WSI values and MassDOT still used less salt compared to years of similar winter severity values in the previous 13 years.

Conclusions

MassDOT must provide the motoring public with safe road conditions even during the winter months. Given the solubility and conservative nature in which chloride travels in the environment, traditional stormwater BMPs are not effective in retaining chloride or reducing concentrations in contrast to other pollutants. Therefore, MassDOT did not assess this stream using the IC Method but instead focused on the source control measures implemented by MassDOT. MassDOT has adopted a number of source control and preventative measures on a statewide basis and will continue to expand upon these measures to gain greater efficiencies and reduce its annual salt usage. As discussed above, these measures have shown success in reducing annual salt use amounts compared to that used historically. It is MassDOT's intent to continue to refine and adopt new measures as cost-effective technologies become available and work with snow removal contractors in the adoption of any new policies or equipment upgrades. These source control measures, to achieve sodium chloride reductions to the maximum extent practicable, are consistent with the intent of the existing stormwater permit.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed of Unnamed Tributary, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education.



MassDOT Roadways in Urban Area
Watershed
Assessed Segment
Impaired Lakes
Impaired Streams

N

0 0.125 0.25 Miles

Figure 1

Unnamed Tributary (MA83-20) Watersheds

June 2014

massDOT
Massachusetts Department of Transportation
Highway Division

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Impaired Waters Assessment for Merrimack River (MA84A-01) - Final Report

Impaired Water Body

Name: Merrimack River

Location: Tyngsborough, Chelmsford, and Lowell, MA

Water Body ID: MA84A-01

Impairments

Merrimack River (MA84A-01) is listed under Category 5, "Waters Requiring a TMDL", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Merrimack River is impaired for the following:

- Fecal Coliform
- Mercury in Fish Tissue

According to MassDEP's *Merrimack River Watershed 2004 Water Quality Assessment Report* (MassDEP, 2010), Merrimack River (MA84A-01) is impaired for fish consumption. The source is unknown, but toxic pollutants due to atmospheric are identified as a likely source. Aquatic life has not yet been assessed and it is supported for aesthetics and primary and secondary contact. Segment MA84A-01 of Merrimack River is covered by a *Draft Pathogen Total Maximum Daily Load (TMDL) for the Merrimack River Watershe*d (MassDEP, no date).

MassDOT has identified a subset of water body impairments in the Merrimack River (MA84A-01) watershed which are not related to stormwater runoff. Specific impairments unrelated to stormwater for the Merrimack River (MA84A-01) include Mercury in Fish Tissue. In accordance with MassDOT's Impaired Waters Assessment for Impaired Waters with Impairments Unrelated to Stormwater in the December 8, 2012 EPA submittal, the non-pollutant impairments are not specifically addressed as part of the Impaired Waters Program (MassDEP, 2012).

The *Northeast Regional Mercury TMDL* indicates that stormwater is a *de minimis* source of mercury contamination. According to the TMDL, the majority of mercury in stormwater comes from atmospheric deposition, and therefore the most effective reductions in mercury loading can be achieved through controls on atmospheric deposition (NEIWPCC, 2007). Accordingly, MassDOT has concluded that stormwater runoff from its roadways is a *de minimis* contributor to the mercury impairment.

Relevant Water Quality Standards

Water Body Classification: Class B

Applicable State Regulations:

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

Site Description

The Merrimack River (MA84A-01) flows from the state line at Hudson, NH/Tyngsborough, MA to the Pawtucket Dam in Lowell. This segment is approximately 9.0 miles long. There are two discharges to Segment MA84A-01 of Merrimack River covered by NPDES permits: Lowell Regional Wastewater Utilities (MA0100633) and Lowell Regional Water Utility (MAG640055) (MassDEP, 2010).

The subwatershed for Segment MA84A-01 of the Merrimack River consists of consists of both residential and commercial areas. The total watershed extends into New Hampshire. Refer to Figure 1 for the subwatershed.

MassDOT's property with the potential to directly contribute stormwater runoff to Segment MA84A-01 of Merrimack River is comprised of portions of Routes 3, 3A, 113, and VFW Highway. Refer to Figure 1 for the location of these roadways within the subwatershed.

BMP 7U for Pathogen Impairment

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7U of MassDOT's Storm Water Management Plan (SWMP), which applies to impairments that have been assigned to a water body prior to completion of a TMDL (MassDOT, 2011). Merrimack River (MA84A-01) is covered by a *Draft Pathogen TMDL for the Merrimack River Watershed* (MassDEP, no date). MassDOT included a review of the draft report as an informational review as part of this assessment even though, due to their draft status, draft TMDLs are not formally part of the Impaired Waters Retrofit program.

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

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

Pathogens in MassDOT Discharge

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

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

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of almost 140 miles and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.

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- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally crosses them.

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

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

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Various sources of fecal contamination have been identified. Dry weather sources include leaking sewer pipes, storm water drainage systems (illicit connections), failing septic systems, recreational activities, wildlife including birds, and illicit boat discharges. Wet weather sources include wildlife and domesticated animals (including pets), storm water runoff including municipal storm sewer systems (MS4), combined sewer overflows (CSOs) and sanitary sewer overflows (SSOs) (MassDEP, no date).

Section 7.0 of the Draft Pathogen TMDL discusses the need to eliminate sewer connections to drainage systems, leaking sewer pipes, SSOs, and failing septic systems. A program is needed to identify sources and encourage responsible entities to take corrective actions. Due to the impact of CSOs and storm water runoff on pathogen levels in the Merrimack River watershed, the Draft Pathogen TMDL recommends intensive application of non-structural BMPs throughout the watershed. Structural controls may be necessary if non-structural BMPs are not successful. The report recommends a basin-wide implementation strategy to eliminate illicit sources and implement storm water BMPs (MassDEP, no date).

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requirement therefore requires that at the point of discharge to the receiving water, all sources include bacteria concentrations that are equal or less than the MassDEP water quality standard for the receiving water body.

In general, pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations (US EPA, 2010a; US EPA, 2010b, US EPA, 2013)**.**

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

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (MassDEP, 2009a)

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

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contain specific requirements for compliance with pathogen TMDLs (in Appendix G) (US EPA, 2010a; US EPA, 2010b). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing stormwater discharges to pathogen-impaired waters. Section 2.2.1(c) of the permit states "For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve

consistency with the WLA." Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

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

In addition to the generic recommendations provided in the draft MS4 permits for Massachusetts, the Draft Pathogen TMDL for the Merrimack River Watershed (Section 7.0) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems and leaking sewer pipes
- Elimination of sewer connections to drainage pipes and elimination of sanitary sewer overflows
- Implementation of non-structural BMPs to reduce pathogen contributions to stormwater runoff.
- Participation in programs to fund the implementation of non-point source management

The Draft TMDL report also indicates that structural BMPs may be appropriate to address runoff from impervious areas in instances where fecal coliform concentrations cannot be reduced by other means.

The following BMPs are identified in the Draft TMDL report as being ongoing and/or planned in order to reduce bacteria contributions to the Merrimack River:

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- Compliance with MS4 general permit requirements, including identification of Minimum Control Measures for stormwater management
- Correction of failing septic systems
- Improved management of recreational waters
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Mitigation Plan

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

- BMP 3C-1: Drainage Connection Policy
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- BMP 3D: Illicit Discharge Detection Review
- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
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- BMP 6A-1: Source Control – 511 Program
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- BMP 6C-1: Maintenance Program

MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens. In addition, as part of its pet waste management program, MassDOT has determined that no targeted MassDOT rest stops are located within the subwatershed of this water body. At rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired water body, and pet waste removal bags and disposal cans will be provided.

The Draft Pathogen TMDL report identifies that non-structural BMPs should be implemented first, but that structural BMPs may be necessary to address runoff from impervious areas in some instances. MassDOT feels that it is not a beneficial approach to implement structural BMPs in advance of other ongoing BMP efforts identified in the watershed, given the documented variability of pathogen concentrations in highway runoff, and the low probability of achieving substantial gains toward meeting the TMDL with solely implementing IC reductions and controls.

Furthermore, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. Any illicit discharges to MassDOT's system could contribute pathogens to impaired waters, however, MassDOT's existing Illicit Discharge Detection and Elimination (IDDE) program is aimed at identifying and addressing these contributions. District maintenance staff are trained to conduct regular inspections of MassDOT infrastructure and note any signs of potential illicit discharges, such as dry weather flow and notable odors or sheens. Similarly, resident engineers overseeing construction projects also receive training to note any suspicious connections or flows, and report these for follow-up investigation and action as appropriate. MassDOT will continue to implement this Illicit Discharge Detection and Elimination (IDDE) training, and District staff will continue to report any suspicious flows requiring further investigation. MassDOT investigates any suspicious flows noted, and will work with owners of confirmed illicit discharges to remove these flows, and thereby minimize the possibility of pathogen contributions to receiving waters. At present, there are no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the subwatershed of this water body that could be contributing pathogens to the impaired water body.

Conclusions

MassDOT has concluded based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, and pathogen TMDLs for Massachusetts waters that the BMPs outlined in the stormwater management plan are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit and the applicable Pathogen TMDLs. As stated

previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from DOT roadways to be a contributing source it is unlikely to be warrant action relative to other sources of pathogens in the watershed. In addition, MassDOT has concluded that runoff from its roadways does not contribute to the impairments that are unrelated to stormwater.

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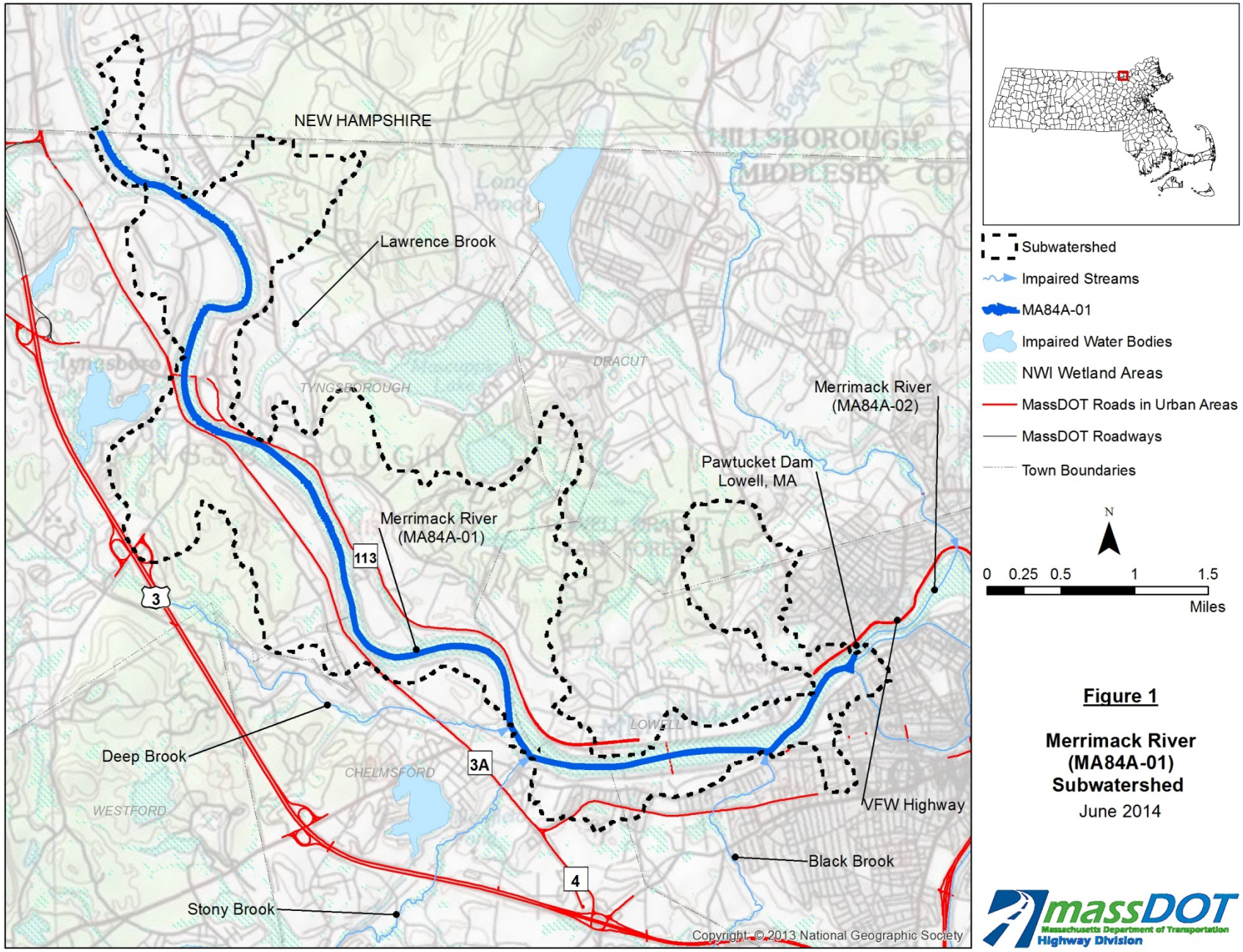

Figure 1

Merrimack River (MA84A-01) Subwatershed

June 2014

massDOT Massachusetts Department of Transportation Highway Division

06/08/2014

Impaired Waters Assessment for Merrimack River (MA84A-05) - Final Report

Impaired Water Body

Name: Merrimack River

Location: Haverhill, West Newbury, and Amesbury, MA

Water Body ID: MA84A-05

Impairments

Merrimack River (MA84A-05) is listed under Category 5, "Waters Requiring a TMDL", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Merrimack River is impaired for the following:

- Enterococcus
- PCB in Fish Tissue

According to MassDEP's *Merrimack River Watershed 2004 Water Quality Assessment Report* (MassDEP, 2010), Merrimack River (MA84A-05) is impaired for primary and secondary contact. The source is unknown, but wet weather discharges including point sources, stormwater, sanitary sewer overflows (SSOs), and combined sewer overflows (CSOs) are suspected. Aquatic life is supported, while fish consumption, shellfishing, and aesthetics have not yet been assessed. Segment MA84A-05 of Merrimack River is covered by a *Draft Pathogen Total Maximum Daily Load (TMDL) for the Merrimack River Watershe*d (MassDEP, no date).

MassDOT has identified a subset of water body impairments in the Merrimack River (MA84A-05) watershed which are not related to stormwater runoff. Specific impairments unrelated to stormwater for the Merrimack River (MA84A-05) include PCB in Fish Tissue. In accordance with MassDOT's Impaired Waters Assessment for Impaired Waters with Impairments Unrelated to Stormwater in the December 8, 2012 EPA submittal, the non-pollutant impairments are not specifically addressed as part of the Impaired Waters Program (MassDEP, 2012).

Polychlorinated Biphenyls (PCBs) refer to a range of man-made organic chemicals that were manufactured in the United States between 1929 and 1979. They had a variety of industrial applications and are extremely persistent in the environment. MassDOT concluded that the impairment for PCB in fish tissue is unrelated to storm water runoff. The *Nationwide Urban Runoff Program* (NURP) conducted by the EPA found that PCB was detected in less than 1% of stormwater samples collected (EPA, 1983). Therefore, MassDOT concluded that stormwater runoff from its roadways does not contribute to the impairments of PCB in fish tissue.

Relevant Water Quality Standards

Water Body Classification: Class SB

Applicable State Regulations:

- 314 CMR 4.05 (5)(e) Toxic Pollutants. All surface waters shall be free from pollutants in concentrations or combinations that are toxic to humans, aquatic life or wildlife. For pollutants not otherwise listed in 314 CMR 4.00, the National Recommended Water Quality Criteria: 2002, EPA 822R-02-047, November 2002 published by EPA pursuant to Section 304(a) of the Federal Water Pollution Control Act, are the allowable receiving water concentrations for the affected waters, unless the Department either establishes a site specific criterion or determines that naturally occurring background concentrations are higher. Where the Department determines that naturally occurring background concentrations are higher, those concentrations shall be the allowable receiving water concentrations. The Department shall use the water quality criteria for the protection of aquatic life expressed in terms of the dissolved fraction of metals when EPA's 304(a) recommended criteria provide for use of the dissolved fraction. The EPA recommended criteria based on total recoverable metals shall be converted to dissolved metals using EPA's published conversion factors. Permit limits will be written in terms of total recoverable metals. Translation from dissolved metals criteria to total recoverable metals permit limits will be based on EPA's conversion factors or other methods approved by the Department. The Department may establish site specific criteria for toxic pollutants based on site specific considerations.
- 314 CMR 4.05 (4)(b) 4 Bacteria.
  - a. Waters designated for shellfishing shall not exceed a fecal coliform median or geometric mean MPN of 88 organisms per 100 ml, nor shall more than 10% of the samples exceed an MPN of 260 per 100 ml or other values of equivalent protection based on sampling and analytical methods used by the Massachusetts Division of Marine Fisheries and approved by the National Shellfish Sanitation Program in the latest revision of the Guide For The Control of Molluscan Shellfish (more stringent regulations may apply, see 314 CMR 4.06(1)(d)(5));
  - b. at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010, no single enterococci sample taken during the bathing season shall exceed 104 colonies per 100 ml and the geometric mean of the five most recent samples taken within the same bathing season shall not exceed 35 enterococci colonies per 100 ml. In non bathing beach waters and bathing beach waters during the non bathing season, no single enterococci sample shall exceed 104 colonies per 100 ml and the geometric mean of all of the samples taken during the most recent six months typically based on a minimum of five samples shall not exceed 35 enterococci colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

Site Description

The Merrimack River (MA84A-05) flows from the confluence with Little River in Haverhill to the confluence with Indian River in West Newbury/Amesbury. This segment is approximately 1.8 square miles. There are three discharges to Segment MA84A-05 of Merrimack River covered by NPDES permits: City of Haverhill Wastewater Division (MA0101621), Haverhill Paperboard Corp. (MAG250961), and Town of Merrimac (MA0101150) (MassDEP, 2010).

The subwatershed consists of residential and commercial areas, with wetlands directly adjacent to portions of the water body. The total watershed extends into New Hampshire. Refer to Figure 1 for the subwatershed.

MassDOT's property with the potential to directly contribute stormwater runoff to Segment MA84A-05 of Merrimack River is comprised of portions of Routes 110, 113, and 495 and Rocks Village Bridge. Also, the bridge of Route 125 over Segment MA84A-05 is MassDOT property. Refer to Figure 1 for the location of these roadways within the subwatershed.

BMP 7U for Pathogen Impairment

MassDOT assessed the indicator bacteria (enterococcus) using the approach described in BMP 7U of MassDOT's Storm Water Management Plan (SWMP), which applies to impairments that have been assigned to a water body prior to completion of a TMDL. Segment MA84A-05 of Merrimack River is covered by the *Draft Pathogen TMDL for the Merrimack River Watershed* (MassDEP, no date). MassDOT included a review of the draft report as an informational review as part of this assessment even though, due to the draft status, draft TMDLs are not formally part of the Impaired Waters Retrofit program

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

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

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

MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens. In addition, as part of its pet waste management program, MassDOT has determined that one targeted MassDOT rest stop is located within the subwatershed of this water body. The MassDOT facility ID is 444 and it is located on the southbound side of Route 495 in Merrimac. At rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired water body, and pet waste removal bags and disposal cans will be provided.

The Draft Pathogen TMDL report identifies that non-structural BMPs should be implemented first, but that structural BMPs may be necessary to address runoff from impervious areas in some instances. MassDOT feels that it is not a beneficial approach to implement structural BMPs in advance of other ongoing BMP efforts identified in the watershed, given the documented variability of pathogen concentrations in highway runoff, and the low probability of achieving substantial gains toward meeting the TMDL with solely implementing IC reductions and controls.

Furthermore, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. Any illicit discharges to MassDOT's system could contribute pathogens to impaired waters, however, MassDOT's existing Illicit Discharge Detection and Elimination (IDDE) program is aimed at identifying and addressing these contributions. District maintenance staff are trained to conduct regular inspections of MassDOT infrastructure and note any signs of potential illicit discharges, such as dry weather flow and notable odors or sheens. Similarly, resident engineers overseeing construction projects also receive training to note any suspicious connections or flows, and report these for follow-up investigation and action as appropriate. MassDOT will continue to implement this Illicit Discharge Detection and Elimination (IDDE) training, and District staff will continue to report any suspicious flows requiring further investigation. MassDOT investigates any suspicious flows noted, and will work with owners of confirmed illicit discharges to remove these flows, and thereby minimize the possibility of pathogen contributions to receiving waters. At present, there are no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the subwatershed of this water body that could be contributing pathogens to the impaired water body.

Conclusions

MassDOT has concluded based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, and pathogen TMDLs for Massachusetts waters that the BMPs outlined in the stormwater management plan are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent

with the intent of its existing stormwater permit and the applicable Pathogen TMDLs. As stated previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from DOT roadways to be a contributing source it is unlikely to be warrant action relative to other sources of pathogens in the watershed. In addition, MassDOT has concluded that runoff from its roadways does not contribute to the impairments that are unrelated to stormwater.

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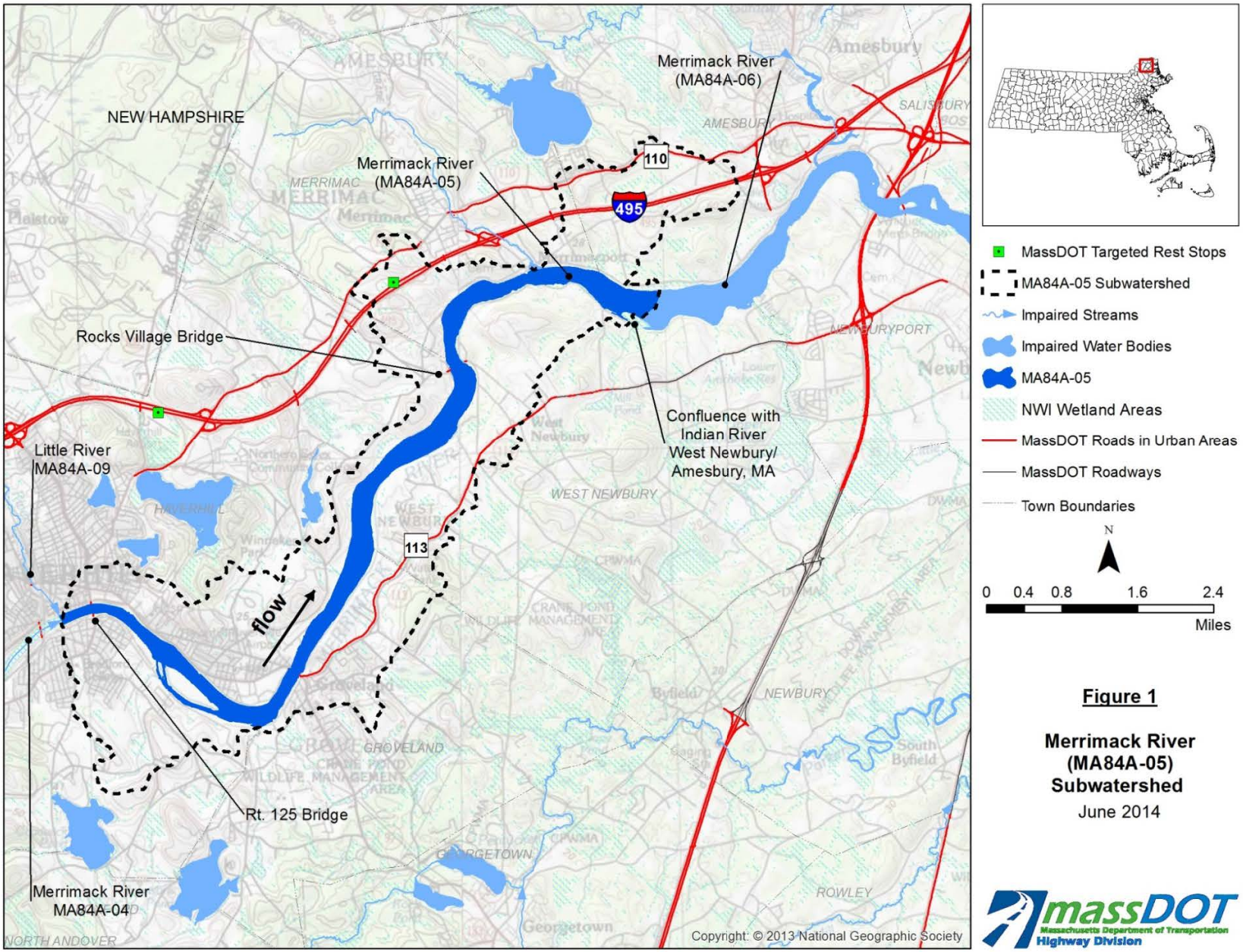

Figure 1

Merrimack River (MA84A-05) Subwatershed

June 2014

Impaired Waters Assessment for Merrimack River (MA84A-06) - Final Report

Impaired Water Body

Name: Merrimack River

Location: West Newbury, Amesbury, Newburyport, and Salisbury MA

Water Body ID: MA84A-06

Impairments

Merrimack River (MA84A-06) is listed under Category 5, "Waters Requiring a TMDL", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Merrimack River is impaired for the following:

- Enterococcus
- Fecal Coliform
- PCB in Fish Tissue

According to MassDEP's *Merrimack River Watershed 2004 Water Quality Assessment Report* (MassDEP, 2010), Merrimack River (MA84A-06) is impaired for primary contact and shellfishing. The source is unknown, but wet weather discharges including point sources, stormwater, sanitary sewer overflows (SSOs), and combined sewer overflows (CSOs) are suspected. Aquatic life and secondary contact are supported, while fish consumption and aesthetics have not yet been assessed. Segment MA84A-06 of Merrimack River is covered by a *Draft Pathogen Total Maximum Daily Load (TMDL) for the Merrimack River Watershed* (MassDEP, no date).

MassDOT has identified a subset of water body impairments in the Merrimack River (MA84A-06) watershed which are not related to stormwater runoff. Specific impairments unrelated to stormwater for the Merrimack River (MA84A-06) include PCB in Fish Tissue. In accordance with MassDOT's Impaired Waters Assessment for Impaired Waters with Impairments Unrelated to Stormwater in the December 8, 2012 EPA submittal, the non-pollutant impairments are not specifically addressed as part of the Impaired Waters Program (MassDEP, 2012).

Polychlorinated Biphenyls (PCBs) refer to a range of man-made organic chemicals that were manufactured in the United States between 1929 and 1979. They had a variety of industrial applications and are extremely persistent in the environment. MassDOT concluded that the impairment for PCB in fish tissue is unrelated to storm water runoff. The *Nationwide Urban Runoff Program* (NURP) conducted by the EPA found that PCB was detected in less than 1% of stormwater samples collected (EPA, 1983). Therefore, MassDOT concluded that stormwater runoff from its roadways does not contribute to the impairments of PCB in fish tissue.

Relevant Water Quality Standards

Water Body Classification: Class SB

Applicable State Regulations:

- 314 CMR 4.05 (5)(e) Toxic Pollutants. All surface waters shall be free from pollutants in concentrations or combinations that are toxic to humans, aquatic life or wildlife. For pollutants not otherwise listed in 314 CMR 4.00, the National Recommended Water Quality Criteria: 2002, EPA 822R-02-047, November 2002 published by EPA pursuant to Section 304(a) of the Federal Water Pollution Control Act, are the allowable receiving water concentrations for the affected waters, unless the Department either establishes a site specific criterion or determines that naturally occurring background concentrations are higher. Where the Department determines that naturally occurring background concentrations are higher, those concentrations shall be the allowable receiving water concentrations. The Department shall use the water quality criteria for the protection of aquatic life expressed in terms of the dissolved fraction of metals when EPA's 304(a) recommended criteria provide for use of the dissolved fraction. The EPA recommended criteria based on total recoverable metals shall be converted to dissolved metals using EPA's published conversion factors. Permit limits will be written in terms of total recoverable metals. Translation from dissolved metals criteria to total recoverable metals permit limits will be based on EPA's conversion factors or other methods approved by the Department. The Department may establish site specific criteria for toxic pollutants based on site specific considerations.
- 314 CMR 4.05 (4)(b) 4 Bacteria.
  - a. Waters designated for shellfishing shall not exceed a fecal coliform median or geometric mean MPN of 88 organisms per 100 ml, nor shall more than 10% of the samples exceed an MPN of 260 per 100 ml or other values of equivalent protection based on sampling and analytical methods used by the Massachusetts Division of Marine Fisheries and approved by the National Shellfish Sanitation Program in the latest revision of the Guide For The Control of Molluscan Shellfish (more stringent regulations may apply, see 314 CMR 4.06(1)(d)(5));
  - b. at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010, no single enterococci sample taken during the bathing season shall exceed 104 colonies per 100 ml and the geometric mean of the five most recent samples taken within the same bathing season shall not exceed 35 enterococci colonies per 100 ml. In non bathing beach waters and bathing beach waters during the non bathing season, no single enterococci sample shall exceed 104 colonies per 100 ml and the geometric mean of all of the samples taken during the most recent six months typically based on a minimum of five samples shall not exceed 35 enterococci colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

Site Description

The Merrimack River (MA84A-06) flows from the confluence with Indian River in West Newbury/Amesbury to mouth at Atlantic Ocean in Newburyport/Salisbury. This segment is approximately 4.5 square miles. There are five discharges to Segment MA84A-06 of the Merrimack River covered by NPDES permits: Town of Amesbury (MA0101745), Ferraz Shawmut, Inc. (MA0000281), Newburyport Water Department (MAG640018), City of Newburyport (MA0101427), and Salisbury Sewer Commission (MA0102873) (MassDEP, 2010).

The subwatershed for Segment MA84A-06 of the Merrimack River consists of wetlands directly adjacent to portions of the segment, as well as commercial and residential areas. The total watershed extends into New Hampshire. Refer to Figure 1 for the subwatershed.

MassDOT's property with the potential to directly contribute stormwater runoff to Segment MA84A-06 of Merrimack River is comprised of portions of Routes 1, 1A, 95, 110, 113, and 495. Refer to Figure 1 for the location of these roadways within the subwatershed.

BMP 7U for Pathogen Impairment

MassDOT assessed the indicator bacteria (enterococcus and fecal coliform) using the approach described in BMP 7U of MassDOT's Storm Water Management Plan (SWMP), which applies to impairments that have been assigned to a water body prior to completion of a TMDL (MassDOT, 2011). Segment MA84A-06 of Merrimack River is covered by a *Draft Pathogen TMDL for the Merrimack River Watershed* (MassDEP, no date). MassDOT included a review of the draft report as an informational review as part of this assessment even though, due to their draft status, draft TMDLs are not formally part of the Impaired Waters Retrofit program.

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

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

Pathogens in MassDOT Discharge

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

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

- Illicit discharges: Due to the typical setback of highways from residential and commercial developments and the stand alone nature of the drainage system, the potential for illicit discharges (e.g. sewer connections, laundry tie-ins) is much lower than in other stormwater systems. This has been confirmed by MassDOT's illicit discharge detection on many miles

of urban roadways within a broad range of areas across Massachusetts. After assessment of almost 140 miles and investigation of more than 2,500 stormwater features, MassDOT's consultant performing the broad scope reviews has found no confirmed illicit discharges.

- Limited Sewer Utilities in Road Right of Ways: Since DOT does not provide sewer services, many MassDOT roads do not have sewer utilities within the road's right of way; thereby eliminating the chance of cross-connections or leaking pipes as a source of pathogens into the stormwater system.
- Pet waste: Pets are only present on highways in rare instances. In urban residential areas pets and their associated waste are much more common. MassDOT is aware that pet waste at road side rest stops may represent a potential source of pathogens to stormwater in certain situations, and has a pet waste management program underway to address this source where necessary.
- Wildlife: Highways are not generally an attractive place for wildlife. Wildlife generally avoids highways and only occasionally crosses them.

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

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

Assessment

The *Draft Pathogen TMDL for the Merrimack River Watershed* covers the Merrimack River and its tributaries. The Merrimack River Watershed covers 5,014 square miles in Massachusetts and New Hampshire. Approximately 1,200 square miles from 24 cities and towns in Massachusetts drain to the Merrimack River.

Various sources of fecal contamination have been identified. Dry weather sources include leaking sewer pipes, storm water drainage systems (illicit connections), failing septic systems, recreational activities, wildlife including birds, and illicit boat discharges. Wet weather sources include wildlife and domesticated animals (including pets), storm water runoff including municipal storm sewer systems (MS4), combined sewer overflows (CSOs) and sanitary sewer overflows (SSOs) (MassDEP, no date).

Section 7.0 of the Draft Pathogen TMDL discusses the need to eliminate sewer connections to drainage systems, leaking sewer pipes, SSOs, and failing septic systems. A program is needed to identify sources and encourage responsible entities to take corrective actions. Due to the impact of CSOs and storm water runoff on pathogen levels in the Merrimack River watershed, the Draft Pathogen TMDL recommends intensive application of non-structural BMPs throughout the watershed. Structural controls may be necessary if non-structural BMPs are not successful. The report recommends a basin-wide implementation strategy to eliminate illicit sources and implement storm water BMPs (MassDEP, no date).

Unlike other TMDLs that establish pollutant load allocations based on mass per time, many bacteria and pathogen TMDLs in Massachusetts establish bacterial TMDLs that are concentration based

and equivalent to the MassDEP water quality standard for the receiving water body. This requirement therefore requires that at the point of discharge to the receiving water, all sources include bacteria concentrations that are equal or less than the MassDEP water quality standard for the receiving water body.

In general, pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations (USEPA, 2010a; US EPA, 2010b; US EPA, 2013).

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

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (MassDEP, 2009a)

- "The NPDES permit does not, however, establish numeric effluent limitations for stormwater discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals."(MassDEP, 2009b)

- "Although the TMDL presents quantified WLAs for stormwater that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs." (MassDEP, 2002).

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

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contain specific requirements for compliance with pathogen TMDLs (in Appendix G) (USEPA, 2010a; US EPA, 2010b). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing stormwater discharges to pathogen-impaired waters. Section 2.2.1(c) of the permit states "For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall

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

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

In addition to the generic recommendations provided in the draft MS4 permits for Massachusetts, the Draft Pathogen TMDL for the Merrimack River Watershed (Section 7.0) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems and leaking sewer pipes
- Elimination of sewer connections to drainage pipes and elimination of sanitary sewer overflows
- Implementation of non-structural BMPs to reduce pathogen contributions to stormwater runoff.
- Participation in programs to fund the implementation of non-point source management

The Draft TMDL report also indicates that structural BMPs may be appropriate to address runoff from impervious areas in instances where fecal coliform concentrations cannot be reduced by other means.

The following BMPs are identified in the Draft TMDL report as ongoing and/or planned in order to reduce bacteria contributions to the Merrimack River:

- Elimination of illicit sewer connections, repairing of failing infrastructure, and controlling impacts of CSOs
- Compliance with MS4 general permit requirements, including identification of Minimum Control Measures for stormwater management
- Correction of failing septic systems
- Improved management of recreational waters
- Participation in programs to fund the implementation of non-point source management

Mitigation Plan

MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing Stormwater Management Plan (SWMP) including educational programs, illicit

connection review and source control. The specific BMPs that can help reduce potential pathogen loading in the current SWMP include:

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

MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens. In addition, as part of its pet waste management program, MassDOT has determined that no targeted MassDOT rest stops are located within the subwatershed of this water body. At rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired water body, and pet waste removal bags and disposal cans will be provided.

The Draft Pathogen TMDL report identifies that non-structural BMPs should be implemented first, but that structural BMPs may be necessary to address runoff from impervious areas in some instances. MassDOT feels that it is not a beneficial approach to implement structural BMPs in advance of other ongoing BMP efforts identified in the watershed, given the documented variability of pathogen concentrations in highway runoff, and the low probability of achieving substantial gains toward meeting the TMDL with solely implementing IC reductions and controls.

Furthermore, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. Any illicit discharges to MassDOT's system could contribute pathogens to impaired waters, however, MassDOT's existing Illicit Discharge Detection and Elimination (IDDE) program is aimed at identifying and addressing these contributions. District maintenance staff are trained to conduct regular inspections of MassDOT infrastructure and note any signs of potential illicit discharges, such as dry weather flow and notable odors or sheens. Similarly, resident engineers overseeing construction projects also receive training to note any suspicious connections or flows, and report these for follow-up investigation and action as appropriate. MassDOT will continue to implement this Illicit Discharge Detection and Elimination (IDDE) training, and District staff will continue to report any suspicious flows requiring further investigation. MassDOT investigates any suspicious flows noted, and will work with owners of confirmed illicit discharges to remove these flows, and thereby minimize the possibility of pathogen contributions to receiving waters. At present, there are no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the subwatershed of this water body that could be contributing pathogens to the impaired water body.

Conclusions

MassDOT has concluded based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, and pathogen TMDLs for Massachusetts waters that the BMPs outlined in the stormwater management plan are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit and the applicable Pathogen TMDLs. As stated previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from DOT roadways to be a contributing source it is unlikely to be warrant action relative to other sources of pathogens in the watershed. In addition, MassDOT has concluded that runoff from its roadways does not contribute to the impairments that are unrelated to stormwater.

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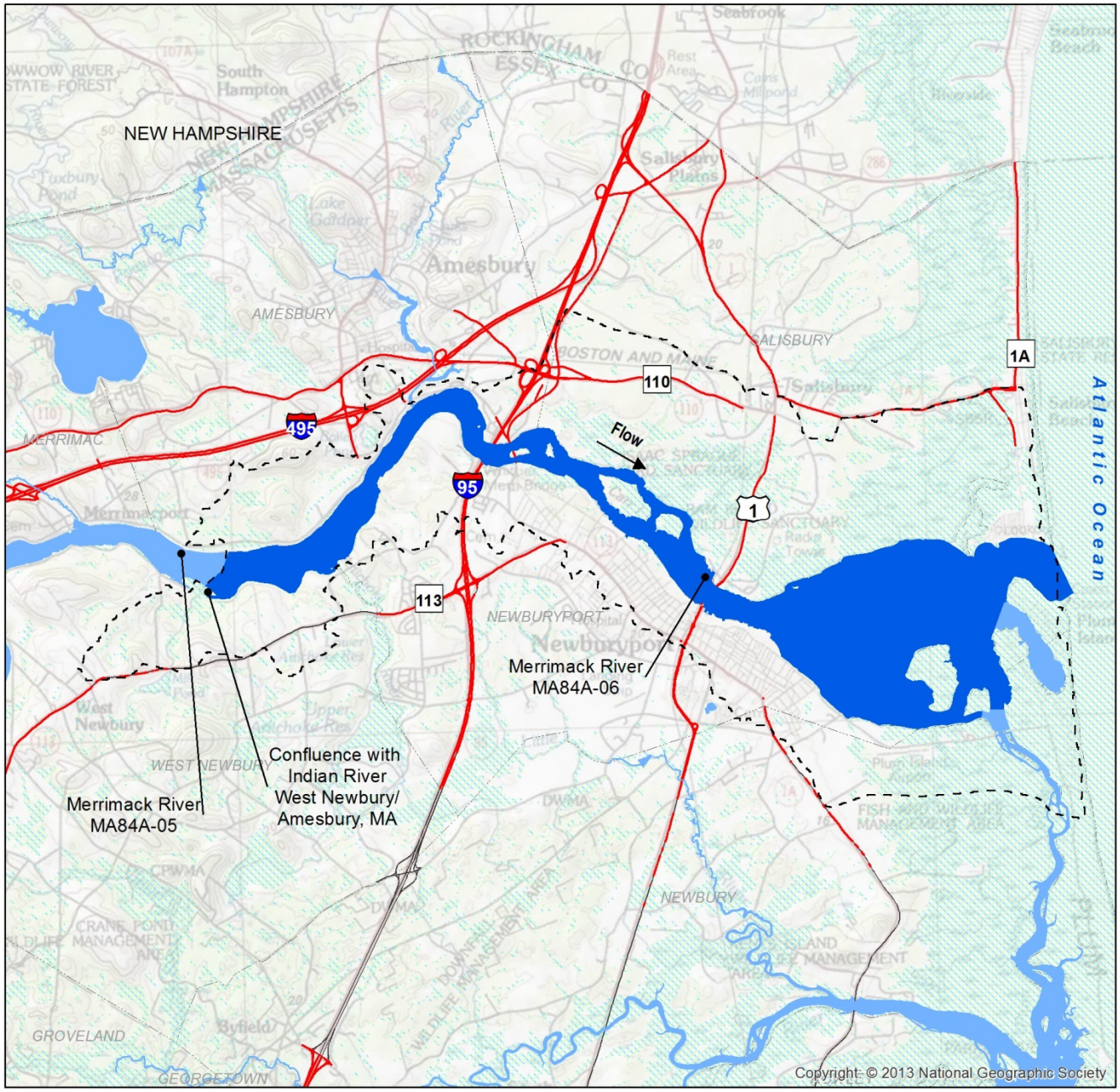

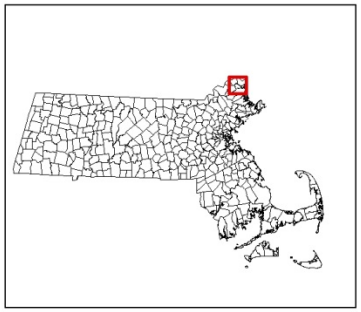

Subwatershed
Impaired Streams
Impaired Water Bodies
MA84A-06
NWI Wetland Areas
MassDOT Roads in Urban Areas
MassDOT Roadways
Town Boundaries

N

0 0.4 0.8 1.6 2.4
Miles

Figure 1

Merrimack River (MA84A-06) Subwatershed

June 2014

MassDOT Massachusetts Department of Transportation Highway Division

06/08/2014

Impaired Waters Assessment for Little River (MA84A-09) - Final Report

Impaired Water Body

Name: Little River

Location: Haverhill, MA

Water Body ID: MA84A-09

Impairments

Little River (MA84A-09) is listed under Category 5, "Waters Requiring a TMDL", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Little River is impaired for the following:

- (Debris/Floatables/Trash*)
- (Habitat Assessment (Streams)*)
- Escherichia coli

According to MassDEP's *Merrimack River Watershed 2004 Water Quality Assessment Report* (MassDEP, 2010), Little River (MA84A-09) is impaired for aquatic life, primary contact, secondary contact, and aesthetics. The sources include habitat modification other than hydromodification and inappropriate waste disposal. Fish consumption has not yet been assessed. Segment MA84A-09 of Little River is covered by a *Draft Pathogen Total Maximum Daily Load (TMDL) for the Merrimack River Watershed* (MassDEP, no date).

According to the final *Massachusetts Year 2012 Integrated List of Waters*, Debris/Floatables/Trash, Habitat Assessment (Streams)] are considered non-pollutants and unrelated to stormwater (MassDEP, 2013). Therefore, MassDOT has determined that further assessment of this impairment for the water bodies is not required under BMP 7U (MassDOT, 2011).

Relevant Water Quality Standards

Water Body Classification: Class B

Applicable State Regulations:

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

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

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

Site Description

The Little River (MA84A-09) flows from the New Hampshire state line to confluence with Merrimack River in Haverhill. This segment is approximately 4.6 miles long (MassDEP, 2010).

The subwatershed for Segment MA84A-09 of Little River consists of wetlands directly adjacent to portions of the segment. The total watershed extends into New Hampshire. Refer to Figure 1 for the total and subwatershed.

MassDOT's property with the potential to directly contribute stormwater runoff to Segment MA84A-09 of Little River is comprised of a portion of Route 495. Refer to Figure 1 for the location of this roadway within the subwatershed.

BMP 7U for Pathogen Impairment

MassDOT assessed the indicator bacteria (E. coli) impairment using the approach described in BMP 7U of MassDOT's Storm Water Management Plan (SWMP), which applies to impairments that have been assigned to a water body prior to completion of a TMDL. Segment MA84A-09 of Little River is covered by a *Draft Pathogen TMDL for the Merrimack River Watershed* (MassDEP, no date). MassDOT included a review of the draft report as an informational review as part of this assessment even though, due to the draft status, draft TMDLs are not formally part of the Impaired Waters Retrofit program.

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

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

Pathogens in MassDOT Discharge

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

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

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

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

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

Assessment

The *Draft Pathogen TMDL for the Merrimack River Watershed* covers the Merrimack River and its tributaries. The Merrimack River Watershed covers 5,014 square miles in Massachusetts and New Hampshire. Approximately 1,200 square miles from 24 cities and towns in Massachusetts drain to the Merrimack River.

Various sources of fecal contamination have been identified. Dry weather sources include leaking sewer pipes, storm water drainage systems (illicit connections), failing septic systems, recreational activities, wildlife including birds, and illicit boat discharges. Wet weather sources include wildlife and domesticated animals (including pets), storm water runoff including municipal storm sewer systems (MS4), combined sewer overflows (CSOs) and sanitary sewer overflows (SSOs) (MassDEP, no date).

Section 7.0 of the Draft Pathogen TMDL discusses the need to eliminate sewer connections to drainage systems, leaking sewer pipes, SSOs, and failing septic systems. A program is needed to identify sources and encourage responsible entities to take corrective actions. Due to the impact of CSOs and storm water runoff on pathogen levels in the Merrimack River Watershed, the Draft Pathogen TMDL recommends intensive application of non-structural BMPs throughout the watershed. Structural controls may be necessary if non-structural BMPs are not successful. The report recommends a basin-wide implementation strategy to eliminate illicit sources and implement storm water BMPs (MassDEP, no date).

Unlike other TMDLs that establish pollutant load allocations based on mass per time, many bacteria and pathogen TMDLs in Massachusetts establish bacterial TMDLs that are concentration based and equivalent to the MassDEP water quality standard for the receiving water body. This requirement therefore requires that at the point of discharge to the receiving water, all sources include bacteria concentrations that are equal or less than the MassDEP water quality standard for the receiving water body.

In general, pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations (US EPA, 2010a; US EPA, 2010b; US EPA, 2013).

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

- “given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP’s expectation is that for stormwater an iterative approach is needed…” (MassDEP, 2009a)

- “The NPDES permit does not, however, establish numeric effluent limitations for stormwater discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals.”(MassDEP, 2009b)

- "Although the TMDL presents quantified WLAs for stormwater that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs." (MassDEP, 2002).

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

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contain specific requirements for compliance with pathogen TMDLs (in Appendix G) (US EPA, 2010a; US EPA, 2010b). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing stormwater discharges to pathogen-impaired waters. Section 2.2.1(c) of the permit states "For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA." Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

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

In addition to the generic recommendations provided in the draft MS4 permits for Massachusetts, the Draft Pathogen TMDL for the Merrimack River Watershed (Section 7.0) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems and leaking sewer pipes
- Elimination of sewer connections to drainage pipes and elimination of sanitary sewer overflows
- Implementation of non-structural BMPs to reduce pathogen contributions to stormwater runoff.
- Participation in programs to fund the implementation of non-point source management

The Draft TMDL report also indicates that structural BMPs may be appropriate to address runoff from impervious areas in instances where fecal coliform concentrations cannot be reduced by other means.

The following BMPs are identified in the Draft TMDL report as being ongoing and/or planned in order to reduce bacteria contributions to the Merrimack River:

- Elimination of illicit sewer connections, repairing of failing infrastructure, and controlling impacts of CSOs
- Compliance with MS4 general permit requirements, including identification of Minimum Control Measures for stormwater management
- Correction of failing septic systems
- Improved management of recreational waters
- Participation in programs to fund the implementation of non-point source management

Mitigation Plan

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

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

MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens. In addition, as part of its pet waste management program, MassDOT has determined that no targeted MassDOT rest stops are located within the subwatershed of this water body. At rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired water body, and pet waste removal bags and disposal cans will be provided.

The Draft Pathogen TMDL report identifies that non-structural BMPs should be implemented first, but that structural BMPs may be necessary to address runoff from impervious areas in some instances. MassDOT feels that it is not a beneficial approach to implement structural BMPs in advance of other ongoing BMP efforts identified in the watershed, given the documented variability of pathogen concentrations in highway runoff, and the low probability of achieving substantial gains toward meeting the TMDL with solely implementing IC reductions and controls.

Furthermore, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. Any illicit discharges to MassDOT's system could contribute pathogens to impaired waters, however, MassDOT's existing Illicit Discharge Detection and Elimination (IDDE) program is aimed at identifying and addressing these contributions. District maintenance staff are trained to conduct regular inspections of MassDOT infrastructure and note any signs of potential illicit discharges, such as dry weather flow and notable odors or sheens. Similarly, resident engineers overseeing construction projects also receive training to note any suspicious connections or flows, and report these for follow-up investigation and action as appropriate. MassDOT will continue to implement this Illicit Discharge Detection and Elimination (IDDE) training, and District staff will continue to report any suspicious flows requiring further investigation. MassDOT investigates any suspicious flows noted, and will work with owners of confirmed illicit discharges to remove these flows, and thereby minimize the possibility of pathogen contributions to receiving waters. At present, there are no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the subwatershed of this water body that could be contributing pathogens to the impaired water body.

Conclusions

MassDOT has concluded based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, and pathogen TMDLs for Massachusetts waters that the BMPs outlined in the stormwater management plan are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit and the applicable Pathogen TMDLs. As stated previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from DOT roadways to be a contributing source it is unlikely to be warrant action relative to other sources of pathogens in the watershed. In addition, MassDOT has concluded that runoff from its roadways does not contribute to the impairments that are unrelated to stormwater.

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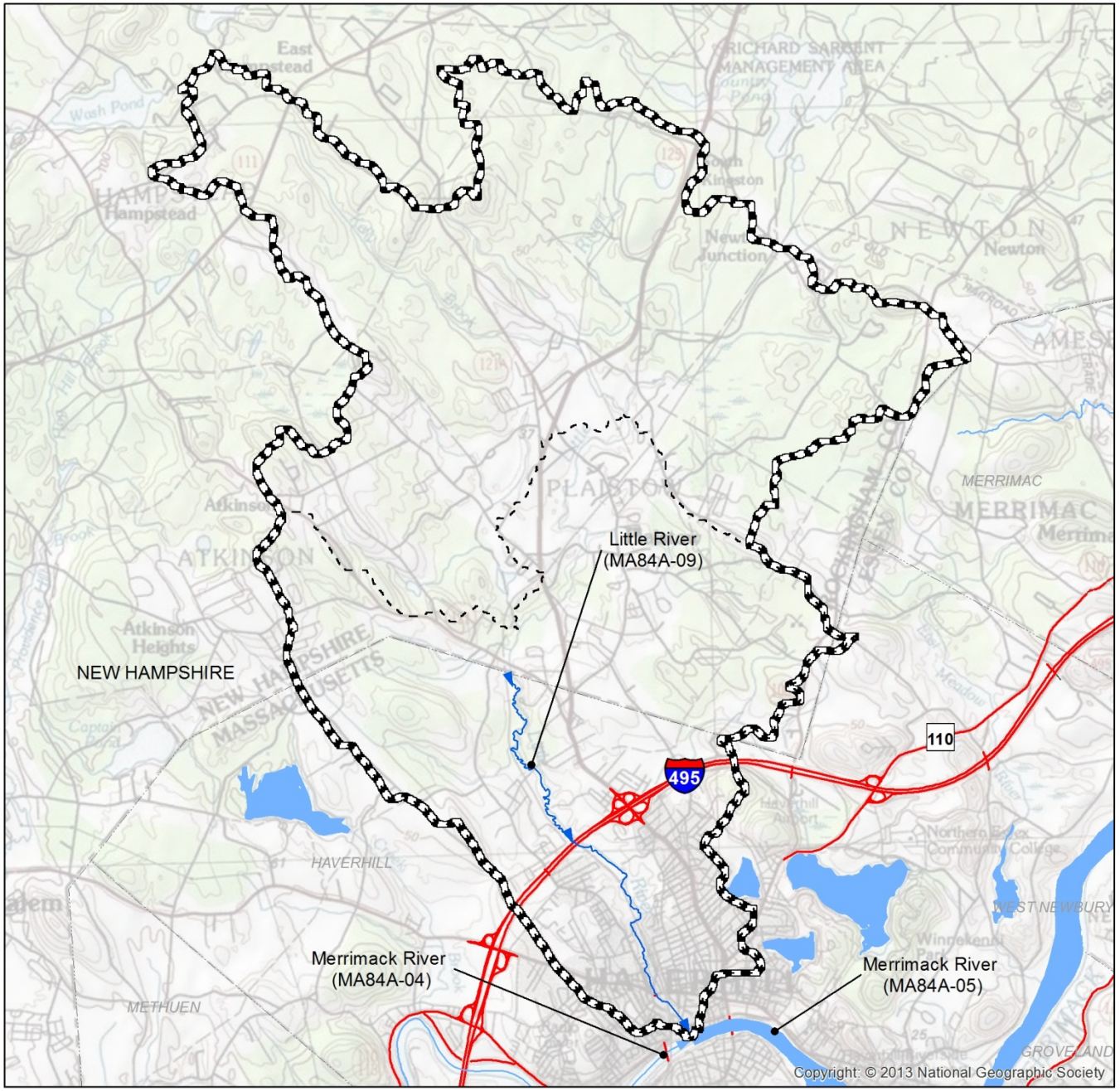

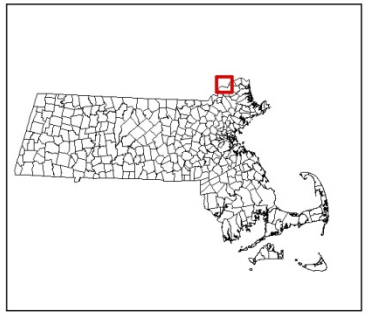

Subwatershed
Total Watershed
MA84A-09
Impaired Streams
Impaired Water Bodies
MassDOT Roads in Urban Areas
MassDOT Roadways
Town Boundaries

N

0 0.375 0.75 1.5 2.25
Miles

Figure 1

Little River (MA84A-09) Total and Subwatershed

June 2014

massDOT
Massachusetts Department of Transportation
Highway Division

06/08/2014

Impaired Waters Assessment for Fish Brook (MA84A-40)

Summary

		Stormwater
Impaired Waters[1]	**Impairments**	Chloride, escherichi coli
	Category:	5 (Waters requiring a TMDL)
	Final TMDLs	None
	WQ Assessment	Merrimack River Watershed 2004 Water Quality Assessment Report[2]
Location	**Towns:**	Andover
	MassDOT Roads:	Interstate 93 and Interstate 495
Assessment Method(s)	**7R (TMDL Method)**	☐
	7U (IC Method)	☒
BMPs	**Existing:**	None

Site Description

Fish Brook (MA84A-40), is a 4.1 mile long brook that flows south to north from its headwater north of Lowell Street in Andover to its confluence with the Merrimack River (MA84A-03) at Fish Brook Dam in Andover. As shown on Figure 1, the watershed to MA84A-40 is approximately 3914 acres and includes a portions of I-93 and I-495. Land uses within the watershed are mostly forest and residential. MassDOT owns I-93 and I-495 within the receiving water body's watershed.

BMP 7R for Pathogen TMDL (CN 122.0)

MassDOT assessed the indicator bacteria (escherichi coli) impairment using the approach described in BMP 7U of MassDOT's Storm Water Management Plan (SWMP).[3] The Merrimack River (MA84A-03) is covered by the *Draft Pathogen Total Maximum Daily Loads Report for the*

1 MassDEP, 2013. Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. Massachusetts. Available at: http://www.mass.gov/eea/docs/dep/water/resources/07v5/12list2.pdf

[2] MassDEP, 2004. Merrimack River Watershed 2004 Water Quality Assessment Report. Available at http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/84wqar09.pdf

[3] Massachusetts Department of Transportation (MassDOT), July 22, 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.mhd.state.ma.us/downloads/projDev/BMP_7R_TMDL_WatershedReview.pdf

Merrimack River Watershed.[4] The TMDL states that the likely bacteria sources are believed to be failing septic systems, combined sewer overflows (CSO), sanitary sewer overflows (SSO), sewer pipes connected to storm drains, certain recreational activities, wildlife including birds along with domestic pets and animals, and direct overland storm water runoff. Recommended TMDL implementation measures include identification and elimination of prohibited sources such as leaky or improperly connected sanitary sewer flows and best management practices to mitigate storm water runoff volume. The TMDL also emphasizes the need for additional development and implementation of an illicit discharge detection and elimination plan. According to the TMDL, combined sewer overflows will be addressed through the on-going long-term control plans.

Pathogen concentrations in stormwater vary widely temporally and spatially; concentrations can vary by an order of magnitude within a given storm event at a single location.[5] Therefore, it is difficult to predict pathogen concentrations in stormwater with accuracy. MassDOT's Southeast Expressway study measured bacterial concentration in stormwater runoff[6] and data indicate that highway's pathogen loading may be lower than urban areas. Considering that the potential sources of pathogens (e.g., illicit discharges, sewer utilities, pet waste, and wildlife) are likely to be less prevalent in the highway environment than along urban roads, this finding is not surprising.

MassDOT does not conduct site specific assessments of loading at each location impaired for pathogens. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and pathogen TMDL requirements. Language in the documents clearly indicates that an iterative adaptive management approach is the appropriate way to address discharges to pathogen impaired waters and recommends implementation of programmatic BMPs such as residential educational programs, illicit connection identification, tracking and removal and pet waste management. MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing SWMP including educational programs, illicit connection review, and source control.

MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. Any illicit discharges to MassDOT's system could contribute pathogens to impaired waters, however, MassDOT's existing Illicit Discharge Detection and Elimination (IDDE) program is aimed at identifying and addressing these contributions. District maintenance staff notes signs of potential illicit discharges, such as dry weather flow and notable odors or sheens. Similarly, Resident Engineers overseeing construction projects also note any suspicious connections or flows, and report these for follow-up investigation and action as appropriate. MassDOT will continue to implement this IDDE training, and District staff will continue to report any suspicious flows requiring further investigation. MassDOT investigates any suspicious flows noted, and proceeds to work with owners of confirmed illicit discharges to remove these flows, and thereby minimize pathogen contributions to receiving waters.

MassDOT is in the process of developing a pet waste management program for MassDOT rest stops located within the sub-watershed of a pathogen impaired waterbody. At these prioritized rest stops, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired waterbody and will be providing pet waste removal bags and disposal cans.

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[4] MassDEP, 2005. Draft Pathogen TMDL for the Merrimack River Watershed. Available at http://www.mass.gov/eea/docs/dep/water/resources/a-thru-m/merimac1.pdf.

[5] ibid.

[6] Smith. (2002). Effectiveness of Three Best Management Practices for Highway Runoff Quality along the Southeast Expressway. USGS Water Resources Investigations Report 02-4059. Boston, Massachusetts.

MassDOT's existing efforts are consistent with the current and draft MS4 permit's requirements and TMDL recommendations.

Assessment of Chloride Impairment under BMP 7U

MassDOT assessed the chloride impairment 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. TMDL studies have not been initiated for chloride impaired streams in Massachusetts.

The water quality impairments for these water bodies are based on water quality data that was collected by EPA-Region 1 in 2009 and 2010 and was included in a Preliminary Data Report, Baseline Assessment of Stream Water Quality in the I-93 Tri-town Project Area from December 1, 2009 to April 7, 2010.[7] The water quality results indicated that chloride levels occasionally exceeded the EPA recommended chronic aquatic life criteria both upstream and downstream of the surrounding major roadways.

MassDOT does not conduct site specific assessments of loading at each location impaired for chloride. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements. MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing SWMP including educational programs, good housekeeping, and source control.

MassDOT's roadway deicing practices are a source of chloride to surrounding waterbodies. As discussed in MassDOT Environmental Status and Planning Report (ESPR),[8] MassDOT constantly reviews the methods employed to meet the safety needs of its traveling public and the potential impact to the environment. These reviews include conducting research on alternate methods for roadway deicing. MassDOT has identified alternative deicing methods, such as acetate based deicers, but determined that they are not appropriate for use in Massachusetts. Acetate based deicers are 10 to 20 times more expensive than traditional deicers, are slow acting and less effective in cold temperatures, and have higher corrosion impacts on infrastructure. Acetate deicers have also been shown to increase the nutrient loading in stormwater runoff from treated surfaces. Due to these factors, MassDOT has decided to continue use of traditional chloride based deicers.

Accident rates following snowfall are proven to increase due to slippery and unsafe roadway conditions. MassDOT's primary focus is safety for all motorists including in the winter months. MassDOT has found that traditional road salt with strategic use of pre-treatment and pre-wetting (using salt brine or liquid $MgCl_2$) is the most effective and economical roadway deicer method available to maintain safe driving conditions.

Traditional stormwater treatment BMPs are not effective in treating or reducing chloride levels in stormwater since chloride, once dissolved, remains dissolved in the water. Therefore, source control is the primary means to reduce the amount of chloride released to the environment.

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[7] EPA, Baseline Assessment of Stream Water Quality in the I-93 Tri-Town Project Areas from December 1, 2009 to April 7, 2010. http://cfpub.epa.gov/si/si_public_record_Report.cfm?dirEntryId=239143&CFID=744254&CFTOKEN=43647609&jsessionid=383040727181ab9a550a609435846661f3e2

8 MassDOT (2012) MassDOT Snow and Ice Control Program. Environmental Status and Planning Report. Public Review Draft. February 2012. http://www.mhd.state.ma.us/downloads/projDev/ESPR_2012/EnvironStatus_PlanningRpt_0212.pdf

MassDOT has recently implemented numerous statewide measures and policies to reduce its road salt usage and become more effective and efficient with deicing practices.

Mitigation Plan

In regards to pathogens, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. Any illicit discharges to MassDOT's system could contribute pathogens to impaired waters, however, MassDOT's existing Illicit Discharge Detection and Elimination (IDDE) program is aimed at identifying and addressing these contributions. District maintenance staff notes signs of potential illicit discharges, such as dry weather flow and notable odors or sheens. Similarly, Resident Engineers overseeing construction projects also note any suspicious connections or flows, and report these for follow-up investigation and action as appropriate. MassDOT will continue to implement this IDDE training, and District staff will continue to report any suspicious flows requiring further investigation. MassDOT investigates any suspicious flows noted, and proceeds to work with owners of confirmed illicit discharges to remove these flows, and thereby minimize pathogen contributions to receiving waters.

MassDOT is in the process of developing a pet waste management program for MassDOT rest stops located within the sub-watershed of a pathogen impaired waterbody. At these prioritized rest stops, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired waterbody and will be providing pet waste removal bags and disposal cans. No MassDOT targeted rest areas are located within the subwatershed of this waterbody.

MassDOT believes the existing pathogen mitigation efforts are consistent with the current and draft MS4 permit's requirements and TMDL recommendations.

In regards to chloride, MassDOT implements a variety of source control measures to reduce the application of road salt. While eliminating salt application in the winter months is not a feasible alternative due to safety concerns, source control can reduce the salt application and in turn reduce the amount of chloride introduced to surrounding waterbodies.

MassDOT stores road salt in covered sheds at maintenance depots across the state. These sheds are located away from streams and watersheds to the extent possible. When located in environmentally sensitive areas, the sheds have been rebuilt or retrofitted with high roofs and access doorways that allow loading and offloading material inside the building.

MassDOT has implemented pre-treatment and pre-wetting practices to increase the effectiveness and efficiency of road salt use. Pre-treatment relies on the use of liquid deicers such as liquid calcium chloride to pre-wet dry road salt and pretreat roadways prior to or in the early part of the storm event. Pre-treatment of roadways using liquid brines helps to prevent the bonding of snow and ice to the pavement, which greatly reduces the potential need to apply heavier amounts to break up these bonds later in the snow event. Pre-wetting dry road salt reduces bounce and scatter so the material adheres to the road surface more readily and can prevent as much as 20 to 30 percent of applied salt from being cast off the pavement (which ultimately reduces the frequency of re-application).

MassDOT requires all contractors to equip their trucks with pre-wetting equipment. Additionally, MassDOT offers a higher reimbursement rate if contractors equip their spreader trucks with electronic ground speed controllers and wing plows. Electronic controllers have proven to be highly effective in using less salt by adjusting salt applications by truck and auger speed. The percentage of contractors using electronic controllers has grown to approximately 80 to 90 percent in 2014.

MassDOT has also increased the number of pre-season training sessions for both MassDOT personnel and its contractors.

Closed loop controllers, electronic devices that provide a more consistent rate of material application, are also used in MassDOT's deicing operations. Closed loop controllers result in greater efficiencies and less deicing material usage. MassDOT reimburses contractors at higher rates if their trucks are equip with closed loop controllers. More than 80 percent of hired contractors in each district had trucks outfitted with closed loop controllers in the winter of 2013.

MassDOT District 4 has been experimenting with the use of a pavement friction meter as means to provide more detailed and real-time information on pavement conditions during snow events to help decide when applications are needed. The friction meter measures the relative "slipperiness" of the pavement surface. The friction meter is still being tested, but use of the meter has preliminarily enhanced the level of understanding as to what type of pavement conditions warrant deicing material applications. If friction meters are determined to reduce salt use, MassDOT will expand their use to other districts.

To evaluate the effect of these various mitigation measures, MassDOT has begun using a winter severity index (WSI) to compare year-to-year differences in annual salt use to historical annual salt use amounts.[9] The WSI value is used to reflect the relative severity of winter weather conditions and the demand for deicing applications. The WSI is based on a number of factors including daily snowfall and daily maximum and minimum temperatures and has enabled MassDOT to correlate annual salt usage to winter weather conditions. This allows MassDOT to assess how salt usage in more recent years with source control measures in place compares to the historical annual salt usage without these measures in place. The historical annual salt usage is based on a 13-year period from 2001 to 2013.

Based on the procedure described in the ESPR, compared to the average annual historical salt usage in the years 2001 to 2013 adjusted for winter severity, MassDOT used approximately 23 percent less road salt on a per-lane basis statewide and 35 percent less road salt in District 4 in the last three years. These reductions are attributed to the combined effect of the measures and policies implemented beginning in 2011. The most recent winters of 2010/11 and 2012/13 were also the third and fifth most severe winters according to their WSI values and MassDOT still used less salt compared to years of similar winter severity values in the previous 13 years.

Conclusions

MassDOT did not assess this stream using the IC Method but instead focused on the source control measures implemented by MassDOT for both pathogens and the chloride impairment. In regards to the chloride impairment, MassDOT must provide the motoring public with safe road conditions even during the winter months. Given the solubility and conservative nature in which chloride travels in the environment, traditional stormwater BMPs are not effective in retaining chloride or reducing concentrations in contrast to other pollutants. MassDOT has adopted a number of source control and preventative measures on a statewide basis and will continue to expand upon these measures to gain greater efficiencies and reduce its annual salt usage. As discussed above, these measures have shown success in reducing annual salt use amounts compared to that used historically. It is MassDOT's intent to continue to refine and adopt new measures as cost-effective technologies become available and work with snow removal contractors in the adoption of any new policies or equipment upgrades. These source control measures, to achieve sodium chloride

[9] MassDOT Snow and Ice Program, Second Annual Report for the 2012/13 Winter.

reductions to the maximum extent practicable, are consistent with the intent of the existing stormwater permit.

For the pathogen impairment, MassDOT has concluded, based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, and pathogen TMDLs for Massachusetts waters that the BMPs outlined in the stormwater management plan are consistent with its existing permit requirements. These measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit and the applicable Pathogen TMDLs. As stated previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from DOT roadways to be a contributing source it is unlikely to be warrant action relative to other sources of pathogens in the watershed.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed of Fish Brook (MA84A-40), including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education.

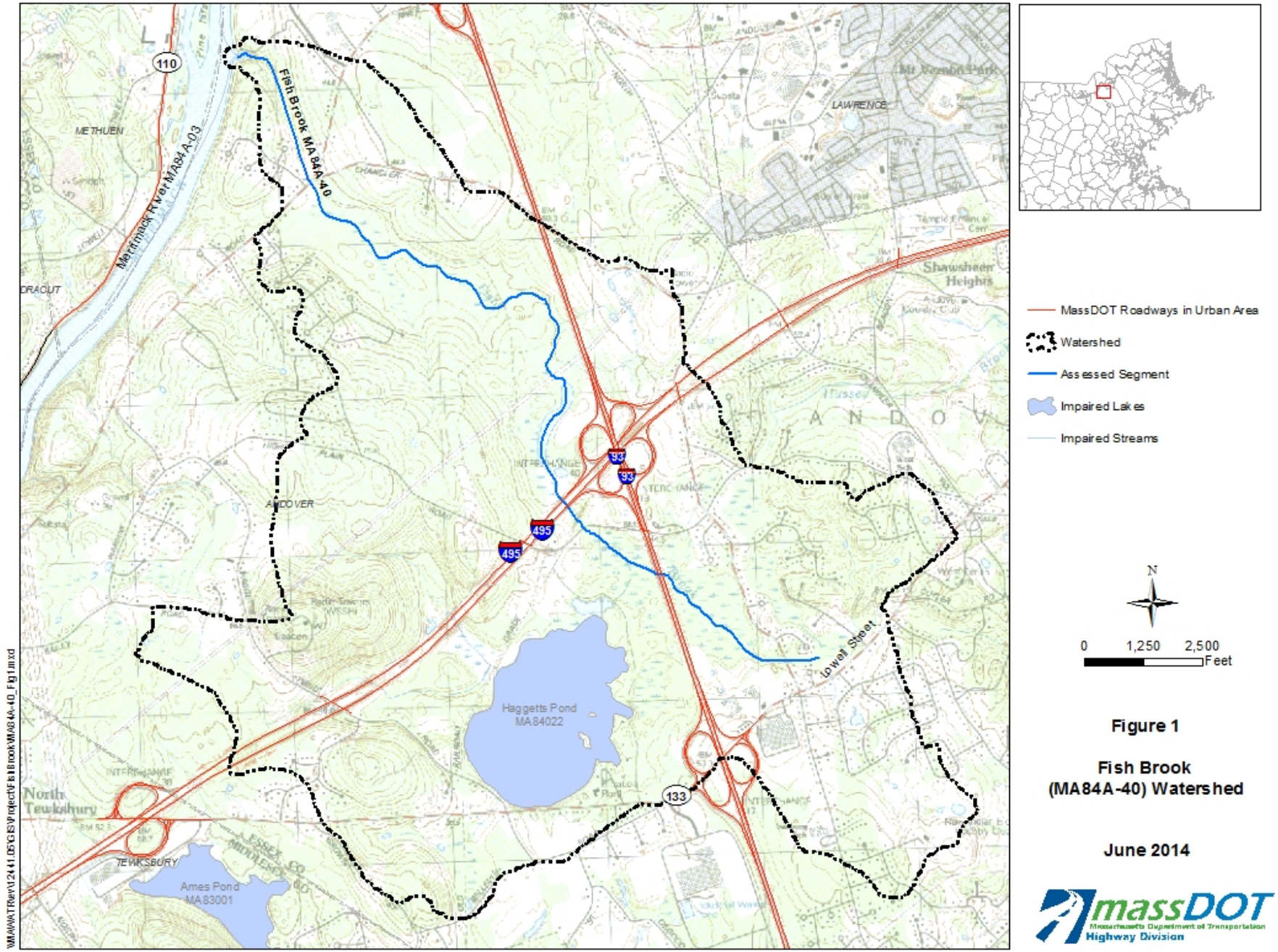

Figure 1

Fish Brook
(MA84A-40) Watershed

June 2014

MassDOT
Massachusetts Department of Transportation
Highway Division

Impaired Waters Assessment for Unnamed Tributary (MA92-26)

Summary

		Stormwater
Impaired Waters[1]	**Impairments**	Chloride
	Category:	5 (Waters requiring a TMDL)
	Final TMDLs	None
	WQ Assessment	None
Location	**Towns:**	Wilmington
	MassDOT Roads:	Interstate 93
Assessment Methods(s)	**7R (TMDL Method)**	☐
	7U (IC Method)	☒
BMPs	**Existing:**	None

Site Description

Unnamed Tributary (MA92-26), is a small stream that flows west to east from west of Interstate 93 (I-93) in Wilmington to the confluence with Martins Brook (MA92-08) in Wilmington. As shown on Figure 1, the watershed to MA92-26 is approximately 792 acres and includes a portion of the I-93 in Wilmington. Land uses within the watershed are mostly forest and residential. MassDOT owns I-93 within the receiving water body's watershed.

Assessment of Chloride Impairment under BMP 7U

MassDOT assessed the chloride impairment 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. TMDL studies have not been initiated for chloride impaired streams in Massachusetts.

The water quality impairments for these water bodies are based on water quality data that was collected by EPA-Region 1 in 2009 and 2010 and was included in a Preliminary Data Report,

1 MassDEP, 2013. Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. Massachusetts. Available at: http://www.mass.gov/eea/docs/dep/water/resources/07v5/12list2.pdf

Baseline Assessment of Stream Water Quality in the I-93 Tri-town Project Area from December 1, 2009 to April 7, 2010.[2] The water quality results indicated that chloride levels occasionally exceeded the EPA recommended chronic aquatic life criteria both upstream and downstream of the surrounding major roadways.

MassDOT does not conduct site specific assessments of loading at each location impaired for chloride. Instead, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements. MassDOT implements a variety of non-structural BMP programs across their system in accordance with their existing SWMP including educational programs, good housekeeping, and source control.

MassDOT's roadway deicing practices are a source of chloride to surrounding waterbodies. As discussed in MassDOT Environmental Status and Planning Report (ESPR),[3] MassDOT constantly reviews the methods employed to meet the safety needs of its traveling public and the potential impact to the environment. These reviews include conducting research on alternate methods for roadway deicing. MassDOT has identified alternative deicing methods, such as acetate based deicers, but determined that they are not appropriate for use in Massachusetts. Acetate based deicers are 10 to 20 times more expensive than traditional deicers, are slow acting and less effective in cold temperatures, and have higher corrosion impacts on infrastructure. Acetate deicers have also been shown to increase the nutrient loading in stormwater runoff from treated surfaces. Due to these factors, MassDOT has decided to continue use of traditional chloride based deicers.

Accident rates following snowfall are proven to increase due to slippery and unsafe roadway conditions. MassDOT's primary focus is safety for all motorists including in the winter months. MassDOT has found that traditional road salt with strategic use of pre-treatment and pre-wetting (using salt brine or liquid $MgCl_2$) is the most effective and economical roadway deicer method available to maintain safe driving conditions.

Traditional stormwater treatment BMPs are not effective in treating or reducing chloride levels in stormwater since chloride, once dissolved, remains dissolved in the water. Therefore, source control is the primary means to reduce the amount of chloride released to the environment. MassDOT has recently implemented numerous statewide measures and policies to reduce its road salt usage and become more effective and efficient with deicing practices.

Mitigation Plan

MassDOT implements a variety of source control measures to reduce the application of road salt. While eliminating salt application in the winter months is not a feasible alternative due to safety concerns, source control can reduce the salt application and in turn reduce the amount of chloride introduced to surrounding waterbodies.

MassDOT stores road salt in covered sheds at maintenance depots across the state. These sheds are located away from streams and watersheds to the extent possible. When located in

[2] EPA, Baseline Assessment of Stream Water Quality in the I-93 Tri-Town Project Areas from December 1, 2009 to April 7, 2010. http://cfpub.epa.gov/si/si_public_record_Report.cfm?dirEntryId=239143&CFID=744254&CFTOKEN=43647609&jsessionid=383040727181ab9a550a609435846661f3e2

3 MassDOT (2012) MassDOT Snow and Ice Control Program. Environmental Status and Planning Report. Public Review Draft. February 2012. http://www.mhd.state.ma.us/downloads/projDev/ESPR_2012/EnvironStatus_PlanningRpt_0212.pdf

environmentally sensitive areas, the sheds have been rebuilt or retrofitted with high roofs and access doorways that allow loading and offloading material inside the building.

MassDOT has implemented pre-treatment and pre-wetting practices to increase the effectiveness and efficiency of road salt use. Pre-treatment relies on the use of liquid deicers such as liquid calcium chloride to pre-wet dry road salt and pretreat roadways prior to or in the early part of the storm event. Pre-treatment of roadways using liquid brines helps to prevent the bonding of snow and ice to the pavement, which greatly reduces the potential need to apply heavier amounts to break up these bonds later in the snow event. Pre-wetting dry road salt reduces bounce and scatter so the material adheres to the road surface more readily and can prevent as much as 20 to 30 percent of applied salt from being cast off the pavement (which ultimately reduces the frequency of re-application).

MassDOT requires all contractors to equip their trucks with pre-wetting equipment. Additionally, MassDOT offers a higher reimbursement rate if contractors equip their spreader trucks with electronic ground speed controllers and wing plows. Electronic controllers have proven to be highly effective in using less salt by adjusting salt applications by truck and auger speed. The percentage of contractors using electronic controllers has grown to approximately 80 to 90 percent in 2014. MassDOT has also increased the number of pre-season training sessions for both MassDOT personnel and its contractors.

Closed loop controllers, electronic devices that provide a more consistent rate of material application, are also used in MassDOT's deicing operations. Closed loop controllers result in greater efficiencies and less deicing material usage. MassDOT reimburses contractors at higher rates if their trucks are equip with closed loop controllers. More than 80 percent of hired contractors in each district had trucks outfitted with closed loop controllers in the winter of 2013.

MassDOT District 4 has been experimenting with the use of a pavement friction meter as a means to provide more detailed and real-time information on pavement conditions during snow events to help decide when applications are needed. The friction meter measures the relative "slipperiness" of the pavement surface. The friction meter is still being tested, but use of the meter has preliminarily enhanced the level of understanding as to what type of pavement conditions warrant deicing material applications. If friction meters are determined to reduce salt use, MassDOT will expand their use to other districts.

To evaluate the effect of these various mitigation measures, MassDOT has begun using a winter severity index (WSI) to compare year-to-year differences in annual salt use to historical annual salt use amounts.[4] The WSI value is used to reflect the relative severity of winter weather conditions and the demand for deicing applications. The WSI is based on a number of factors including daily snowfall and daily maximum and minimum temperatures and has enabled MassDOT to correlate annual salt usage to winter weather conditions. This allows MassDOT to assess how salt usage in more recent years with source control measures in place compares to the historical annual salt usage without these measures in place. The historical annual salt usage is based on a 13-year period from 2001 to 2013.

Based on the procedure described in the ESPR, compared to the average annual historical salt usage in the years 2001 to 2013 adjusted for winter severity, MassDOT used approximately 23 percent less road salt on a per-lane basis statewide and 35 percent less road salt in District 4 in the last three years. These reductions are attributed to the combined effect of the measures and policies implemented beginning in 2011. The most recent winters of 2010/11 and 2012/13 were also

[4] MassDOT Snow and Ice Program, Second Annual Report for the 2012/13 Winter.

the third and fifth most severe winters according to their WSI values and MassDOT still used less salt compared to years of similar winter severity values in the previous 13 years.

Conclusions

MassDOT did not assess this stream using the IC Method but instead focused on the source control measures implemented by MassDOT for the chloride impairment. In regards to the chloride impairment, MassDOT must provide the motoring public with safe road conditions even during the winter months. Given the solubility and conservative nature in which chloride travels in the environment, traditional stormwater BMPs are not effective in retaining chloride or reducing concentrations in contrast to other pollutants. MassDOT has adopted a number of source control and preventative measures on a statewide basis and will continue to expand upon these measures to gain greater efficiencies and reduce its annual salt usage. As discussed above, these measures have shown success in reducing annual salt use amounts compared to that used historically. It is MassDOT's intent to continue to refine and adopt new measures as cost-effective technologies become available and work with snow removal contractors in the adoption of any new policies or equipment upgrades. These source control measures, to achieve sodium chloride reductions to the maximum extent practicable, are consistent with the intent of the existing stormwater permit.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the watershed of Unnamed Tributary (MA92-26), including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education.

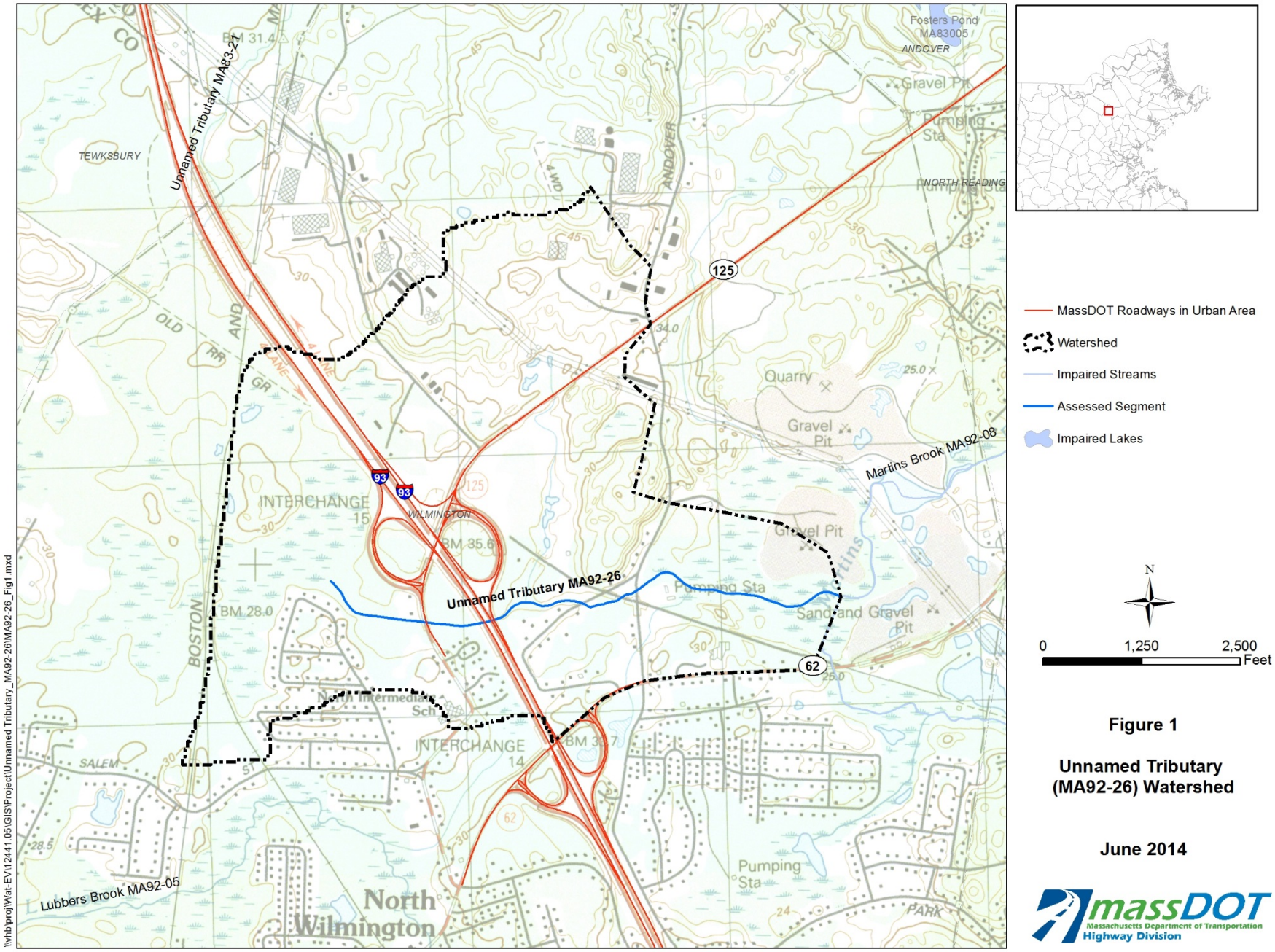

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Figure 1

Unnamed Tributary (MA92-26) Watershed

June 2014

Impaired Waters Assessment for North River (MA94-05) - Final Report

Impaired Water Body

Name: North River

Location: Marshfield, Scituate, Pembroke and Hanover, MA

Water Body ID: MA94-05

Impairments

North River (MA94-05) is listed under Category 5, "Waters requiring a TMDL", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). The North River is impaired for the following:

- Fecal Coliform
- Mercury in Fish Tissue

According to MassDEP's *South Shore Coastal Watersheds 2001 Water Quality Assessment Report* (MassDEP, 2006), North River (MA94-05) is impaired for shellfish harvesting in the lower 0.21 square miles due to elevated fecal coliform bacteria, and is impaired for primary contact in the upper 0.02 square miles due to fecal coliform bacteria. The sources of fecal coliform are unknown; however, stormwater discharges from municipal separate storm sewer systems and wet weather discharges from non-point sources are suspected sources (MassDEP, 2006). North River is considered an Outstanding Resource Water (ORW). The *Draft Pathogen Total Maximum Daily Load (TMDL) for the South Coastal Watershed* (MassDEP, no date) which covers the North River has not been finalized. The aquatic life, secondary contact and aesthetics designated uses are all supported for this segment of North River (MassDEP, 2006).

MassDOT has identified a subset of water body impairments in the North River watershed which are not related to stormwater runoff. Specific impairments unrelated to stormwater for the North River (MA94-05) include Mercury in Fish Tissue. In accordance with MassDOT's Impaired Waters Assessment for Impaired Waters with Impairments Unrelated to Stormwater in the December 8, 2012 EPA submittal, the non-pollutant impairments are not specifically addressed as part of the Impaired Waters Program (MassDEP, 2012).

The *Northeast Regional Mercury TMDL* indicates that stormwater is a *de minimis* source of mercury contamination. According to the TMDL, the majority of mercury in stormwater comes from atmospheric deposition, and therefore the most effective reductions in mercury loading can be achieved through controls on atmospheric deposition (NEIWPCC, 2007). Accordingly, MassDOT has concluded that stormwater runoff from its roadways is a *de minimis* contributor to the mercury impairment.

Relevant Water Quality Standards

Water Body Classification: Class SA, Outstanding Resource Water

Applicable State Regulations:

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

- 314 CMR 4.05 (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;

Site Description

The North River is divided into two segments in the final *Massachusetts Year 2012 Integrated List of Waters.* Segment MA94-05 of the North River flows from Indian Head River (MA94-04) approximately 9.8 miles northwest to its confluence with Segment MA94-06 of North River at the Scituate/Marshfield town line. Segment MA94-05, which is the subject of this assessment, has a surface area of approximately 0.3 square miles. North River is a tidal river with a tidal flood plain that extends over 1,300 feet wide at some locations.

The total watershed for Segment MA94-05 of the North River extends approximately 73.8 square miles in the Towns of Marshfield, Scituate, Norwell, Pembroke, Hanover, Rockland, Abington and Hanson. The total watershed is comprised of approximately 49% forested areas, 31% residential development, and 6% open land (MassDEP, 2006). The subwatershed for Segment MA94-05 of North River is an approximately 16.5 square mile area that primarily consists of forested and residential areas. Refer to Figure 1 for the total and subwatershed.

MassDOT's property with the potential to directly contribute stormwater runoff to Segment MA94-05 of North River is comprised of portions of State Routes 3, 53, and 139. MassDOT operates two parking/rest areas along State Route 3 near the North River crossing in Marshfield. These areas do not have sanitary facilities. Refer to Figure 1 for the locations of these roadways within the subwatershed of Segment MA94-05 of North River.

BMP 7U for Pathogen Impairment

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7U of MassDOT's Storm Water Management Plan (SWMP), which applies to impairments that have been assigned to a water body prior to completion of a TMDL (MassDOT, 2011). North River (MA94-05) is covered by the *Draft Pathogen TMDL for the South Coastal Watershed* (MassDEP, no date). MassDOT included a review of the draft report as an informational review as part of this assessment even though, due to their draft status, draft TMDLs are not formally part of the Impaired Waters Retrofit program.

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

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

Pathogens in MassDOT Discharge

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

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

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

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

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

Assessment

The *Draft Pathogen TMDL for the South Coastal Watershed* covers six estuary segments and six river segments including North River (MA94-05). The South Coastal Watershed covers approximately 240.7 square miles in southeastern Massachusetts. The watershed extends across 19 communities and is drained through four main river systems, North River, South River, Jones River, and Gulf/Bound Brook.

Various sources of fecal contamination have been identified. Dry weather sources include leaking sewer pipes, storm water drainage systems (illicit connections), failing septic systems, recreational activities, wildlife including birds, illicit boat discharges, animal feeding operations, and animal grazing in riparian zones. Wet weather sources include wildlife and domesticated animals (including pets), storm water runoff including municipal storm sewer systems (MS4), combined sewer overflows (CSOs) and sanitary sewer overflows (SSOs) (MassDEP, no date).

Section 7.0 of the Draft Pathogen TMDL discusses the need to eliminate sewer connections to drainage systems, leaking sewer pipes, SSOs, and failing septic systems. A program is needed to

identify sources and encourage responsible entities to take corrective actions. Due to the impact of CSOs and storm water runoff on pathogen levels in the South Coastal watershed, the Draft Pathogen TMDL recommends intensive application of non-structural BMPs throughout the watershed. Structural controls may be necessary if non-structural BMPs are not successful. The report recommends a basin-wide implementation strategy to eliminate illicit sources and implement storm water BMPs (MassDEP, no date).

Unlike other TMDLs that establish pollutant load allocations based on mass per time, many bacteria and pathogen TMDLs in Massachusetts establish bacterial TMDLs that are concentration based and equivalent to the MassDEP water quality standard for the receiving water body. This requirement therefore requires that at the point of discharge to the receiving water, all sources include bacteria concentrations that are equal or less than the MassDEP water quality standard for the receiving water body.

In general, pathogen loadings are highly variable and, as a result, quantitative assessments are challenging and of little value. Therefore, MassDOT reviewed its existing programs and their consistency with EPA NPDES MS4 general permit requirements and Pathogen TMDL recommendations (US EPA, 2010a; US EPA, 2010b; US EPA, 2013).

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

- "given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed…" (MassDEP, 2009a)

- "The NPDES permit does not, however, establish numeric effluent limitations for stormwater discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals."(MassDEP, 2009b)

- "Although the TMDL presents quantified WLAs for stormwater that are set equivalent to the criteria in the Massachusetts Water Quality Standards, the Phase II NPDES permits will not include numeric effluent limitations. Phase II permits are intended to be BMP based permits that will require communities to develop and implement comprehensive stormwater management programs involving the use of BMPs. Massachusetts and EPA believe that BMP based Phase II permits involving comprehensive stormwater management together with specific emphasis on pollutants contributing to existing water quality problems can be consistent with the intent of the quantitative WLAs for stormwater discharges in TMDLs." (MassDEP, 2002).

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

The draft North Coastal Watershed General MS4 permit and the draft Interstate, Merrimack, and South Coastal (IMS) watershed permits contain specific requirements for compliance with pathogen TMDLs (in Appendix G) (US EPA, 2010a; US EPA, 2010b). While these permits are still in draft form, MassDOT believes they represent the best available guidance on what EPA believes is appropriate for addressing stormwater discharges to pathogen-impaired waters. Section 2.2.1(c) of the permit states "For any discharge from its MS4 to impaired waters with an approved TMDL, the permittee shall comply with the specific terms of Part 2.1 of this permit. In addition, where an approved TMDL establishes a WLA that applies to its MS4 discharges, the permittee shall implement the specific BMPs and other permit requirements identified in Appendix G to achieve consistency with the WLA." Appendix G references a number of programmatic BMPs that are necessary to address pathogen loading. These cover the following general topics:

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

In addition to the generic recommendations provided in the draft MS4 permits for Massachusetts, the Draft Pathogen TMDL for the South Coastal Watershed (Section 7.0) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems and leaking sewer pipes
- Elimination of sewer connections to drainage pipes and elimination of sanitary sewer overflows
- Implementation of non-structural BMPs to reduce pathogen contributions to stormwater runoff.
- Implementation of BMPs for field application of manure, animal feeding operations, barnyards, and managing animal grazing areas
- Controlling impacts of CSOs
- Compliance with MS4 general permit requirements, including identification of Minimum Control Measures for stormwater management
- Improved management of recreational waters

The Draft TMDL report also indicates that structural BMPs may be appropriate to address runoff from impervious areas in instances where fecal coliform concentrations cannot be reduced by other means.

The following BMPs are identified in the Draft TMDL report as being ongoing and/or planned in order to reduce bacteria contributions to water bodies in the South Coastal Watershed:

- Implementation of Title V program to improve failing system systems where possible
- Implementation of grant programs to fund the implementation of non-point source management through development of local shellfish management plans
- Training for local shellfish constables

- Implementation of a Shellfish Bed Restoration Program

Mitigation Plan

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

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

MassDOT believes that existing efforts are consistent with the current and draft MS4 permit requirements and TMDL recommendations in regard to pathogens. As part of its pet waste management program, MassDOT has determined that there are no targeted MassDOT rest areas located within the subwatershed of this water. At targeted rest stops that have been identified as being within subwatersheds of water bodies impaired for pathogens, MassDOT will be installing signs informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired water body, and pet waste removal bags and disposal cans will be provided.

The Draft Pathogen TMDL report identifies that non-structural BMPs should be implemented first, but that structural BMPs may be necessary to address runoff from impervious areas in some instances. MassDOT feels that it is not a beneficial approach to implement structural BMPs in advance of other ongoing BMP efforts identified in the watershed, given the documented variability of pathogen concentrations in highway runoff, and the low probability of achieving substantial gains toward meeting the TMDL with solely implementing IC reductions and controls.

Furthermore, MassDOT has an ongoing inspection and monitoring program aimed at identifying and addressing illicit discharges to MassDOT's stormwater management system. Any illicit discharges to MassDOT's system could contribute pathogens to impaired waters, however, MassDOT's existing Illicit Discharge Detection and Elimination (IDDE) program is aimed at identifying and addressing these contributions. District maintenance staff are trained to conduct regular inspections of MassDOT infrastructure and note any signs of potential illicit discharges, such as dry weather flow and notable odors or sheens. Similarly, resident engineers overseeing

construction projects also receive training to note any suspicious connections or flows, and report these for follow-up investigation and action as appropriate. MassDOT will continue to implement this Illicit Discharge Detection and Elimination (IDDE) training, and District staff will continue to report any suspicious flows requiring further investigation. MassDOT investigates any suspicious flows noted, and will work with owners of confirmed illicit discharges to remove these flows, and thereby minimize the possibility of pathogen contributions to receiving waters. At present, there are no suspected or known illicit discharges, or unauthorized drainage tie-ins, within the subwatershed of this water body that could be contributing pathogens to the impaired water body.

Conclusions

MassDOT has concluded based on review of the draft North Coastal Watershed General MS4 permit, the draft Interstate, Merrimack, and South Coastal watershed permits, pathogen TMDLs for Massachusetts waters, that the BMPs outlined in the stormwater management plan are consistent with its existing permit requirements. MassDOT believes that these measures achieve pathogen reductions (including fecal coliform) to the maximum extent practicable and are consistent with the intent of its existing stormwater permit and the applicable Pathogen TMDLs. As stated previously, pathogen loadings are highly variable and although there is potential for stormwater runoff from DOT roadways to be a contributing source, it is unlikely to warrant action relative to other sources of pathogens in the watershed. In addition, MassDOT has concluded that runoff from its roadways does not contribute to the impairments that are unrelated to stormwater.

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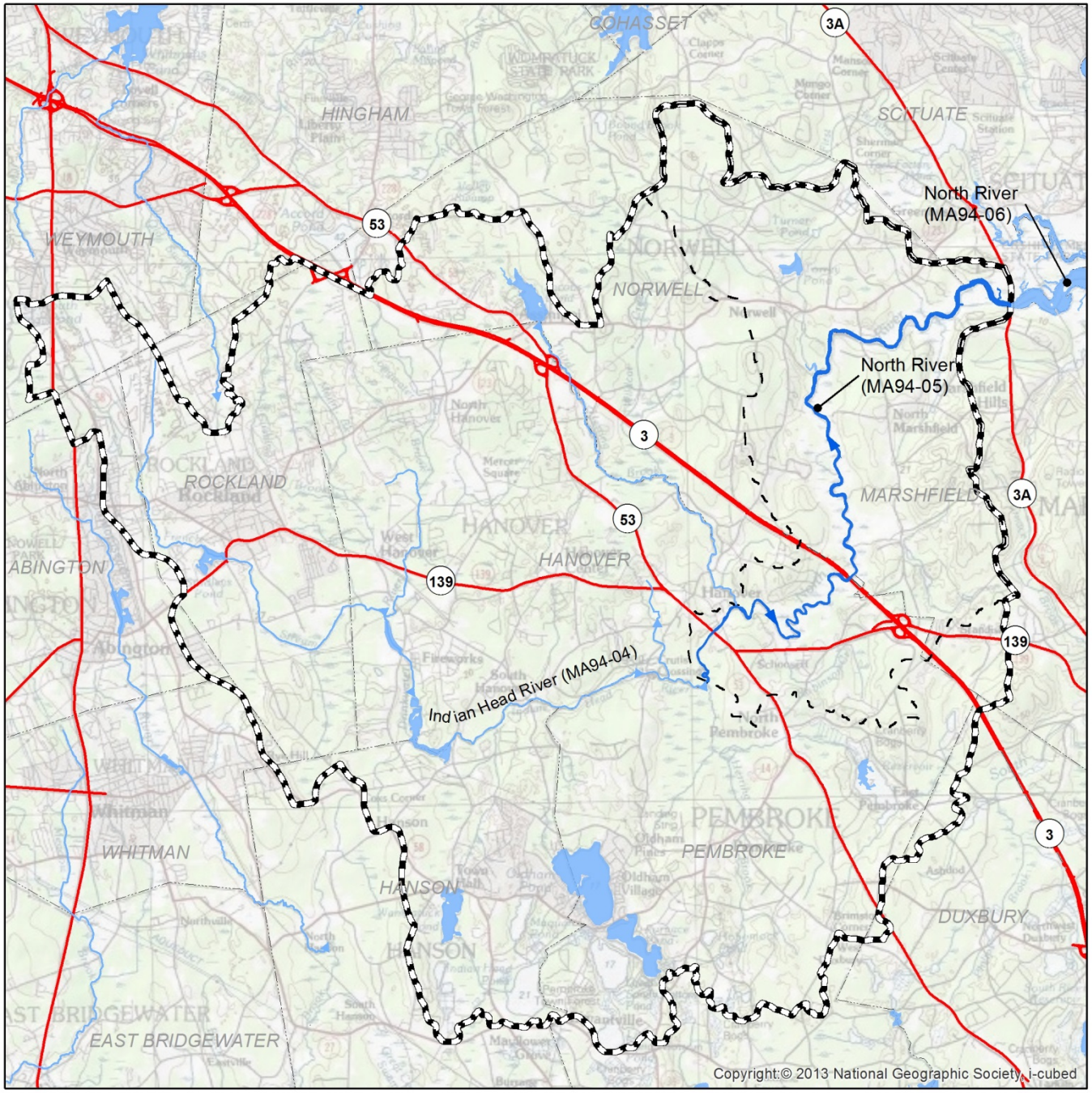

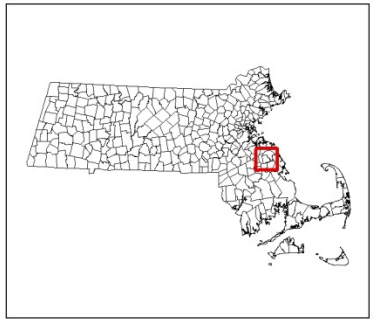

North River (MA94-05)
Impaired Water Body
Impaired Stream Segment
Subwatershed
Total Watershed
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

N

0 1 2 3 4 Miles

Figure 1

North River (MA94-05) Total and Subwatershed

June 2014

massDOT
Massachusetts Department of Transportation
Highway Division

06/08/2014

Impaired Waters Assessment for 2008 to 2012 303d List Category Change Water Bodies

Introduction

MassDEP updates the Integrated List of Waters ("303(d) list") every two years to reflect changes to the water quality of Massachusetts' streams and lakes. The *Final Massachusetts 2012 Integrated List of Waters* (MassDEP, 2013) was finalized in March 2013 and replaces the *Final Massachusetts Year 2010 Integrated List of Waters* (MassDEP, 2010). Two water bodies that were previously included for assessment under the MassDOT Impaired Waters Program as part of Appendix L-1, due to their listed impairment on the 2008 "303(d) list" were removed as their categories changed on the updated 2012 "303(d) List". These water bodies were either a Category 5, "Waters requiring a TMDL", or a Category 4A, "TMDL Completed" on the 2008 "303(d) list" and were changed to either a Category 3, "No Uses Assessed" or Category 2, "Attaining some uses; other uses not assessed" on the 2012 "303d list". MassDEP's additional assessment determined that these two water bodies are no longer impaired and thus, does not require development of Total Maximum Daily Load (TMDL). Table 1 provides the two water bodies and associated impairments as listed on the "303(d) list".

Table 1. MassDOT Impaired Waters Program Water Bodies Re-categorized from Category 5 or 4A in 2008 to Category 2 or 3 in 2012.

Water Body ID	Water Body Name	2008 Category	2008 303(d) List: Impairments of Concern	2012 Category	2012 303(d) List: Impairments of Concern
MA96-34	Wellfleet Harbor	5	Pathogens	2	N/A
MA96-69	Coonamessett River	4a	Nutrients	3	N/A

*Table highlights impairments presented in the 2008 "303 (d) List" which were part of the Appendix L-1.

Siting Description

This assessment applies to the impaired water bodies listed in Table 1. These water bodies are both located within the Cape Cod watershed in Barnstable County. These waters may receive direct discharge from MassDOT urban roadways; however, they are no longer listed as impaired according to the 2012 "303(d) list".

Assessment under BMP 7U

Wellfleet Harbor (MA96-34): According to the 2008 "303(d) list", Wellfleet Harbor was impaired for pathogens which required the development of a TMDL. According to the 2012 "303(d) list", the impairment related to pathogens (Fecal Coliform) was removed based on a new assessment of the

water body. Shellfish harvesting and primary and secondary contact recreation uses were all met (MassDEP, 2011).

Since MA96-34 Wellfleet Harbor did not have a TMDL developed, MassDOT planned to complete the assessment using the Impervious Cover Method, described in BMP 7U of MassDOT's Storm Water Management Plan (MassDOT, 2011). However, this water body is no longer listed as Category 5 which was identified as "impaired" (i.e., not supporting one or more intended use), the impairment was related to the presence of one or more 'pollutants', and the source of those pollutants was not considered to be natural" (MassDEP, 2008). It is now listed as Category 2 which identifies them as "supporting the uses for which they were assessed, but other uses were unassessed" (MassDEP, 2013).

Coonamesset River (MA96-69): MA96-69 Coonamessett River was listed as a Category 4a in the 2008 "303(d) list" which was identified as, "waters for which the required TMDL(s) have already been completed and approved by the EPA". According to the 2008 "303(d) list", Coonamesset River was impaired for nitrogen and was included in the Final Great, Green and Bournes Pond Embayment Systems TMDL for Nitrogen. However, in appendix 3 of the 2012 "303(d) list", 'Pollutants removed from the 2012 303(d) List', nitrogen (total) was removed based on the new assessment. In the Appendix 5, 'Response to public comments', MassDEP responded to a comment from the EPA regarding the removal of nitrogen as a pollutant for the Coonamesset River explaining that the Coonamesset River has never been assessed as impaired and indicates that it was erroneously placed in Category 4a in 2008 following the approval of the Final Great, Green and Bournes Pond Embayment Systems TMDL for Total Nitrogen. The updated 2012 "303(d) list" indicates that there was insufficient or no information available to assess any uses and therefore it was identified as Category 3 in the 2012 "303(d) list" so the TMDL no longer applies.

As a result, MassDOT has concluded that no additional efforts need to be conducted to reduce effective IC within these water bodies' watersheds. The paragraphs below discuss each water body in more detail.

Conclusions

MassDOT has concluded, in accordance with BMP 7U, that there is no required reduction in impervious area for the water bodies listed in Table 1 because they are no longer listed as impaired according to the 2012 "303(d) list". As such, further assessment of these water bodies is not warranted under the Impaired Waters Program.

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