Attachment 4:

Pathogen Only

List of Impaired Water Bodies

Waterbody ID	Waterbody Name
MA62-02	Taunton River
MA84A-08	Powwow River
MA84B-01	Unnamed Tributary
MA92-02	Ipswich River
MA92-12	Unnamed Tributary
MA95-07	Sippican River
MA95-13	Buttonwood Brook
MA95-14	Cape Cod Canal
MA95-18	Red Brook Harbor
MA95-20	Wild Harbor
MA95-25	Quissett Harbor
MA95-40	East Branch Westport River
MA95-49	Broad Marsh River
MA95-50	Wankinco River
MA95-51	Crooked River
MA95-52	Cedar Island Creek
MA95-58	Bread and Cheese Brook
MA95-60	Mattapoisett River
MA96-05	Hyannis Harbor
MA96-06	Maraspin Creek
MA96-09	Quivett Creek
MA96-13	Sesuit Creek
MA96-16	Rock Harbor Creek
MA96-19	Little Harbor
MA96-22	Herring River
MA96-23	Saquatucket Harbor
MA96-26	Little Namskaket Creek
MA96-30	Scorton Creek
MA96-38	Parkers River
MA96-41	Mill Creek

Impaired Waters Assessment for Taunton River (MA62-02)

Impaired Water Body

Name: Taunton River

Location: Taunton and Berkley, MA

Water Body ID: MA62-02

Impairments

Taunton River (MA62-02) is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Taunton River is impaired for the following:

- Fecal Coliform

According to MassDEP's *Taunton River Watershed 2001 Water Quality Assessment Report* (MassDEP, 2001), Taunton River (MA62-02) is impaired for shellfish harvesting due to elevated total fecal coliform bacteria; however, the source is unknown. The aquatic life use has not been assessed due to limited data being available. Taunton River is covered by the *Final Pathogen Total Maximum Daily Load (TMDL) for the Taunton River Watershed* (MassDEP, 2011).

Relevant Water Quality Standards

Water Body Classification: Class SB

Applicable State Regulations:

- 314 CMR 4.05 (4)(b) 4 Bacteria.
  - a. Waters designated for shellfishing shall not exceed a fecal coliform median or geometric mean MPN of 88 organisms per 100 ml, nor shall more than 10% of the samples exceed an MPN of 260 per 100 ml or other values of equivalent protection based on sampling and analytical methods used by the Massachusetts Division of Marine Fisheries and approved by the National Shellfish Sanitation Program in the latest revision of the Guide For The Control of Molluscan Shellfish (more stringent regulations may apply, see 314 CMR 4.06(1)(d)(5)).
  - b. at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010, no single enterococci sample taken during the bathing season shall exceed 104 colonies per 100 ml and the geometric mean of the five most recent samples taken within the same bathing season shall not exceed 35 enterococci colonies per 100 ml. In non bathing beach waters and bathing beach waters during the non bathing season, no single enterococci sample shall exceed 104 colonies per 100 ml and the geometric mean of all of the samples taken during the most recent six months typically based on a minimum of five samples shall not exceed 35 enterococci

colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department.

Site Description

The Taunton River is formed by the confluence of the Matfield and Town rivers in Bridgewater and follows an approximately 40-mile course to Mount Hope Bay. The main stem Taunton River flows through the communities of Bridgewater, Raynham, Taunton, Dighton, Berkley, Fall River, Freetown and Somerset. The main stem of the Taunton River is separated into four segments for the purposes of the final *Massachusetts Year 2012 Integrated List of Waters.* Segment MA62-02 of the Taunton River, which is the subject of this assessment, extends from the Route 24 Bridge in Taunton/Raynham, MA to the Berkley Bridge in Dighton/Berkley MA. This segment is considered an estuary with an area of approximately 0.29 square miles.

Land along the main stem Taunton River is mostly undeveloped, approximately 50% forested and 25% in residential use. The impervious cover is less than 10% indicating that there is a low potential for adverse water quality impacts from impervious surface water runoff.

MassDEP's *Taunton River Watershed 2001 Water Quality Assessment Report* reports three dischargers along Segment 62-02 of the Taunton River. These are the Taunton Wastewater Treatment Plant, which discharged an average monthly flow of 8.4 MGD of treated wastewater and stormwater to the Taunton River; Bay State Gas, a natural gas/propane distribution facility was authorized to discharge non-contact cooling water into the Taunton River from December 1 2000 until March 26, 2004; and the Taunton Municipal Lighting Plant withdraws water for use as cooling water and is authorized to discharge at multiple outfalls along the Taunton River. Refer to Figure 1 for the Taunton River watershed and Figure 2 for the subwatershed to Segment MA62-02 of Taunton River.

MassDOT's property with the potential to directly contribute stormwater runoff to Segment MA62-02 of Taunton River is comprised of portions of Route 24, Winthrop Street (Route 44), and Somerset Ave (Route 138). Figure 2 displays the locations of these roadways. Although other roadways are located within the subwatershed, they are more than two miles from Segment MA 62-02 and therefore unlikely to directly contribute stormwater.

BMP 7R for Pathogen TMDL (CN 0256.0)

MassDOT assessed the pathogen impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP), which applies to impairments that have been assigned to a water body covered by a final TMDL (MassDOT, 2012). Segment MA62-02 of the Taunton River is covered by the *Final Pathogen TMDL for the Taunton River Watershed* (MassDEP, 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 (USEPA, 2010a; USEPA, 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, 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 *Final Pathogen Total Maximum Daily Load (TMDL) for the Taunton River Watershed (CN 0256.0)* applies to the 20 pathogen impaired segments of the Taunton River watershed that are currently listed on the *Massachusetts Year 2012 Integrated List of Waters*.

According to the Final TMDL, numerous point and non-point sources of fecal contamination have been identified in the Taunton River Watershed. Sources of indicator bacteria in the Taunton River watershed were found to be many and varied. Dry weather sources include leaking sewer pipes, illicit connections of sanitary sewers to storm drains, failing septic systems, recreational activities, wildlife including birds, and inadequately treated boat wastes. Wet weather sources include wildlife and domesticated animals, stormwater runoff including municipal separate storm sewer systems (MS4s), combined sewer overflows (CSOs), and sanitary sewer overflows (SSOs). Most of the bacteria sources are believed to be stormwater related (MassDEP, 2011).

The TMDL states on page 17 that 100% of the total estuary area assessed was impaired. Several of the Taunton River Segments (both on and off the main stem) are prioritized and will require additional bacterial source tracking work and implementation of structural and non-structural Best Management Practices (BMP's). In total, there are 20 pathogen impaired segments (12 river and 8 estuary), that contain indicator bacteria concentrations in excess of the Massachusetts water quality standards. The majority of the priority areas are located near downtown Taunton, MA where there are relatively dense residential developments and nearby major roads and highways including Route 44 and Route 24. The portion of Segment MA62-02 near Longmeadow Road Bridge in Taunton and the portion near Center Street (Berkley Bridge) in Berkley are listed as a medium priority. The portion of Segment MA62-02 near Plain Street in Taunton is listed as a high priority (MassDEP, 2011).

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 to 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.

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 (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. MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program, MassDOT has determined that two rest stops are located within the sub-watershed of this waterbody along Route 24. The MassDOT facility IDs for the southbound side rest stop and the northbound side rest stop are 453 and 454, respectively. MassDOT will be installing signs at these rest stops, informing the public of the need to remove pet waste in order to minimize contributions of pathogens to the impaired waterbody, 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 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 waterbody that could be contributing pathogens to the impaired waterbody.

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, and the *Final Pathogen TMDL for the Taunton River Watershed*, 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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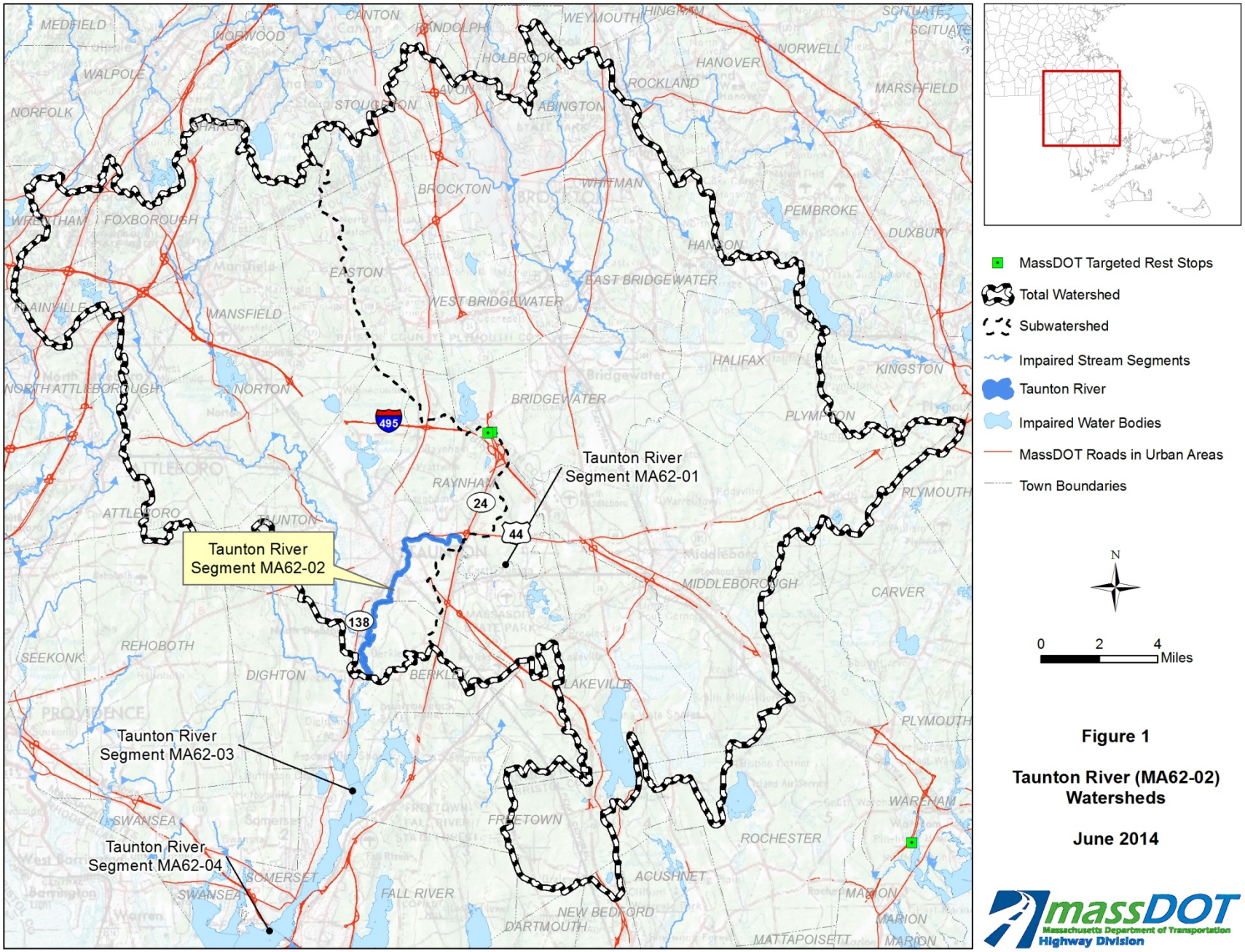
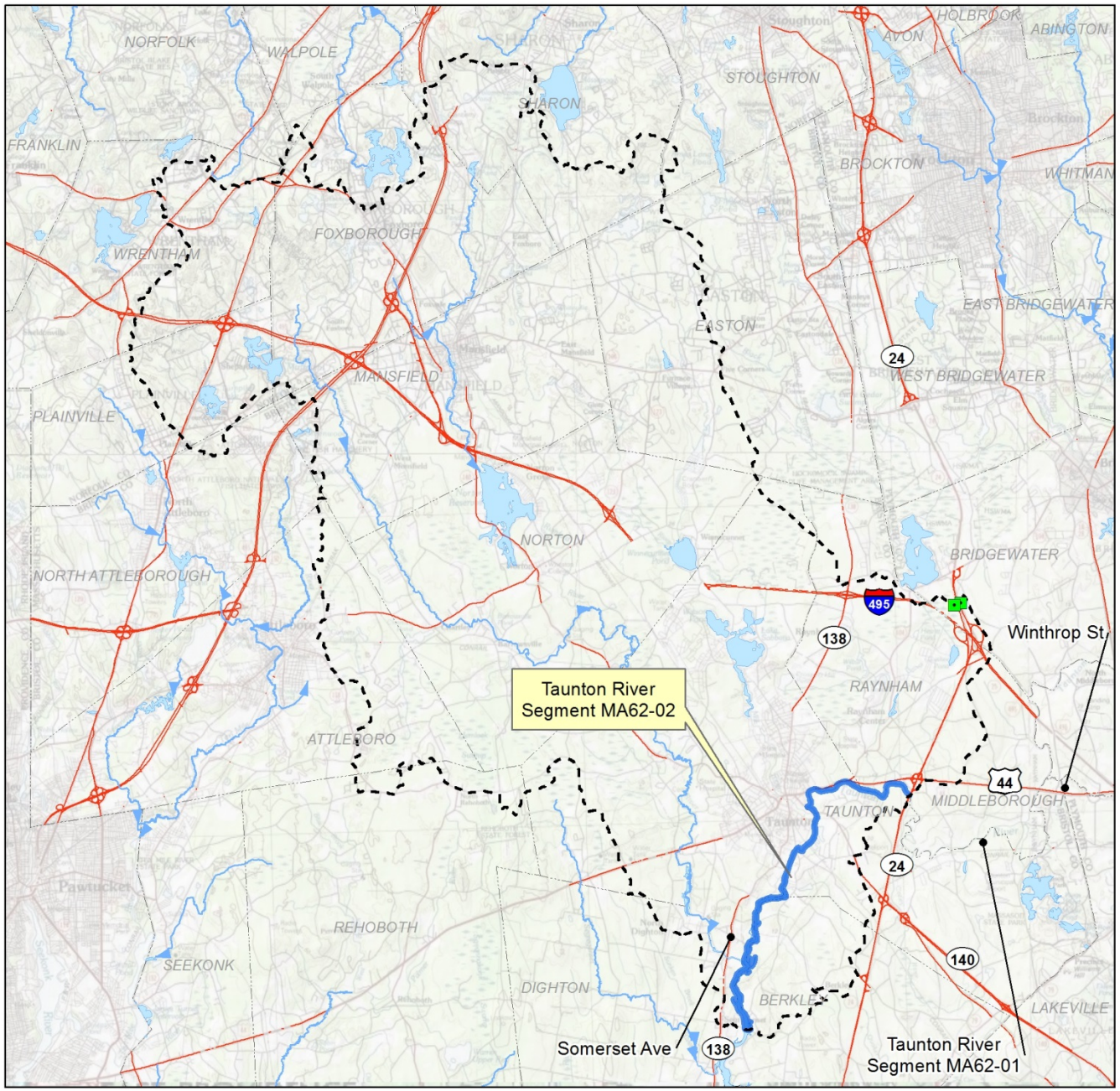


Figure 1

Taunton River (MA62-02) Watersheds

June 2014



MassDOT Targeted Rest Stops
Subwatershed
Impaired Streams
Taunton River (MA62-02)
Impaired Water Bodies
MassDOT Roads in Urban Areas
Town Boundaries

N

0 2 4 Miles

Figure 2

Taunton River (MA62-02)
Subwatershed

June 2014

massDOT
Massachusetts Department of Transportation
Highway Division

Impaired Waters Assessment for Powwow River (MA84A-08)

Impaired Water Body

Name: Powwow River

Location: Amesbury, MA

Water Body ID: MA84A-08

Impairments

Powwow River (MA84A-08) is listed under Category 5, "Waters Requiring a TMDL", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Powwow River is impaired for the following:

- Escherichia coli

According to MassDEP's *Merrimack River Watershed 2004 Water Quality Assessment Report* (MassDEP, 2010), Powwow River (MA84A-08) is impaired for primary contact. The sources include unspecified urban stormwater. Secondary contact is supported and aquatic life, fish consumption, shellfishing, and aesthetics have not yet been assessed. Segment MA84A-08 of Powwow River is covered by a *Draft Pathogen Total Maximum Daily Load (TMDL) for the Merrimack River Watershed* (MassDEP, no date).

Relevant Water Quality Standards

Water Body Classification: Class SB

Applicable State Regulations:

- 314 CMR 4.05 (4)(b) 4 Bacteria.
  - a. Waters designated for shellfishing shall not exceed a fecal coliform median or geometric mean MPN of 88 organisms per 100 ml, nor shall more than 10% of the samples exceed an MPN of 260 per 100 ml or other values of equivalent protection based on sampling and analytical methods used by the Massachusetts Division of Marine Fisheries and approved by the National Shellfish Sanitation Program in the latest revision of the Guide For The Control of Molluscan Shellfish (more stringent regulations may apply, see 314 CMR 4.06(1)(d)(5));
  - b. at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010, no single enterococci sample taken during the bathing season shall exceed 104 colonies per 100 ml and the geometric mean of the five most recent samples taken within the same bathing season shall not exceed 35 enterococci colonies per 100 ml. In non bathing beach waters and bathing beach waters during the non bathing season, no single enterococci sample shall exceed 104 colonies per 100

ml and the geometric mean of all of the samples taken during the most recent six months typically based on a minimum of five samples shall not exceed 35 enterococci colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department;

Site Description

The Powwow River (MA84A-08) segment is the tidal portion of the river just downstream of Main Street in Amesbury to the confluence with Merrimack River in Amesbury. This segment is approximately 0.1 square miles (MassDEP, 2010).

The subwatershed for Segment MA84A-08 of Powwow River is predominantly developed with some wetlands directly adjacent to portions of the river segment. The total watershed extends into New Hampshire. Refer to Figure 1 for the subwatershed to Segment MA84A-08 of Powwow River. The total watershed is not included in the figure as it encompasses a very large area and extends into the state of NH.

MassDOT's property with the potential to directly contribute stormwater runoff to Segment MA84A-08 of Powwow River is comprised of portions of Interstate 95 and 495, and Route 110, as well a bridge on portion of Main Street in Amesbury that is MassDOT property. Refer to Figure 1 for the location of these roadways within the subwatershed to Segment MA84A-08 of Powwow River.

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 Final TMDL (MassDOT, 2011). Powwow River (MA84A-08) 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 (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, 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.

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
- Design and construction of improvements to wastewater treatment facilities

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.

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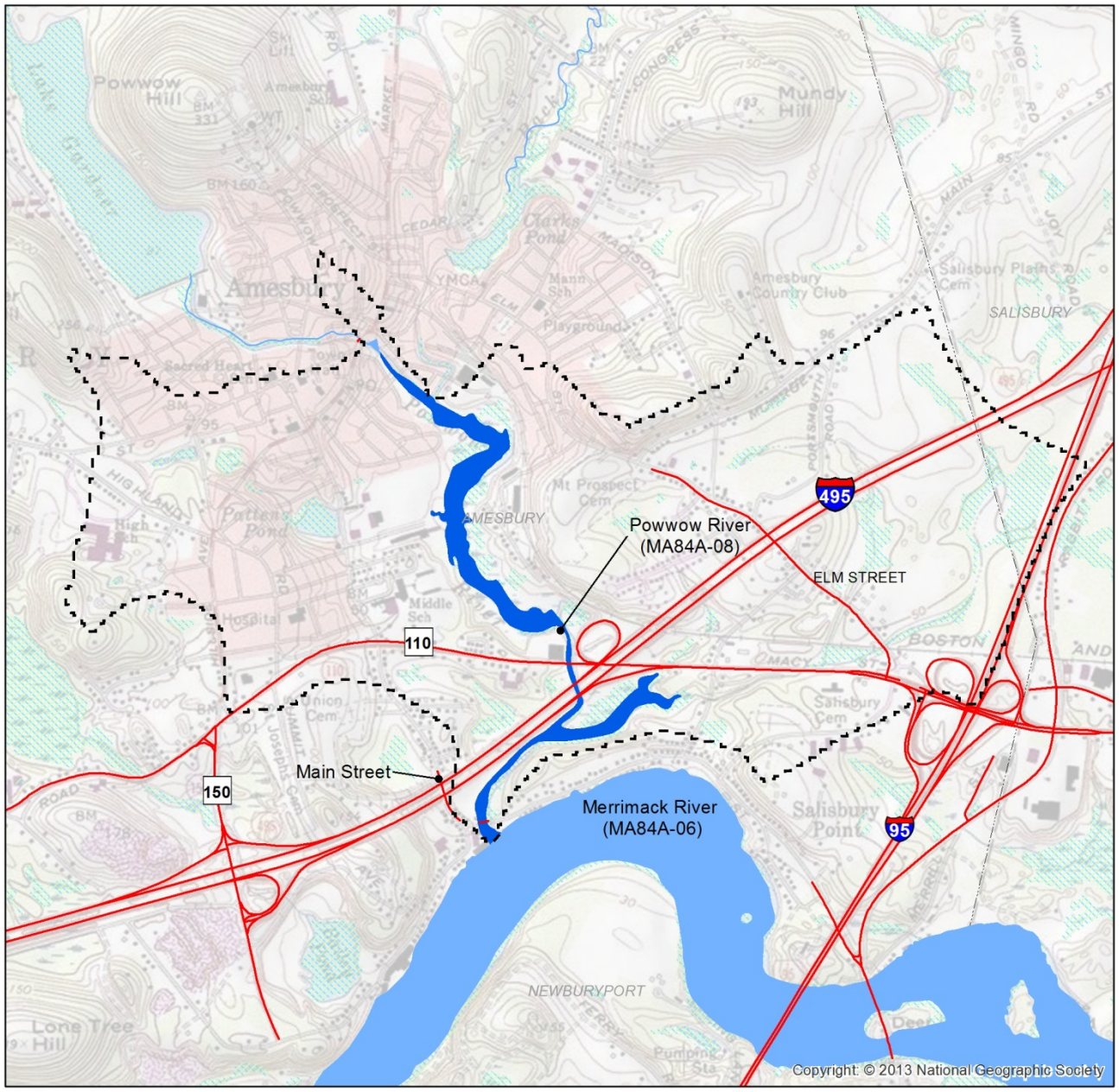

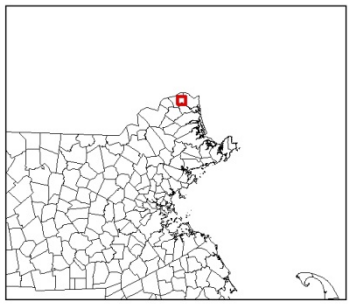

Subwatershed
MassDOT Roads in Urban Areas
Impaired Streams
Impaired Water Bodies
MA84A-08
NWI Wetland Areas
Town Boundaries

N

0 0.1 0.2 0.4 0.6
Miles

Figure 1

Powwow River (MA84A-08) Subwatershed

June 2014

Impaired Waters Assessment for Unnamed Tributary (MA84B-01)

Impaired Water Body

Name: Unnamed Tributary

Location: Littleton, MA

Water Body ID: MA84B-01

Impairments

Unnamed Tributary (MA84B-01) is listed under Category 5, "Waters Requiring a TMDL", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Unnamed Tributary is impaired for the following:

- Fecal coliform

According to MassDEP's *Merrimack River Watershed 2004 Water Quality Assessment Report* (MassDEP, 2010), Unnamed Tributary (MA84B-01) has not yet been assessed for aquatic life primary contact, secondary contact, fish consumption, and aesthetics. There is an alert for aquatic life, due to evidence of ambient toxicity during sampling by Veryfine Products, Inc. Segment MA84B-01 of Unnamed Tributary is covered by a *Draft Pathogen Total Maximum Daily Load (TMDL) for the Merrimack River Watershed* (MassDEP, no date).

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

Unnamed Tributary (MA84B-01) flows from the outlet of a small unnamed impoundment upstream of Bruce Street to an inlet to Mill Pond in Littleton. This Unnamed Tributary is locally known as Reedy Meadow Brook. This segment is approximately 1.5 miles long.

The watershed for Segment MA84B-01 of Unnamed Tributary consists of wetlands directly adjacent to portions of the segment. The total and watershed are the same for this segment. Refer to Figure 1 for the total and subwatershed to Segment MA84B-01 of Unnamed Tributary.

MassDOT's property with the potential to directly contribute stormwater runoff to Segment MA84B-01 of Unnamed Tributary is comprised of portions of Route 2A/110. Refer to Figure 1 for the location of this roadway within the subwatershed to Segment MA84B-01 of Unnamed Tributary.

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 (SWMP), which applies to impairments that have been assigned to a water body prior to completion of a TMDL (MassDOT, 2011). Unnamed Tributary (MA84B-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 (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, 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.

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
- Participation in programs to fund the implementation of non-point source management runoff.

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
- Design and construction of improvements to wastewater treatment facilities

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.

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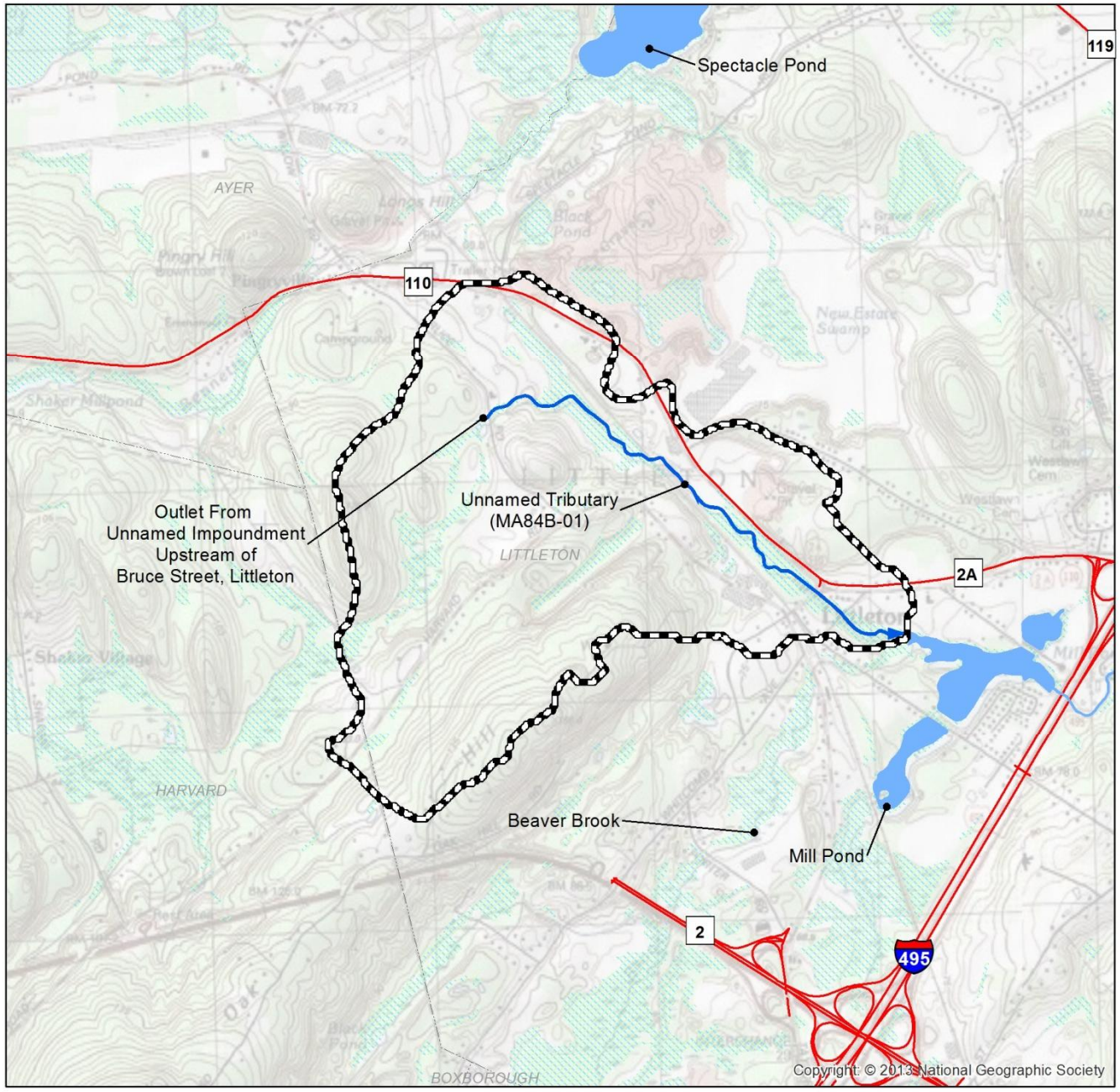

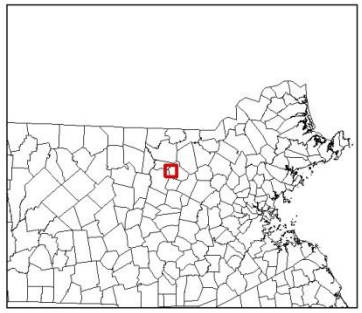

Total and Subwatershed
Impaired Streams
MA84B-01
Impaired Water Bodies
NWI Wetland Areas
MassDOT Roads in Urban Areas
Town Boundaries

N

0 0.125 0.25 0.5 0.75
Miles

Figure 1

Unnamed Tributary (MA84B-01) Watersheds

June 2014

massDOT
Massachusetts Department of Transportation
Highway Division

Impaired Waters Assessment for Ipswich River (MA92-02)

Impaired Water Body

Name: Ipswich River

Location: Ipswich, MA

Water Body ID: MA92-02

Impairments

Ipswich River (MA92-02) is listed under Category 5, "Waters Requiring a TMDL", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Ipswich River is impaired for the following:

- Fecal Coliform

According to MassDEP's *Ipswich River Watershed 2000 Water Quality Assessment Report* (MassDEP, 2004), Ipswich River (MA92-02) is impaired for shellfish harvesting. The known source of this impairment is on-site septic systems and an additional suspected source is municipal storm sewer systems (MS4). Fish consumption, aquatic life, and primary and secondary contact have not yet been assessed. Segment MA92-02 of the Ipswich River is covered by a *Draft Pathogen Total Maximum Daily Load (TMDL) for the Ipswich River Watershed* (MassDEP, no date).

Relevant Water Quality Standards

Water Body Classification: Class SA

Applicable State Regulations:

- 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 Ipswich River (MA92-02) flows from the Ipswich Dam, formerly known as Sylvania Dam, to mouth at Ipswich Bay in Ipswich. This segment is approximately 0.411 square miles (MassDEP, 2004).

The subwatershed for Segment MA92-02 of Ipswich River consists of wetlands directly adjacent to portions of the segment. The total watershed contains commercial properties along several of the major MassDOT roads. Refer to Figure 1 for the total watershed and Figure 2 for the subwatershed to Segment MA92-02 of Ipswich River.

MassDOT's property with the potential to directly contribute stormwater runoff to Segment MA92-02 of Ipswich River is comprised of a portion of Route 1A/Route 133. Refer to Figure 2 for the location of these roadways within the subwatershed to Segment MA92-02 of Ipswich River.

BMP 7U for Pathogen Impairment

MassDOT assessed the indicator bacteria (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 final TMDL (MassDOT, 2011). Segment MA92-02 of the Ipswich River is covered by a *Draft Pathogen TMDL for the Ipswich 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 (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, 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 Ipswich River Watershed* covers the Ipswich River and its tributaries. The Ipswich River Watershed covers 155 square miles in 22 communities. The TMDL includes nine segments.

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), 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. The MADEP, the Eight Towns and the Bay (8T&B), the Ipswich River Watershed Association (IRWA), the Ipswich Coastal Pollution Control Committee (ICPCC), and communities have invested in efforts to identify sources and encourage responsible entities to take corrective actions. Due to the impact of storm water runoff on pathogen levels in the Ipswich 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.

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 Ipswich 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 and other illicit discharges to drainage pipes and elimination of sanitary sewer overflows
- Implementation of non-structural BMPs to reduce pathogen contributions to stormwater runoff.
- Improved management of recreational waters
- 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 Ipswich River:

- Study and rehabilitation of closed coastal shellfish Beds
- Compliance with MS4 general permit requirements, including identification of Minimum Control Measures for stormwater management
- Correction of failing septic systems

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 MassDOT targeted 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.

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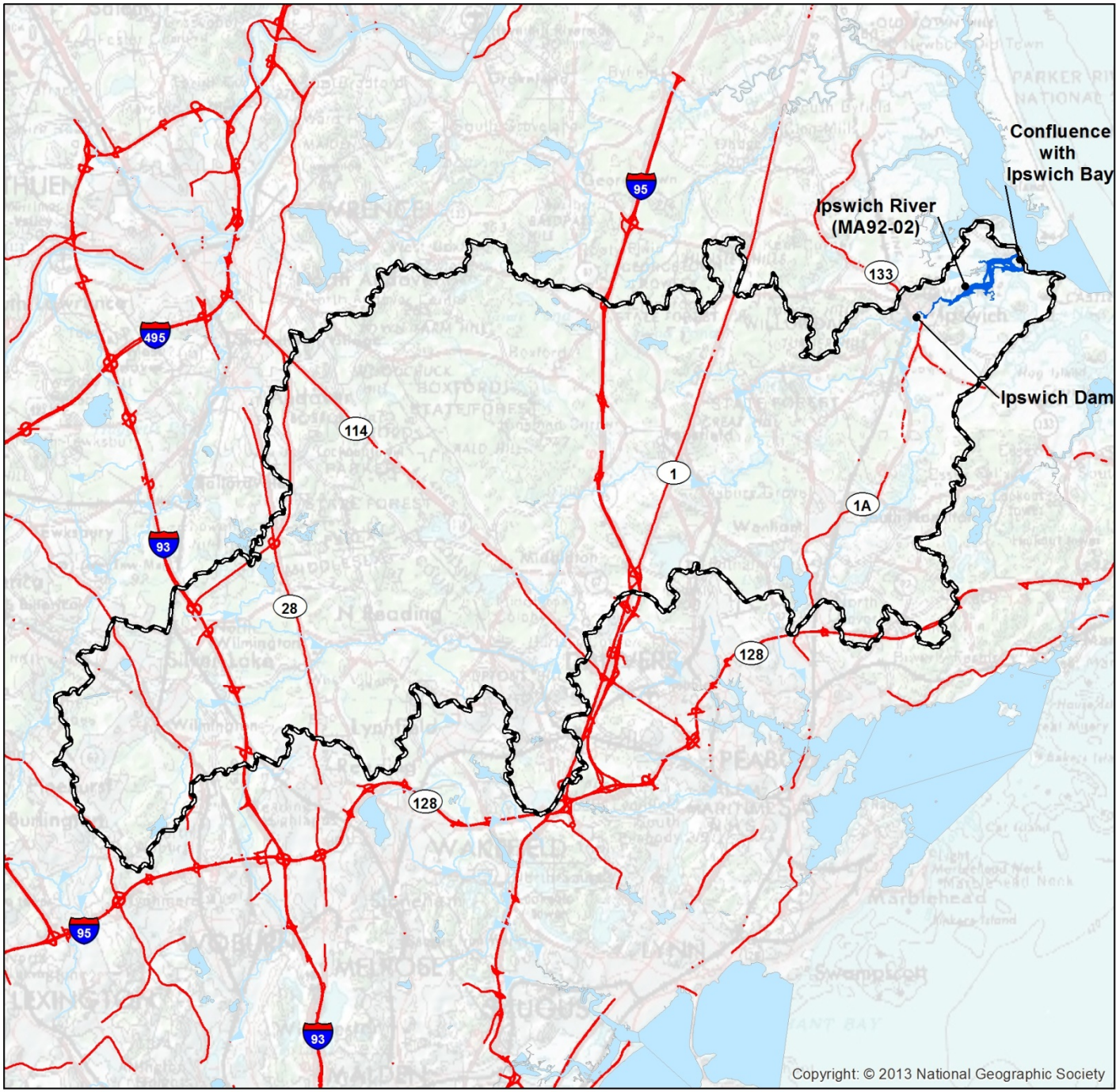
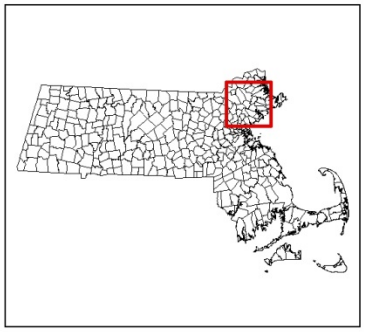




Ipswich River Total Watershed
Impaired Streams
Impaired Water Bodies
MA92-02
MassDOT Roads in Urban Areas

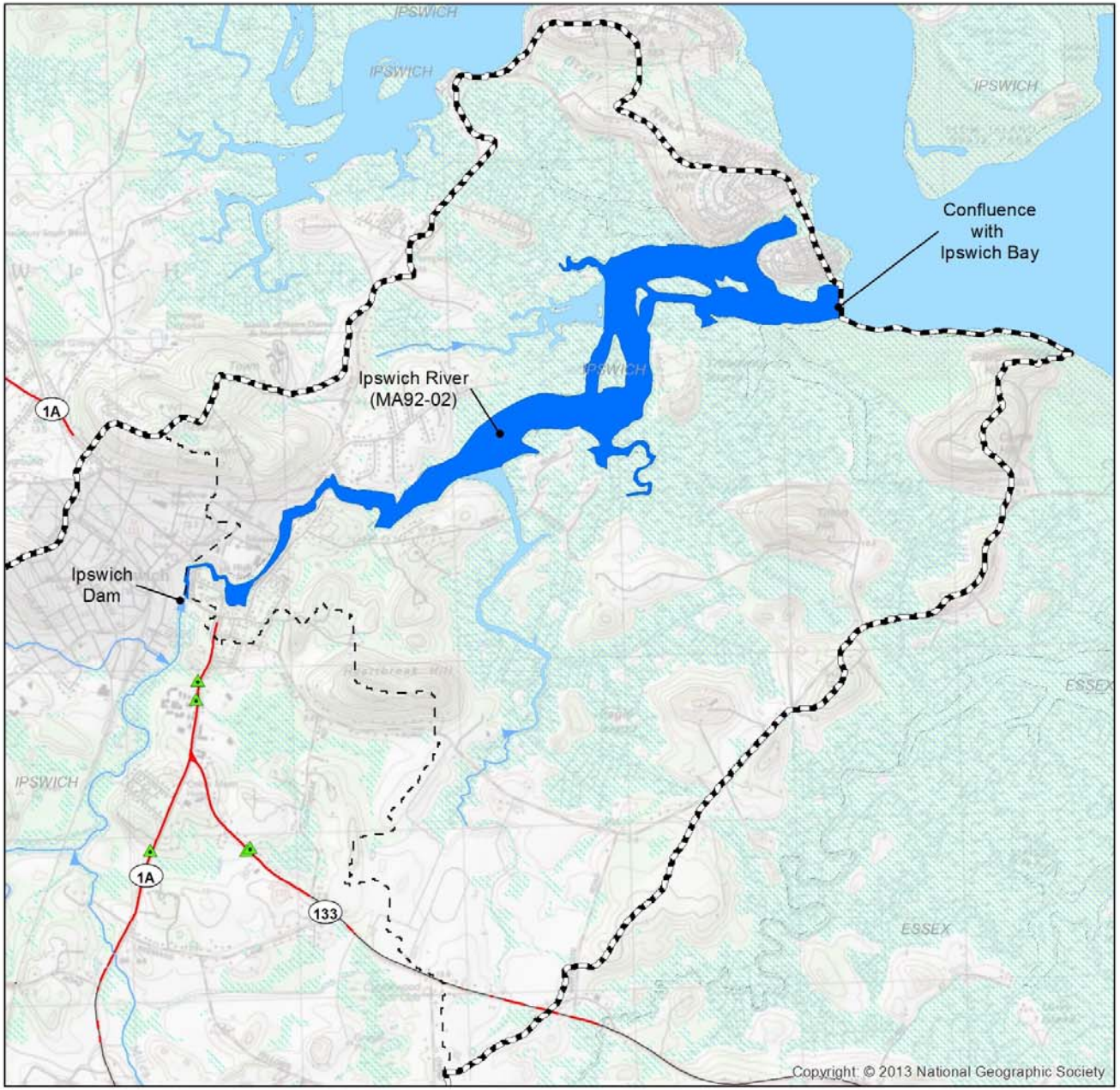
N

0 1.25 2.5 5
Miles

Figure 1
Ipswich River (MA92-02) Watersheds

June 2014

massDOT
Massachusetts Department of Transportation
Highway Division



MassDOT Outfalls
Total Watershed
Subwatershed
Impaired Streams
Ipswich River
Impaired Water Bodies
MassDOT Roads in Urban Areas
MassDOT Roads
NWI Wetland Areas
Town Boundaries

N

0 1,250 2,500 5,000
Feet

Figure 2
Ipswich River
(MA92-02)
Subwatershed

June 2014

massDOT
Massachusetts Department of Transportation
Highway Division

Impaired Waters Assessment for Unnamed Tributary (MA92-12)

Impaired Water Body

Name: Unnamed Tributary

Location: Middleton, MA

Water Body ID: MA92-12

Impairments

Unnamed Tributary (MA92-12) is listed under Category 5, "Waters Requiring a TMDL", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Unnamed Tributary is impaired for the following:

- Fecal Coliform

According to MassDEP's *Ipswich River Watershed 2000 Water Quality Assessment Report* (MassDEP, 2004), Unnamed Tributary (MA92-12) has not yet been assessed for aquatic life, fish consumption, or primary and secondary contact. It is supported for aesthetics. Unnamed Tributary is covered by a Draft Pathogen Total Maximum Daily Load (TMDL) for the Ipswich River Watershed (MassDEP, no date).

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. 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 Unnamed Tributary (MA92-12) flows, from the outlet of Middleton Pond to confluence with Ipswich River in Middleton. This segment is approximately 1.4 miles long (MassDEP, 2004).

The subwatershed for Segment MA92-12 of Unnamed Tributary consists of wetlands directly adjacent to portions of the segment. The subwatershed contains some urbanization including several commercial properties along Route 114. Refer to Figure 1 for the total watershed and Figure 2 for the subwatershed to Segment MA92-12 of Unnamed Tributary.

MassDOT's property with the potential to directly contribute stormwater runoff to Segment MA92-12 of Unnamed Tributary is comprised of portions of Route 114. Refer to Figure 2 for the location of this roadway within the subwatershed to Segment MA92-12 of Unnamed Tributary.

BMP 7U for Pathogen Impairment

MassDOT assessed the pathogen 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 final TMDL (MassDOT, 2011). Unnamed Tributary (MA95-20) is covered by the *Draft Pathogen TMDL for the Ipswich 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 (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, 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 Ipswich River Watershed* covers the Ipswich River and its tributaries. The Ipswich River Watershed covers 155 square miles in 22 communities. The TMDL includes nine segments.

Various sources of fecal contamination have been identified throughout the watershed. 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), and sanitary sewer overflows (SSOs) (MassDEP, no date). However, potential sources for segment MA92-12 specifically are identified as unknown in the draft TMDL report (Mass DEP, 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. The MADEP, the Eight Towns and the Bay (8T&B), the Ipswich River Watershed Association (IRWA), the Ipswich Coastal Pollution Control Committee (ICPCC), and communities have invested in efforts to identify sources and encouraging responsible entities to take corrective actions. Due to the impact of storm water runoff on pathogen levels in the Ipswich 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.

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 Ipswich 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 and other illicit discharges to drainage pipes and elimination of sanitary sewer overflows
- Implementation of non-structural BMPs to reduce pathogen contributions to stormwater runoff.
- Improved management of recreational waters
- 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 Ipswich River:

- Study and rehabilitation of closed coastal shellfish beds
- Compliance with MS4 general permit requirements, including identification of Minimum Control Measures for stormwater management
- Correction of failing septic systems.

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 MassDOT targeted 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.

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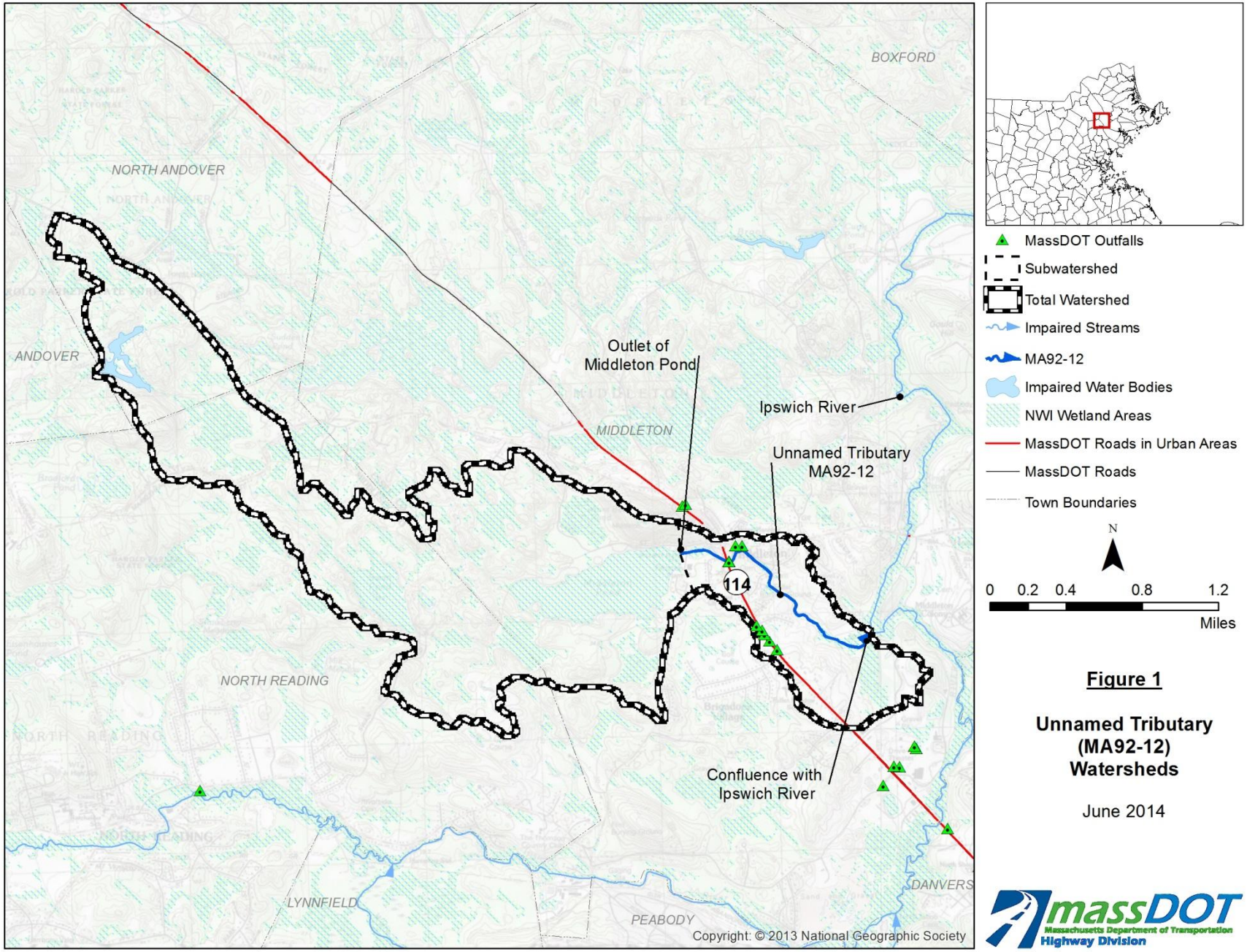

Figure 1

Unnamed Tributary (MA92-12) Watersheds

June 2014

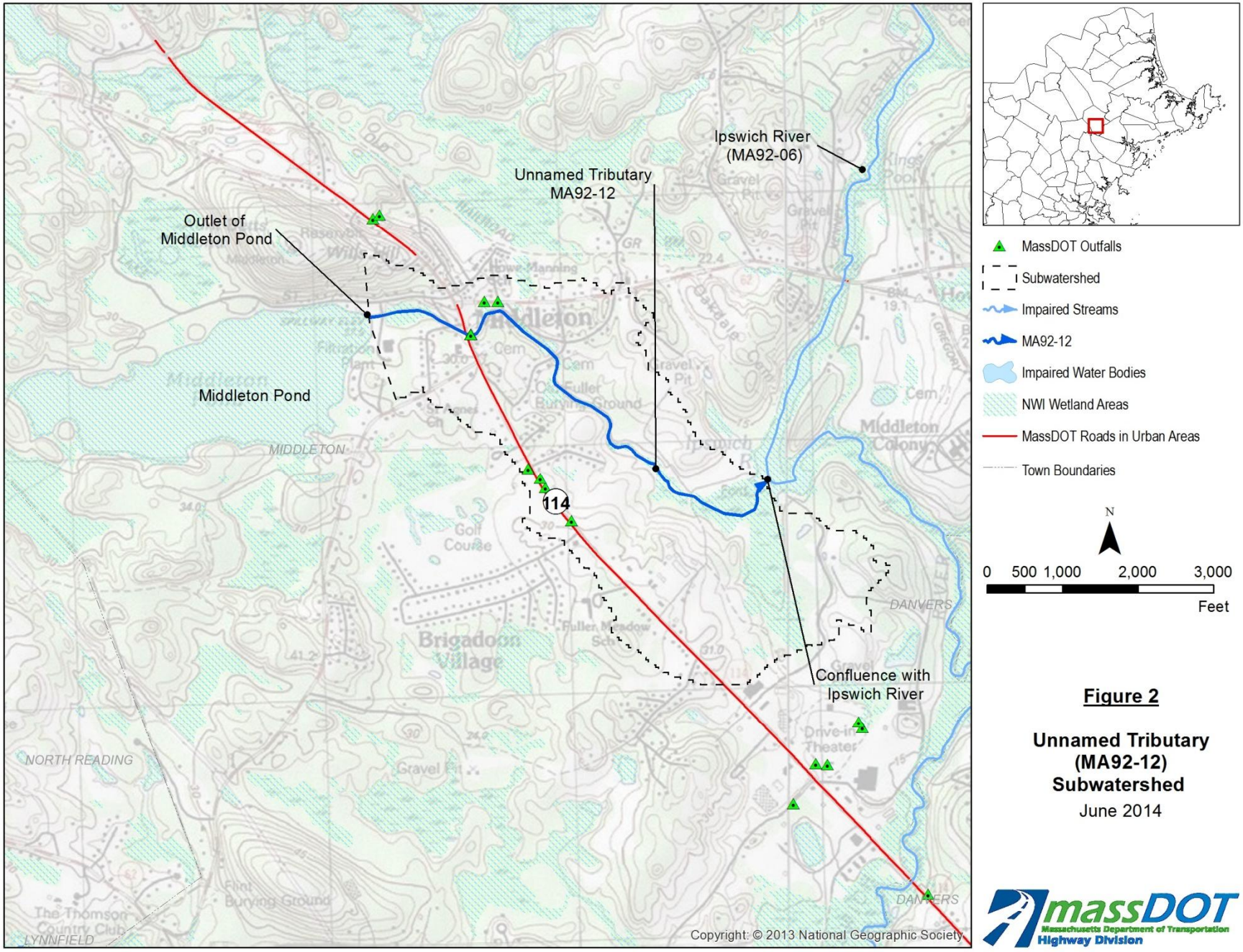

Figure 2

Unnamed Tributary (MA92-12) Subwatershed

June 2014

Impaired Waters Assessment for Sippican River (MA95-07)

Impaired Water Body

Name: Sippican River

Location: Marion and Wareham, MA

Water Body ID: MA95-07

Impairments

Sippican River (MA95-07) is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Sippican River is impaired for the following:

- Fecal Coliform

According to MassDEP's *Buzzards Bay Watershed 2000 Water Quality Assessment Report* (MassDEP, 2003), Sippican River (MA95-07) is impaired for shellfish harvesting due to elevated total fecal coliform bacteria; however, the source is unknown. The aquatic life use has not been assessed. Sippican River is covered by the *Final Pathogen Total Maximum Daily Load (TMDL) for the Buzzards Bay Watershed* (MassDEP, 2009a).

Relevant Water Quality Standards

Water Body Classification: Class SA

Applicable State Regulations:

- 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 Sippican River is a tributary of Buzzards Bay. The final *Massachusetts Year 2012 Integrated List of Waters* identifies two segments of the Sippican River, Segment MA95-06 which extends from Leonards Pond in Rochester, Massachusetts to County Road at the Marion and Wareham border, and Segment MA95-07 which extends from County Road to the Weweantic River. Segment MA95-07 of the Sippican River, which is the subject of this assessment, is approximately 2.75 miles long and has a surface area of approximately 0.08 square miles. It is a tidal river classified by MADEP as Class SA, Shellfishing (open) river segment that is excellent habitat for fish, other aquatic life and wildlife.

The subwatershed for Segment MA95-07 of Sippican River is an approximately 0.65 square mile area consisting primarily of residential and forested areas and a cranberry bog. The total watershed has a similar mix of residential and forested areas and according to the MassDEP's *Buzzards Bay Watershed 2000 Water Quality Assessment Report* has approximately 2,313 acres of cranberry bogs. Segment MA95-07 of Sippican River is located in the eastern portion of the watershed. Refer to Figure 1 for the total watershed and Figure 2 for the subwatershed of Segment MA95-07 of Sippican River.

MassDOT's property with the potential to directly contribute stormwater runoff to Segment MA95-07 of Sippican River is comprised of portions of Interstate 195 and US Route 6. Refer to Figure 2 for the locations of these roads within the subwatershed of Segment MA95-07 of the Sippican River.

BMP 7R for Pathogen TMDL (CN 251.1)

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP), which applies to impairments that have been assigned to a water body covered by a final TMDL (MassDOT, 2012). Sippican River is covered by the *Final Pathogen TMDL for the Buzzards Bay Watershed* (MassDEP, 2009a).

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 (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, 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 *Final Pathogen Total Maximum Daily Load (TMDL) for the Buzzards Bay Watershed (CN 251.1)* covers the rivers, estuary areas, and tributaries of the Buzzards Bay Watershed, including the Sippican River. Groundwater seepage also enters the Bay (Mass DEP, 2009a).

The Buzzards Bay watershed has no documented point sources of bacteria pollution. Suspected dry-weather sources of bacteria reported in the TMDL report include illicit sewer connections, failing septic systems, and direct wildlife, while suspected and known wet-weather sources reported include sanitary sewer overflows, combined sewer overflows, failing septic systems, and stormwater runoff including MS4s. MS4s are specifically mentioned as potential sources of bacterial pollution to segment MA95-07 of Sippican River (MassDEP, 2009a).

In an effort to eliminate bacteria sources, segments of the Buzzards Bay Watershed were prioritized based on a number of considerations, including value as a shellfish resource, existing fecal coliform concentration in receiving water, and proximity to swimming beaches. Sippican River is listed as a medium priority due to its value as a resource for shellfishing. It is suspected that elevated dry-weather bacteria concentrations indicate illicit sewer connections or failing septic systems, and these sources should be eliminated (MassDEP, 2009a).

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.

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 *Final Pathogen TMDL for the Buzzards Bay Watershed* (Section 8.0-8.9) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems
- Non-structural practices (street sweeping and/or managerial strategies)
- Controls for agricultural runoff, such as improved grazing management

The 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 specifically identified as being ongoing and/or planned in order to meet the *Final Pathogen TMDL for the Buzzards Bay Watershed*:

- Agricultural BMPs
- Septic tank controls
- Documentation of storm drain outfall locations
- Recreational Waters use management
- Watershed resident education

- Additional monitoring

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 accordance with the BMPs identified in the TMDL report as planned measures to reach compliance with the Buzzards Bay pathogen TMDL report, 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 targeted 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.

Although the TMDL report also identifies the benefits of structural BMPs to address runoff from impervious areas in some instances, MassDOT feels that it is not a beneficial approach to implement these 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 towards 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, and the Final Pathogen TMDL for this impaired water body segment 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.

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US EPA, 2013. Draft New Hampshire Small MS4 General Permit. February. Available at: http://www.epa.gov/region1/npdes/stormwater/MS4_2013_NH.html

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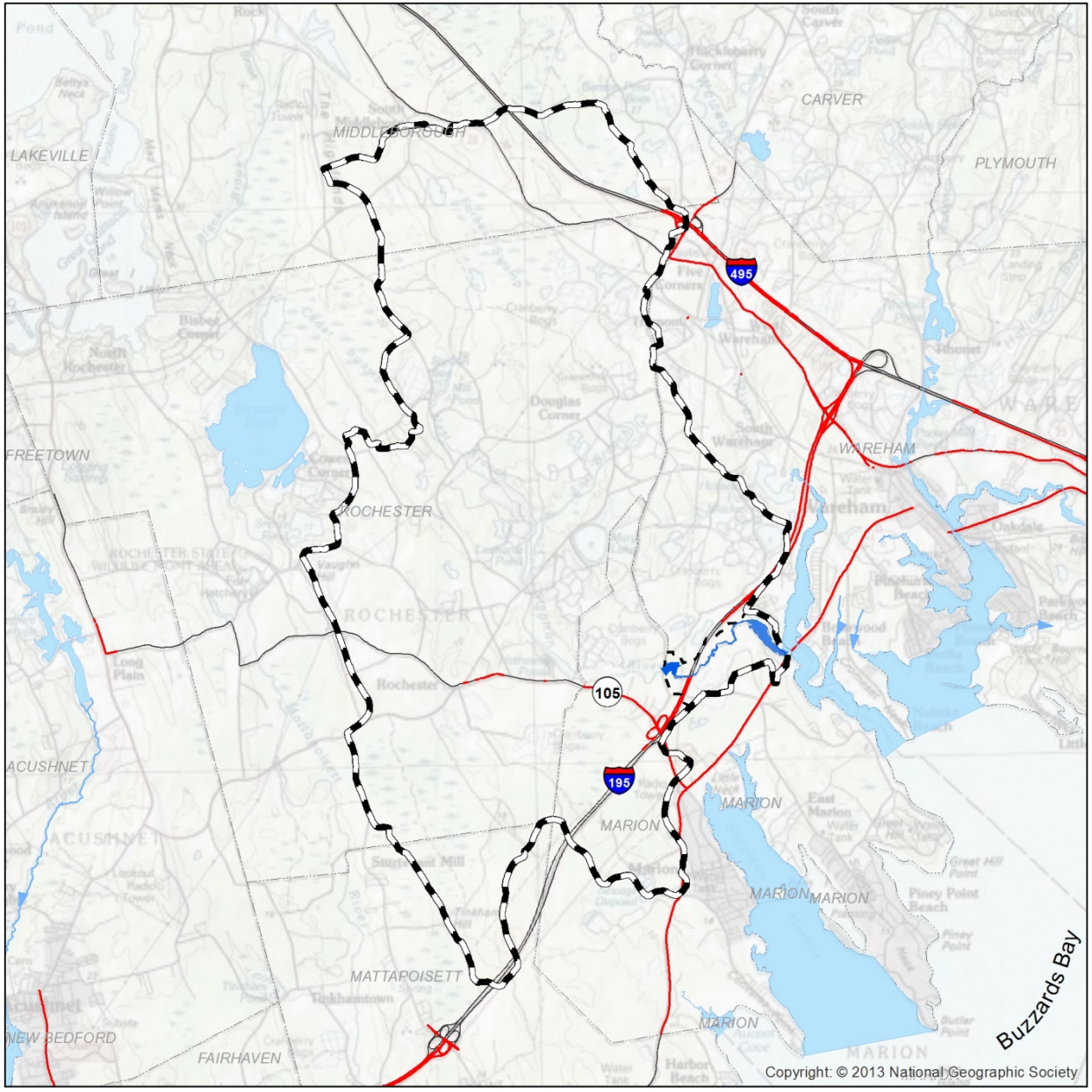
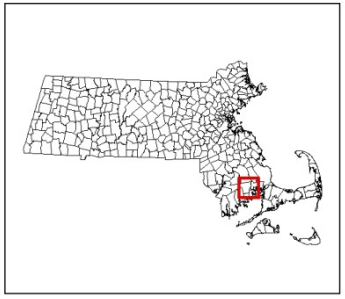




Impaired Water Bodies

Sippican River (MA95-07)

Impaired Streams

Total Watershed

Subwatershed

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

N

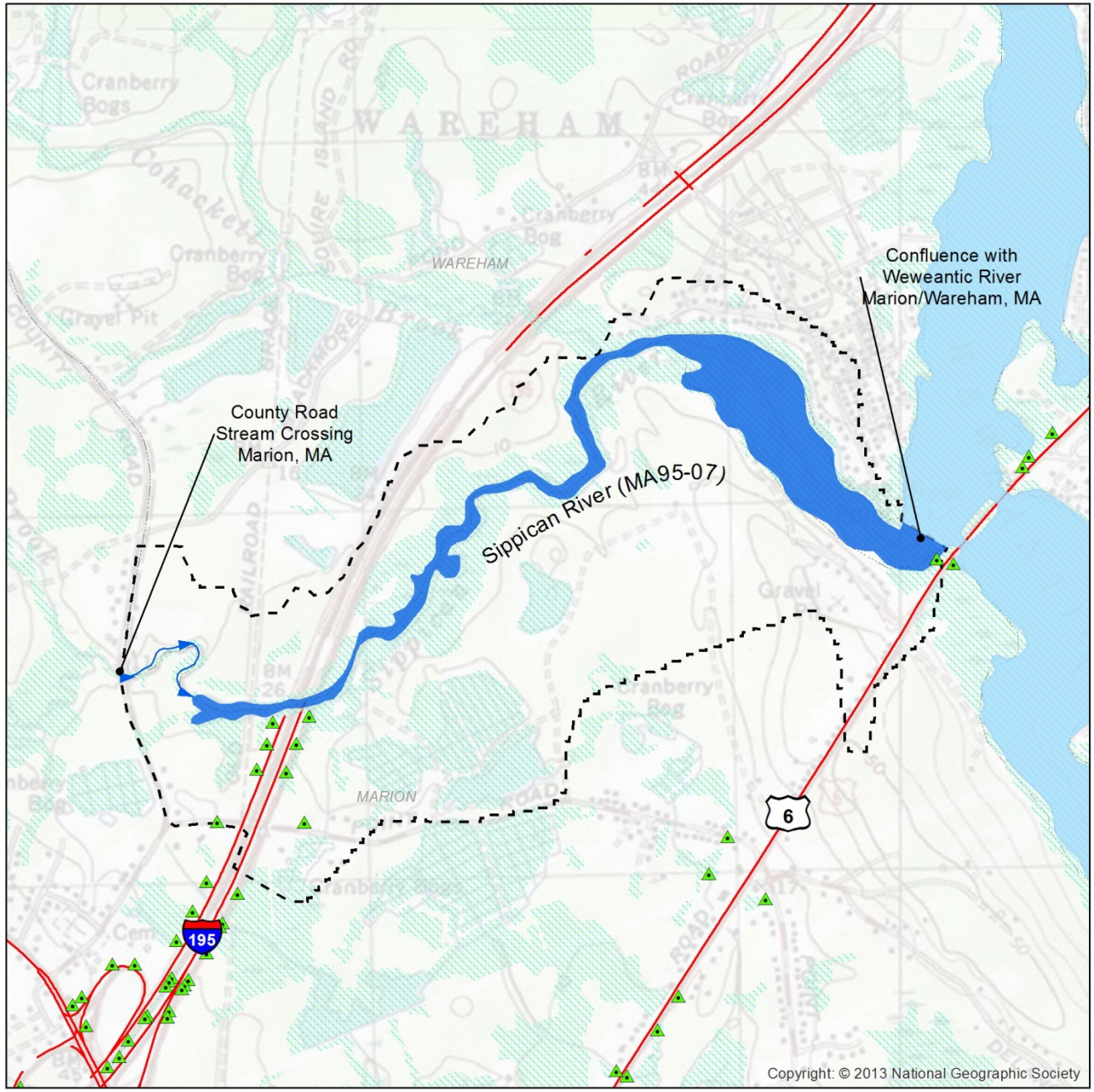
0 1 2 3 4 Miles

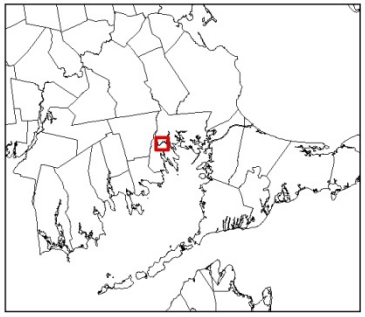
Figure 1

Sippican River (MA95-07) Total Watershed

June 2014

massDOT Massachusetts Department of Transportation Highway Division





MassDOT Outfalls
MA95-07
Impaired Streams
Impaired Water Bodies
MA95-07
Subwatershed
NWI Wetland Areas
MassDOT Roads in Urban Areas
Town Boundaries

N

0 0.2 0.4 Miles

Figure 2

Sippican River (MA95-07) Subwatershed

June 2014

massDOT Massachusetts Department of Transportation Highway Division

Impaired Waters Assessment for Buttonwood Brook (MA95-13)

Impaired Water Body

Name: Buttonwood Brook

Location: New Bedford and Dartmouth, MA

Water Body ID: MA95-13

Impairments

Buttonwood Brook (MA95-13) is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Buttonwood Brook is impaired for the following:

- Fecal Coliform

According to MassDEP's *Buzzards Bay Watershed 2000 Water Quality Assessment Report* (MassDEP, 2003), Buttonwood Brook (MA95-13) is impaired due to elevated total fecal coliform bacteria. The Buttonwood Park Zoo which is situated along the brook is a suspected source of pathogens. Due to the lack of available data, designated uses for Buttonwood Brook have not been assessed (MassDEP, 2003). Buttonwood Brook is covered by the *Final Pathogen Total Maximum Daily Load (TMDL) for the Buzzards Bay Watershed* (MassDEP, 2009a).

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

Buttonwood Brook (MA95-13) is approximately 3.8 miles long, extending from its headwaters in New Bedford south to its confluence with Apponagansett Bay in Dartmouth, Massachusetts. There are no documented point-source discharges to this brook other than those covered under the New Bedford and Dartmouth MS4 NPDES Phase II stormwater permits.

The total and subwatershed for Buttonwood Brook is an approximately 3.0 square mile area consisting of high to medium density residential areas with some forested and park areas. Refer to Figure 1 for the total and subwatersheds of Buttonwood Brook.

MassDOT's property with the potential to directly contribute stormwater runoff to Buttonwood Brook (MA95-13) is comprised of portions of Interstate 195, US Route 6 and State Route 140. Refer to Figure 1 for the locations of these roads within the subwatershed of Buttonwood Brook.

BMP 7R for Pathogen TMDL (CN 251.1)

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP), which applies to impairments that have been assigned to a water body covered by a final TMDL (MassDOT, 2012). Buttonwood Brook is covered by the *Final Pathogen TMDL for the Buzzards Bay Watershed* (MassDEP, 2009a).

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 (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, 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 *Final Pathogen Total Maximum Daily Load (TMDL) for the Buzzards Bay Watershed (CN 251.1)* covers the rivers, estuary areas, and tributaries of the Buzzards Bay Watershed, including the Buttonwood Brook. Groundwater seepage also enters the Bay (Mass DEP, 2009a).

The Buzzards Bay watershed has no documented point sources of bacteria pollution. Suspected dry-weather sources of bacteria reported in the TMDL report include illicit sewer connections, failing septic systems, and direct wildlife, while suspected and known wet-weather sources reported include sanitary sewer overflows, combined sewer overflows, failing septic systems, and stormwater runoff including MS4s. Specific potential sources of bacterial pollution to segment MA95-13 of Buttonwood Brook are unknown (MassDEP, 2009a).

In an effort to eliminate bacteria sources, segments of the Buzzards Bay Watershed were prioritized based on a number of considerations, including value as a shellfish resource, existing fecal coliform

concentration in receiving water, and proximity to swimming beaches. Buttonwood Brook is listed as a low priority due to lack of data. It is suspected that elevated dry-weather bacteria concentrations indicate illicit sewer connections or failing septic systems, and these sources should be eliminated (MassDEP, 2009a).

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.

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 *Final Pathogen TMDL for the Buzzards Bay Watershed* (Section 8.0-8.9) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems
- Non-structural practices (street sweeping and/or managerial strategies)
- Controls for agricultural runoff, such as improved grazing management

The 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 specifically identified as being ongoing and/or planned in order to meet the *Final Pathogen TMDL for the Buzzards Bay Watershed*:

- Agricultural BMPs
- Septic tank controls
- Documentation of storm drain outfall locations
- Recreational Waters use management
- Watershed resident education
- Additional monitoring

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 accordance with the BMPs identified in the TMDL report as planned measures to reach compliance with the Buzzards Bay pathogen TMDL report, 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 targeted 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.

Although the TMDL report also identifies the benefits of structural BMPs to address runoff from impervious areas in some instances, MassDOT feels that it is not a beneficial approach to implement these 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 towards 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, and the Final Pathogen TMDL for this impaired water body segment, 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.

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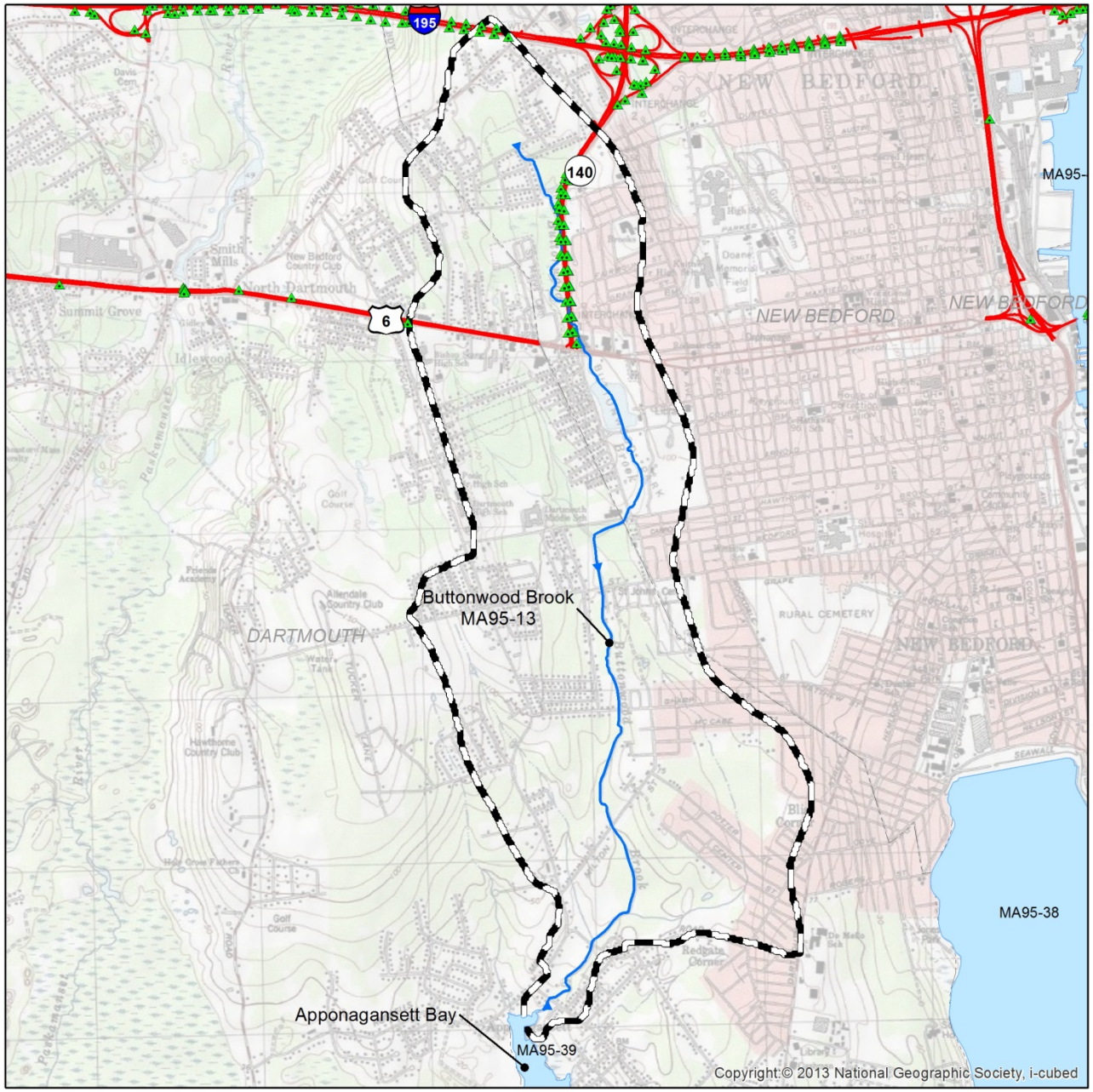

MassDOT Outfalls

Buttonwood Brook (MA95-13)

Impaired Stream Segment

Impaired Water Body

Total and Subwatershed

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

N

0 3,500 7,000 Feet

Figure 1

Buttonwood Brook (MA95-13) Total and Subwatersheds

June 2014

massDOT Massachusetts Department of Transportation Highway Division

Impaired Waters Assessment for Cape Cod Canal (MA95-14)

Impaired Water Body

Name: Cape Cod Canal

Location: Bourne and Sandwich, MA

Water Body ID: MA95-14

Impairments

Cape Cod Canal (MA95-14) is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Cape Cod Canal is impaired for the following:

- Fecal Coliform

According to MassDEP's *Buzzards Bay Watershed 2000 Water Quality Assessment Report* (MassDEP, 2003), 0.46 square miles of Cape Cod Canal (MA95-14) is impaired for shellfish harvesting due to elevated total fecal coliform bacteria. Specific sources are not identified; however, there are permitted wastewater and stormwater discharges into this water body. Designated use for shellfish harvesting is supported in 0.67 square miles of this water body, and 0.67 square miles supports primary and secondary contact uses, whereas the remaining 0.46 square miles is not assessed (Mass DEP, 2003). Cape Cod Canal is covered by the *Final Pathogen Total Maximum Daily Load (TMDL) for the Buzzards Bay Watershed* (MassDEP, 2009a).

Relevant Water Quality Standards

Water Body Classification: Class SB

Applicable State Regulations:

- 314 CMR 4.05 (4)(b) 4 Bacteria.
    - a. Waters designated for shellfishing shall not exceed a fecal coliform median or geometric mean MPN of 88 organisms per 100 ml, nor shall more than 10% of the samples exceed an MPN of 260 per 100 ml or other values of equivalent protection based on sampling and analytical methods used by the Massachusetts Division of Marine Fisheries and approved by the National Shellfish Sanitation Program in the latest revision of the *Guide For The Control of Molluscan Shellfish* (more stringent regulations may apply, see 314 CMR 4.06(1)(d)(5)).
    - b. at bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.010, no single enterococci sample taken during the bathing season shall exceed 104 colonies per 100 ml and the geometric mean of the five most recent samples taken within the same bathing season shall not exceed 35 enterococci colonies per 100 ml. In non bathing beach waters and bathing beach waters during the non bathing season, no single enterococci sample shall exceed

104 colonies per 100 ml and the geometric mean of all of the samples taken during the most recent six months typically based on a minimum of five samples shall not exceed 35 enterococci colonies per 100 ml. These criteria may be applied on a seasonal basis at the discretion of the Department.

Site Description

The Cape Cod Canal (MA95-14) extends 7.4 miles from Buzzards Bay to Cape Cod Bay through the Towns of Bourne and Sandwich, Massachusetts. The water body has a surface area of approximately 1.13 square miles and is approximately 700 feet wide and 32 feet deep (MassDEP, 2003).

Stormwater and wastewater discharges into this water body are permitted from Mirant Canal, L.L.C. (treated wastewater and stormwater), Massachusetts Maritime Academy (treated sanitary wastewater), and MS4 stormwater from Bourne and Sandwich. Due to the lack of available data, aquatic life use for Cape Cod Canal has not been assessed (MassDEP, 2003).

The watersheds and subwatersheds for Cape Cod were provided by USGS based on groundwater modeling developed under the Massachusetts Estuary Program (MEP) and contributing groundwater areas as delineated and published in the USGS 451 groundwater contributing areas data (Walter, et al., 2004; USGS 2009). The Cape Cod watersheds are based on groundwater delineations and not ground surface topography (USGS, 2009). The watershed for Cape Cod Canal is an approximately 21.8 square mile area consisting primarily of undeveloped forested areas with areas of residential and commercial development near the Bourne and Sagamore Bridges. Refer to Figure 1 for the watershed of Cape Cod Canal.

MassDOT's property with the potential to contribute stormwater runoff to Cape Cod Canal (MA95-14) is comprised of portions of US Route 6 and State Routes 3, 25, 28 and 130. Refer to Figure 1 for the locations of these roads within the Cape Cod Canal subwatershed.

BMP 7R for Pathogen TMDL (CN 251.1)

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP), which applies to impairments that have been assigned to a water body covered by a final TMDL (MassDOT, 2012). Cape Cod Canal is covered by the *Final Pathogen TMDL for the Buzzards Bay Watershed* (MassDEP, 2009a).

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 (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, 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 *Final Pathogen Total Maximum Daily Load (TMDL) for the Buzzards Bay Watershed (CN 251.1)* covers the rivers, estuary areas, and tributaries of the Buzzards Bay Watershed, including Cape Cod Canal. Groundwater seepage also enters the Bay (Mass DEP, 2009a).

The Buzzards Bay watershed has no documented point sources of bacteria pollution. Suspected dry-weather sources of bacteria reported in the TMDL report include illicit sewer connections, failing septic systems, and direct wildlife, while suspected and known wet-weather sources reported include sanitary sewer overflows, combined sewer overflows, failing septic systems, and stormwater runoff including MS4s. Boats and MS4s are specifically mentioned as potential sources of bacterial pollution to segment MA95-14 of Cape Cod Canal (MassDEP, 2009a).

In an effort to eliminate bacteria sources, segments of the Buzzards Bay Watershed were prioritized based on a number of considerations, including value as a shellfish resource, existing fecal coliform concentration in receiving water, and proximity to swimming beaches. Cape Cod Canal (MA95-14) is listed as a medium priority due to its value as a resource for shellfishing. It is suspected that elevated dry-weather bacteria concentrations indicate illicit sewer connections or failing septic systems, and these sources should be eliminated (MassDEP, 2009a).

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.

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 *Final Pathogen TMDL for the Buzzards Bay Watershed* (Sections 8.0-8.9) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems
- Non-structural practices (street sweeping and/or managerial strategies)
- Controls for agricultural runoff, such as improved grazing management

The 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 specifically identified as being ongoing and/or planned in order to meet the *Final Pathogen TMDL for the Buzzards Bay Watershed*:

- Agricultural BMPs
- Septic tank controls

- Documentation of storm drain outfall locations
- Recreational Waters use management
- Watershed resident education
- Additional monitoring

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 accordance with the BMPs identified in the TMDL report as planned measures to reach compliance with the Buzzards Bay pathogen TMDL report, MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program, MassDOT has identified three (3) MassDOT targeted rest stops located within the subwatershed of this water body on the east bound lane of US Route 6 on the northwestern side of the canal. The MassDOT facility ID's of these rest stops are 464, 465, and 466. 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.

Although the TMDL report also identifies the benefits of structural BMPs to address runoff from impervious areas in some instances, MassDOT feels that it is not a beneficial approach to implement these 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 towards 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, and the Final Pathogen TMDL for this impaired water body segment 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.

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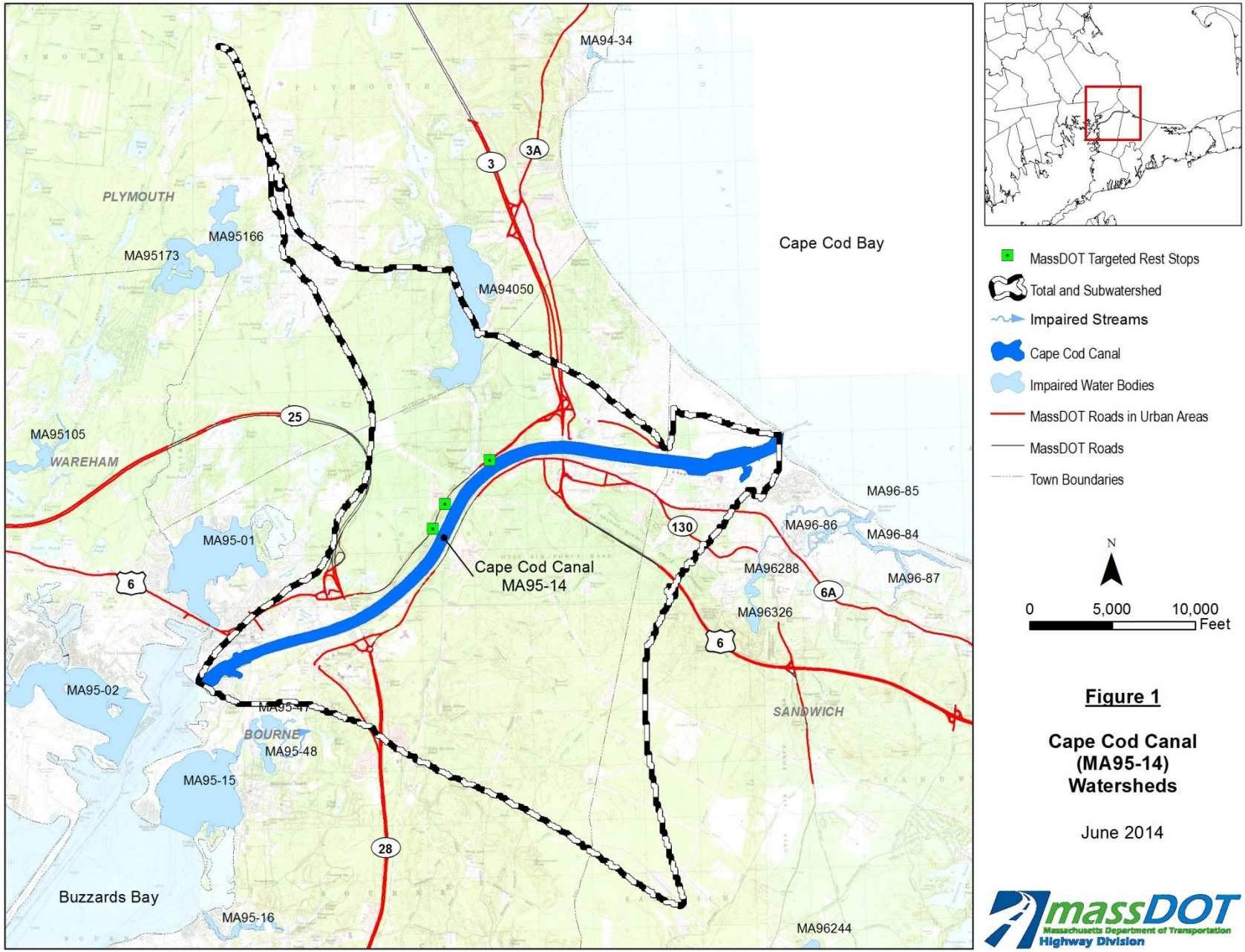

Figure 1

Cape Cod Canal (MA95-14) Watersheds

June 2014

Impaired Waters Assessment for Red Brook Harbor (MA95-18)

Impaired Water Body

Name: Red Brook Harbor

Location: Bourne, MA

Water Body ID: MA95-18

Impairments

Red Brook Harbor (MA95-18) is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Red Brook Harbor is impaired for the following:

- Fecal Coliform

According to MassDEP's *Buzzards Bay Watershed 2000 Water Quality Assessment Report* (MassDEP, 2003), 0.11 square miles of Red Brook Harbor (MA95-18) is impaired for shellfish harvesting due to elevated total fecal coliform bacteria, and 0.80 square miles support the shellfish harvesting designated use. The sources are unknown; however, suspected sources include on-site treatment systems, highway/road runoff, and municipal separate storm sewer systems (MassDEP, 2003). The aquatic life use has not been assessed due to the lack of available data. Red Brook Harbor is covered by the *Final Pathogen Total Maximum Daily Load (TMDL) for the Buzzards Bay Watershed* (MassDEP, 2009a).

Relevant Water Quality Standards

Water Body Classification: Class SA

Applicable State Regulations:

- 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 Red Brook Harbor (MA95-18) extends from its confluence with Pocasset Harbor, between the northern portion of Bassetts Island and Patuisett, to its mouth at Buzzards Bay between, Bassetts Island and Scraggy Neck, Bourne. Red Brook Harbor has a surface area of approximately 0.91 square miles. There are no documented point-source discharges to this harbor other than those covered under the Bourne MS4 NPDES Phase II stormwater permit.

The watersheds for Cape Cod were provided by USGS based on groundwater modeling developed under the Massachusetts Estuary Program (MEP) and contributing groundwater areas as delineated and published in the USGS 451 groundwater contributing areas data (Walter, et al., 2004; USGS 2009). The Cape Cod watersheds are based on groundwater delineations and not ground surface topography (USGS, 2009). Refer to Figure 1 for the watershed of Red Brook Harbor.

MassDOT's property with the potential to contribute stormwater runoff to Red Brook Harbor (MA95-18) is comprised of portions of State Routes 28 and 28A. Refer to Figure 1 for the locations of these roads within the watershed of Red Brook Harbor.

BMP 7R for Pathogen TMDL (CN 251.1)

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP) TMDL Watershed Review, which applies to impairments that have been assigned to a water body covered by a final TMDL (MassDOT, 2012). Red Brook Harbor is covered by the *Final Pathogen TMDL for the Buzzards Bay Watershed* (MassDEP, 2009a).

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 (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, 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 *Final Pathogen Total Maximum Daily Load (TMDL) for the Buzzards Bay Watershed (CN 251.1)* covers the rivers, estuary areas, and tributaries of the Buzzards Bay Watershed, including the Red Brook Harbor. Groundwater seepage also enters the Bay (Mass DEP, 2009a).

The Buzzards Bay watershed has no documented point sources of bacteria pollution. Suspected dry-weather sources of bacteria reported in the TMDL report include illicit sewer connections, failing septic systems, and direct wildlife, while suspected and known wet-weather sources reported include sanitary sewer overflows, combined sewer overflows, failing septic systems, and stormwater runoff including MS4s. On-site treatment systems (septic systems), highway/ road runoff, and MS4s are specifically mentioned as potential sources of bacterial pollution to segment MA95-18 of Red Brook Harbor (MassDEP, 2009a).

In an effort to eliminate bacteria sources, segments of the Buzzards Bay Watershed were prioritized based on a number of considerations, including value as a shellfish resource, existing fecal coliform concentration in receiving water, and proximity to swimming beaches. Red Brook Harbor is listed as a medium priority due to its value as a resource for shellfishing and swimming. It is suspected that elevated dry-weather bacteria concentrations indicate illicit sewer connections or failing septic systems, and these sources should be eliminated (MassDEP, 2009a).

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.

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 *Final Pathogen TMDL for the Buzzards Bay Watershed* (Section 8.0-8.9) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems
- Non-structural practices (street sweeping and/or managerial strategies)
- Controls for agricultural runoff, such as improved grazing management

The 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 specifically identified as being ongoing and/or planned in order to meet the *Final Pathogen TMDL for the Buzzards Bay Watershed*:

- Agricultural BMPs
- Septic tank controls
- Documentation of storm drain outfall locations
- Recreational Waters use management
- Watershed resident education

- Additional monitoring

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 accordance with the BMPs identified in the TMDL report as planned measures to reach compliance with the Buzzards Bay pathogen TMDL report, 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 targeted 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.

Although the TMDL report also identifies the benefits structural BMPs to address runoff from impervious areas in some instances, MassDOT feels that it is not a beneficial approach to implement these 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 towards 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, and the *Final Pathogen TMDL for the Buzzards Bay Watershed*, 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.

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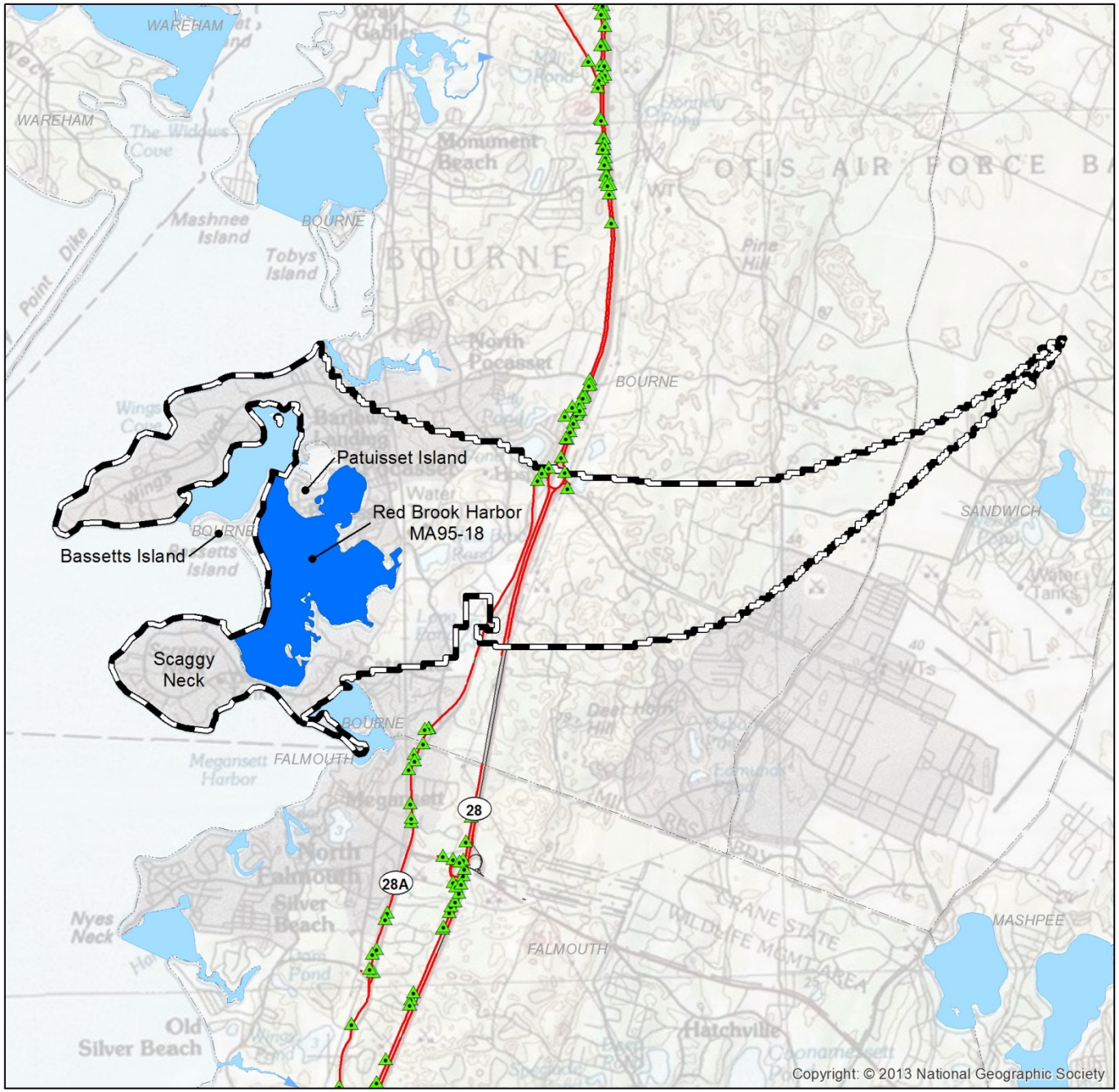

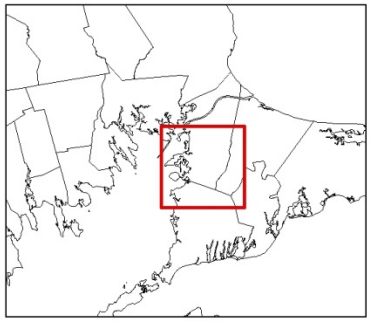

MassDOT Outfalls

Groundwatershed

Impaired Streams

Red Brook Harbor

Impaired Water Bodies

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

N

0 3,000 6,000 Feet

Figure 1

Red Brook Harbor (MA95-18) Groundwatershed

June 2014

massDOT Massachusetts Department of Transportation Highway Division

Impaired Waters Assessment for Wild Harbor (MA95-20)

Impaired Water Body

Name: Wild Harbor

Location: Falmouth, MA

Water Body ID: MA95-20

Impairments

Wild Harbor (MA95-20) is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Wild Harbor is impaired for the following:

- Fecal Coliform

According to MassDEP's *Buzzards Bay Watershed 2000 Water Quality Assessment Report* (MassDEP, 2003), Wild Harbor (MA95-20) is impaired for shellfish harvesting due to elevated total fecal coliform bacteria. The sources are unknown, however, suspected sources include on-site treatment systems, spill related impact, highway/road runoff, and municipal separate storm sewer systems (MS4s) (MassDEP, 2009a). The aquatic life use has not been assessed. Wild Harbor is covered by the *Final Pathogen Total Maximum Daily Load (TMDL) for the Buzzards Bay Watershed* (MassDEP, 2009a).

Relevant Water Quality Standards

Water Body Classification: Class SA

Applicable State Regulations:

- 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

Wild Harbor is mainly fed by Wild Harbor River (MA95-68) and is part of Buzzards Bay. This segment is considered an embayment with salt marsh ringing the edges, and includes an area of approximately 0.14 square miles. The embayment extends from Point Road, Nyes Neck to Crow Point at the end of Bay Shore Drive in North Falmouth. There are no known discharges other than MS4s; the Town of Falmouth has applied for coverage of these discharges under the general NPDES permit (MassDEP, 2009a). New Silver Beach is a public beach located on the shore of Wild Harbor (MassDEP, 2003).

The watersheds for Cape Cod were provided by USGS based on groundwater modeling developed under the Massachusetts Estuary Program (MEP) and contributing groundwater areas as delineated and published in the USGS 451 groundwater contributing areas data (Walter, et al., 2004; USGS 2009). The Cape Cod watersheds are based on groundwater delineations and not ground surface topography (USGS, 2009). Refer to Figure 1 for the watershed to Segment MA95-20 of Wild Harbor.

MassDOT's property with the potential to contribute stormwater runoff to Segment MA95-20 of Wild Harbor is comprised of portions of Routes 28 and 28A. Refer to Figure 1 for the location of these roadways within the watershed to Segment MA95-20 of Wild Harbor.

BMP 7R for Pathogen TMDL (CN 251.1)

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP), which applies to impairments that have been assigned to a water body covered by a final TMDL (MassDOT, 2012). Wild Harbor is covered by the *Final Pathogen TMDL for the Buzzards Bay Watershed* (MassDEP, 2009a).

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 (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, 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 *Final Pathogen Total Maximum Daily Load (TMDL) for the Buzzards Bay Watershed (CN: 251.1)* covers the rivers, estuary areas, and tributaries of the Buzzards Bay Watershed, including Wild Harbor. Groundwater seepage also enters the Bay (MassDEP, 2009a).

The Buzzards Bay watershed has no documented point sources of bacteria pollution. Suspected dry-weather sources of bacteria reported in the TMDL report include illicit sewer connections, failing septic systems, and direct wildlife, while suspected and known wet-weather sources reported include sanitary sewer overflows, combined sewer overflows, failing septic systems, and stormwater runoff including MS4s. On-site treatment systems (septic systems), highway/road runoff, and MS4s are specifically mentioned as potential sources of bacterial pollution to segment MA95-20 of Wild Harbor (MassDEP, 2009a).

In an effort to eliminate bacteria sources, segments of the Buzzards Bay Watershed were prioritized based on a number of considerations, including value as a shellfish resource, existing fecal coliform concentration in receiving water, and proximity to swimming beaches. Wild Habor is listed as a medium priority due to its value as a shellfish resource. It is suspected that elevated dry-weather bacteria concentrations indicate illicit sewer connections or failing septic systems, and these sources should be eliminated (MassDEP, 2009a).

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.

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 *Final Pathogen TMDL for the Buzzards Bay Watershed* (Section 8.0-8.9) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems
- Non-structural practices (street sweeping and/or managerial strategies)
- Controls for agricultural runoff, such as improved grazing management

The 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 specifically identified as being ongoing and/or planned in order to meet the *Final Pathogen TMDL for the Buzzards Bay Watershed*:

- Agricultural BMPs
- Septic tank controls
- Documentation of storm drain outfall locations
- Recreational Waters use management
- Watershed resident education
- Additional monitoring

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 accordance with the BMPs identified in the TMDL report as planned measures to reach compliance with the Buzzards Bay pathogen TMDL report, 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 targeted 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.

Although the TMDL report also identifies the benefits of structural BMPs to address runoff from impervious areas in some instances, MassDOT feels that it is not a beneficial approach to implement these 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 towards 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, and the Final Pathogen TMDL for this impaired water body segment 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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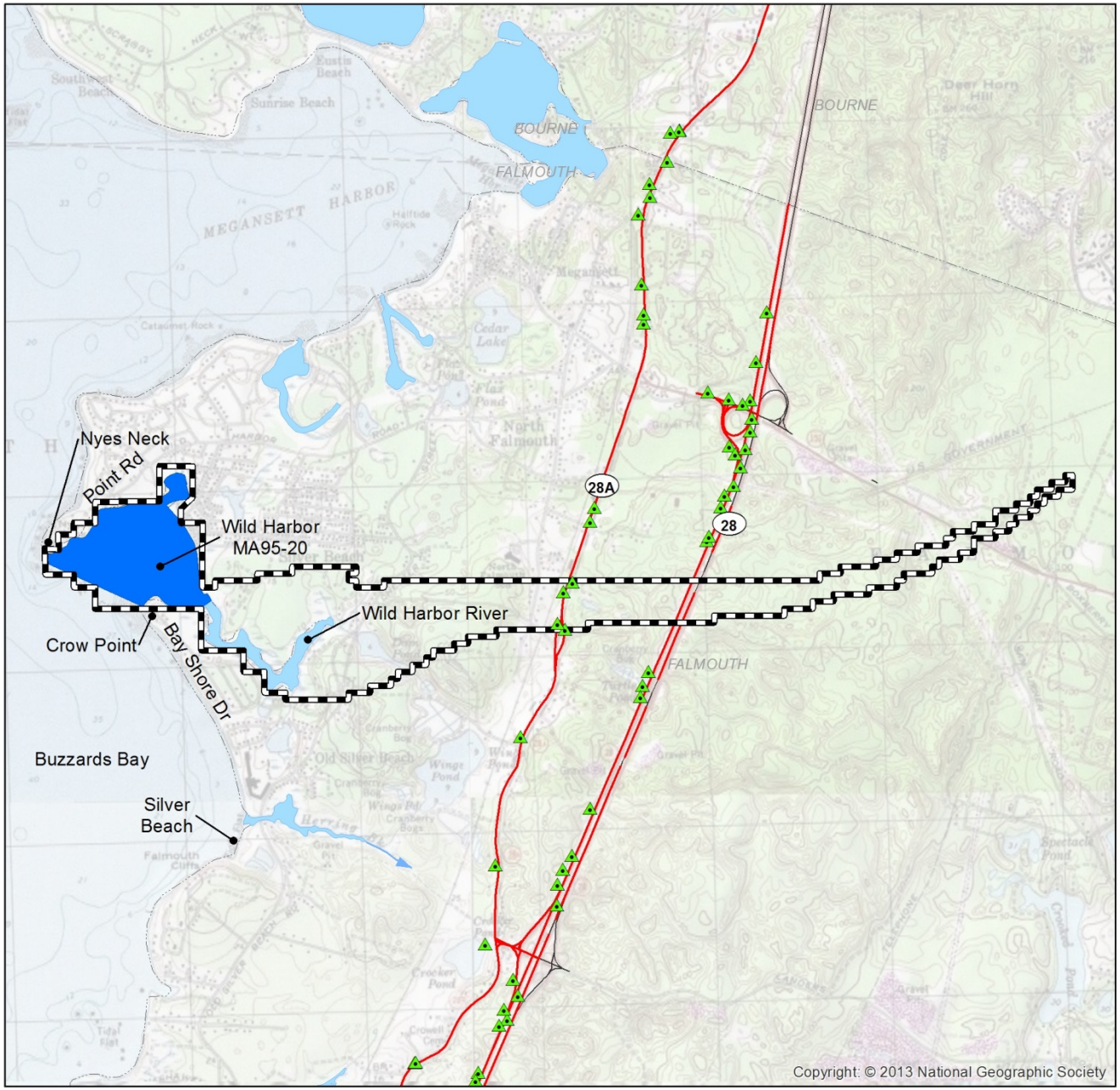

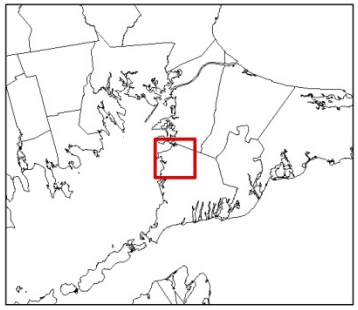

MassDOT Outfalls
Groundwatershed
Impaired Streams
Wild Harbor
Impaired Water Bodies
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

N

0 1,500 3,000 Feet

Figure 1
Wild Harbor (MA95-20)
Groundwatershed

June 2014

massDOT
Massachusetts Department of Transportation
Highway Division

Impaired Waters Assessment for Quissett Harbor (MA95-25)

Impaired Water Body

Name: Quissett Harbor

Location: Falmouth, MA

Water Body ID: MA95-25

Impairments

Quissett Harbor (MA95-25) is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Quissett Harbor is impaired for the following:

- Fecal Coliform

According to MassDEP's *Buzzards Bay Watershed 2000 Water Quality Assessment Report* (MassDEP, 2003), Quissett Harbor (MA95-25) is impaired for shellfish harvesting due to elevated total fecal coliform bacteria. The sources are unknown, however, suspected sources include on-site treatment systems and road runoff. The aquatic life use has not been assessed. Quissett Harbor is covered by the *Final Pathogen Total Maximum Daily Load (TMDL) for the Buzzards Bay Watershed* (MassDEP, 2009a).

Relevant Water Quality Standards

Water Body Classification: Class SA

Applicable State Regulations:

- 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

Quissett Harbor is the semi-enclosed water body between the Knob and Gansett Point in Falmouth (MassDEP, 2013). The segment is approximately 0.2 square miles. There are no known discharges other than MS4s; the Town of Falmouth has applied for coverage for these discharges under the general NPDES permit (MassDEP, 2009a).

The watersheds and subwatersheds for Cape Cod were provided by USGS based on groundwater modeling developed under the Massachusetts Estuary Program (MEP) and contributing groundwater areas as delineated and published in the USGS 451 groundwater contributing areas data (Walter, et al., 2004; USGS 2009). The Cape Cod watersheds are based on groundwater delineations and not ground surface topography (USGS, 2009). Refer to Figure 1 for the watershed to Segment MA95-25 of Quissett Harbor.

MassDOT's property with the potential to directly contribute stormwater runoff to Segment MA95-25 of Quissett Harbor is comprised of portions of Woods Hole Road. Refer to Figure 1 for the location of this roadway within the watershed to Segment MA95-25 of Quissett Harbor.

BMP 7R for Pathogen TMDL (251.1)

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP), which applies to impairments that have been assigned to a water body covered by a final TMDL (MassDOT, 2012). Quissett Harbor is covered by the *Final Pathogen TMDL for the Buzzards Bay Watershed* (MassDEP, 2009a).

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 (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, 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 *Final Pathogen Total Maximum Daily Load (TMDL) for the Buzzards Bay Watershed (CN: 251.1)* covers the rivers, estuary areas, and tributaries of the Buzzards Bay Watershed, including Quissett Harbor. Groundwater seepage also enters the Bay (MassDEP, 2009a).

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specifically mentioned as potential sources of bacterial pollution to segment MA95-25 of Quissett Harbor (MassDEP, 2009a).

In an effort to eliminate bacteria sources, segments of the Buzzards Bay Watershed were prioritized based on a number of considerations, including value as a shellfish resource, existing fecal coliform concentration in receiving water, and proximity to swimming beaches. Quissett Habor is listed as a medium priority due to its value as a shellfish resource. It is suspected that elevated dry-weather bacteria concentrations indicate illicit sewer connections or failing septic systems, and these sources should be eliminated (MassDEP, 2009a).

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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:

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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

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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, and the Final Pathogen TMDL for this impaired water body segment 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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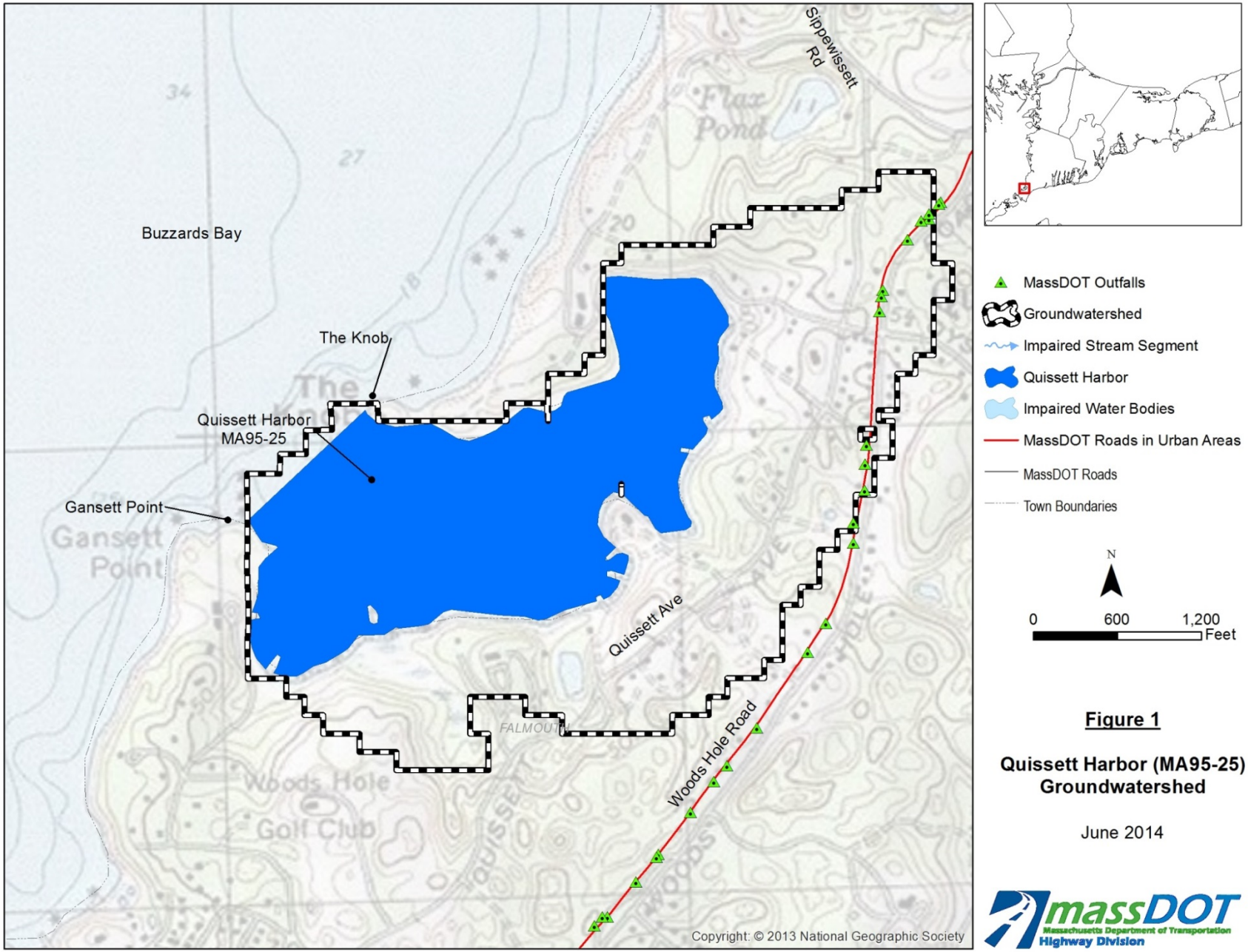

Figure 1

Quissett Harbor (MA95-25) Groundwatershed

June 2014

Impaired Waters Assessment for East Branch Westport River (MA95-40)

Impaired Water Body

Name: East Branch Westport River

Location: Dartmouth and Westport, MA

Water Body ID: MA95-40

Impairments

East Branch Westport River (MA95-40) is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). East Branch Westport River is impaired for the following:

- Fecal Coliform

According to MassDEP's *Buzzards Bay Watershed 2000 Water Quality Assessment Report* (MassDEP, 2003), East Branch Westport River (MA95-40) is impaired for primary contact due to elevated total fecal coliform bacteria. A 0.32 mile stretch of the river is also impaired for secondary contact. The sources are unknown, however, suspected sources include potential illicit connections of municipal separate storm sewer systems (MS4s), highway/road runoff, and animal feeding operations. The aquatic life use has not been assessed. East Branch Westport River is covered by the *Final Pathogen Total Maximum Daily Load (TMDL) for the Buzzards Bay Watershed* (MassDEP, 2009a).

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

East Branch Westport River flows from the outlet at Noquochoke Lake in Dartmouth to the Old County Road Bridge in Westport. The segment is approximately 2.9 miles.

Both the total and subwatershed for Segment MA95-40 of East Branch Westport River include portions of Routes 6, 177, and Interstate 195, each of which contain several commercial properties. Refer to Figure 1 for the total watershed and Figure 2 for the subwatershed to Segment MA95-40 of East Branch Westport River.

MassDOT's property with the potential to directly contribute stormwater runoff to Segment MA95-40 of East Branch Westport River is comprised of portions of Routes 6, 177, and 195. Refer to Figure 2 for the location of these roadways within the subwatershed to Segment MA95-40 of East Branch Westport River.

BMP 7R for Pathogen TMDL (CN 251.1)

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP), which applies to impairments that have been assigned to a water body covered by a final TMDL (MassDOT, 2012). East Branch Westport River is covered by the *Final Pathogen TMDL for the Buzzards Bay Watershed* (MassDEP, 2009a).

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 (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, 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 *Final Pathogen Total Maximum Daily Load (TMDL) for the Buzzards Bay Watershed (CN: 251.1)* covers the rivers, estuary areas, and tributaries of the Buzzards Bay Watershed, including the East Branch of the Westport River. Groundwater seepage also enters the Bay (MassDEP, 2009a).

The Buzzards Bay watershed has no documented point sources of bacteria pollution. Suspected dry-weather sources of bacteria reported in the TMDL report include illicit sewer connections, failing septic systems, and direct wildlife, while suspected and known wet-weather sources reported include sanitary sewer overflows, combined sewer overflows, failing septic systems, and stormwater runoff including MS4s. Animal feeding operations, highway/road runoff, and MS4s are

specifically mentioned as potential sources of bacterial pollution to segment MA95-40 of East Branch Westport River (MassDEP, 2009a).

In an effort to eliminate bacteria sources, segments of the Buzzards Bay Watershed were prioritized based on a number of considerations, including value as a shellfish resource, existing fecal coliform concentration in receiving water, and proximity to swimming beaches. East Branch Westport River is listed as a medium priority. It is suspected that elevated dry-weather bacteria concentrations indicate illicit sewer connections or failing septic systems, and these sources should be eliminated (MassDEP, 2009a).

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.

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 *Final Pathogen TMDL for the Buzzards Bay Watershed* (Section 8.0-8.9) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems
- Non-structural practices (street sweeping and/or managerial strategies)
- Controls for agricultural runoff, such as improved grazing management

The 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 specifically identified as being ongoing and/or planned in order to meet the *Final Pathogen TMDL for the Buzzards Bay Watershed*:

- Agricultural BMPs
- Septic tank controls
- Documentation of storm drain outfall locations
- Recreational Waters use management
- Watershed resident education
- Additional monitoring

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 accordance with the BMPs identified in the TMDL report as planned measures to reach compliance with the Buzzards Bay Pathogen TMDL report, 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 targeted 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.

Although the TMDL report also identifies the benefits of structural BMPs to address runoff from impervious areas in some instances, MassDOT feels that it is not a beneficial approach to implement these 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 towards 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, and the Final Pathogen TMDL for this impaired water body segment 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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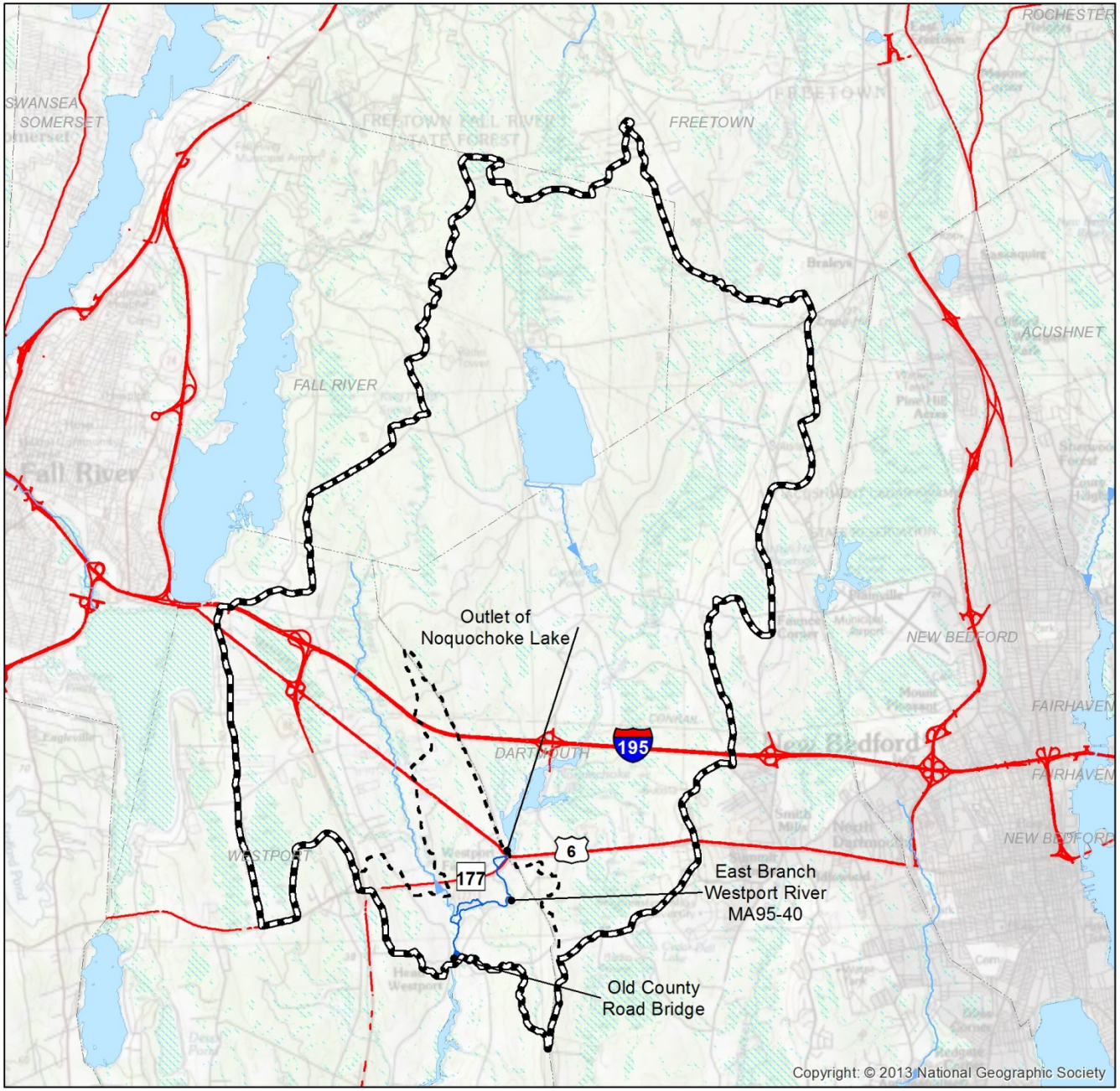
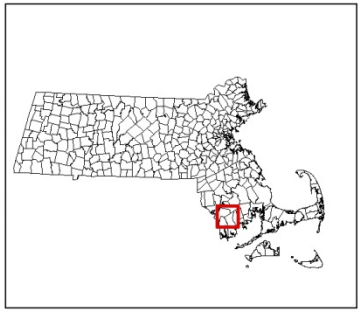




Total Watershed
Subwatershed
Impaired Streams
MA95-40
Impaired Water Bodies
NWI Wetland Areas
MassDOT Roads in Urban Areas
Town Boundaries

N

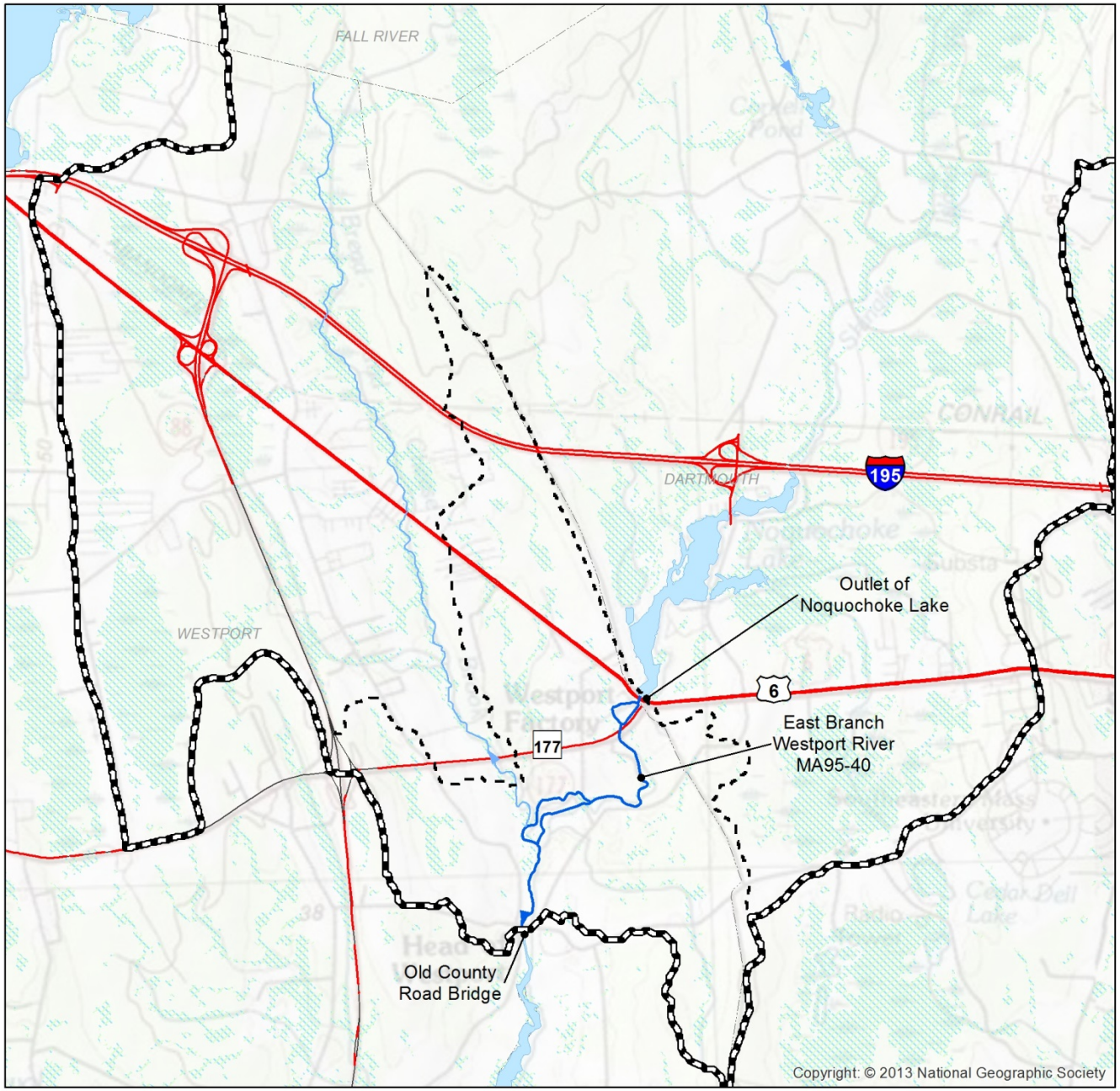
0 0.5 1 2 3
Miles

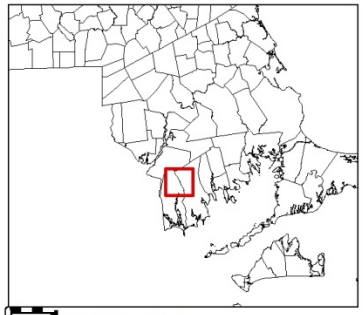
Figure 1

East Branch Westport River (MA95-40) Total Watershed

June 2014

MassDOT
Massachusetts Department of Transportation
Highway Division





Total Watershed
Subwatershed
Impaired Streams
MA95-40
Impaired Water Bodies
MassDOT Roads in Urban Areas
MassDOT Roads
NWI Wetland Areas
Town Boundaries

N

0 0.25 0.5 1
Miles

Figure 2

East Branch Westport River (MA95-40) Subwatershed

June 2014

massDOT
Massachusetts Department of Transportation
Highway Division

Impaired Waters Assessment for Broad Marsh River (MA95-49), Wankinco River (MA95-50), Crooked River (MA95-51), and Cedar Island Creek (MA95-52)

Impaired Water Body

Name: Broad Marsh River, Wankinco River, Crooked River, and Cedar Island Creek

Location: Wareham, MA

Water Body ID: MA95-49, MA95-50, MA95-51, and MA95-52

Impairments

Broad Marsh River (MA95-49), Wankinco River (MA95-50), Crooked River (MA95-51), and Cedar Island Creek (MA95-52) are listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Broad Marsh River, Wankinco River, Crooked River, and Cedar Island Creek are impaired for the following:

- Fecal Coliform

According to MassDEP's *Buzzards Bay Watershed 2000 Water Quality Assessment Report* (MassDEP, 2003), Broad Marsh River (MA95-49), Wankinco River (MA95-50), Crooked River (MA95-51), and Cedar Island Creek (MA95-52) are impaired for shellfish harvesting due to elevated total fecal coliform bacteria; however, the source is unknown. The suspected source reported is potential illicit connections of Municipal Separate Storm Sewer Systems (MS4s). The aquatic life use has not been assessed for any of these water bodies due to limited data being available. Broad Marsh River, Wankinco River, Crooked River, and Cedar Island Creek are covered by the Final Pathogen Total Maximum Daily Load (TMDL) for the Buzzards Bay Watershed (MassDEP, 2009a).

Relevant Water Quality Standards

Water Body Classification: Class SA

Applicable State Regulations:

- 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

Broad Marsh River (MA95-49) flows from its headwaters in a salt marsh south of Marion Road in Wareham, to the confluence with the Wareham River in Wareham. This segment has an area of 0.16 square miles, with an approximate drainage area of 1.2 square miles.

Wankinco River (MA95-50) flows from the Elm Street Bridge to the confluence with the Agawam River near Sandwich Road in Wareham. This segment has an area of 0.05 square miles, with an approximate drainage area of 20.7 square miles.

Crooked River (MA95-51) begins at the outlet of a cranberry bog east of Indian Neck Road and flows to the confluence with the Wareham River in Wareham. This segment has an area of 0.04 square miles, with an approximate drainage area of 0.5 square miles.

Cedar Island Creek (MA95-52) flows from its headwaters near the intersection of Parker Drive and Camardo Drive to its mouth at Marks Cove, in Wareham. This segment has an area of 0.01 square miles, with an approximate drainage area of 0.4 square miles (MassDEP, 2003).

The watersheds and subwatersheds for Cape Cod were provided by USGS based on groundwater modeling developed under the Massachusetts Estuary Program (MEP) and contributing groundwater areas as delineated and published in the USGS 451 groundwater contributing areas data (Walter, et al., 2004; USGS 2009). The Cape Cod watersheds are based on groundwater delineations and not ground surface topography (USGS, 2009). Refer to Figures 1 and 2 for the groundwatershed to Broad Marsh River (MA95-49), Wankinco River (MA95-50), Crooked River (MA95-51), and Cedar Island Creek (MA95-52).

The groundwatershed includes both residential and commercial areas. MassDOT's property with the potential to contribute stormwater runoff to Segments MA95-49 of Broad Marsh River, MA95-50 of Wankinco River, MA95-51 of Crooked River, and/or MA95-52 of Cedar Island Creek is comprised of portions of Route 6, Route 25, Route 28, and Route 195. Refer to Figures 1 and 2 for the location of these roadways in relation to the groundwatershed of the assessed segments.

BMP 7R for Pathogen TMDL (CN 251.1)

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP), which applies to impairments that have been assigned to a water body covered by a final TMDL. Broad Marsh River, Wankinco River, Crooked River, and Cedar Island Creek are covered by the Final Pathogen TMDL for the Buzzards Bay Watershed (MassDEP, 2009a).

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 (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, 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 *Final Pathogen TMDL for the Buzzards Bay Watershed (CN: 251.1)* covers the rivers, estuary areas, and tributaries of the Buzzards Bay Watershed, including Broad Marsh River, the Wankinco River, Crooked River and Cedar Island Creek . Groundwater seepage also enters Buzzards Bay (MassDEP, 2009a).

The Buzzards Bay watershed has no documented point sources of bacteria pollution. Suspected dry-weather sources of bacteria reported in the TMDL report include illicit sewer connections, failing septic systems, and direct wildlife, while suspected and known wet-weather sources reported include sanitary sewer overflows, combined sewer overflows, failing septic systems, and stormwater runoff including MS4s. MS4s are specifically mentioned as potential sources of bacterial pollution to segments MA95-49 of Broad Marsh River, MA95-50 of Wankinco River, MA95-51 of Crooked River, and MA95-52 of Cedar Island Creek (MassDEP, 2009a).

In an effort to eliminate bacteria sources, segments of the Buzzards Bay Watershed were prioritized based on a number of considerations, including value as a shellfish resource, existing fecal coliform concentration in receiving water, and proximity to swimming beaches. Broad Marsh River is listed as a medium priority due to its value as a resource for shellfishing and swimming. Wankinco River, Crooked River, and Cedar Island Creek are listed as medium priorities due to their value as resources for shellfishing. It is suspected that elevated dry-weather bacteria concentrations indicate illicit sewer connections or failing septic systems, and these sources should be eliminated (MassDEP, 2009a).

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.

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 *Final Pathogen TMDL for the Buzzards Bay Watershed* (Section 8.0-8.9) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems

- Non-structural practices (street sweeping and/or managerial strategies)
- Controls for agricultural runoff, such as improved grazing management.

The 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 specifically identified as ongoing and/or planned in order to meet the *Final Pathogen TMDL for the Buzzards Bay Watershed*:

- Agricultural BMPs
- Septic tank controls
- Documentation of storm drain outfall locations
- Recreational waters use management
- Watershed resident education
- Additional monitoring.

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 accordance with the BMPs identified in the TMDL report as planned measures to reach compliance with the Buzzards Bay Pathogen TMDL report, MassDOT has documented the locations of its stormwater outfalls. 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 for this rest stop is 456 and it is located on the northbound side of Route 195 in Wareham. 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.

Although the TMDL report also identifies the benefits of structural BMPs to address runoff from impervious areas in some instances, MassDOT feels that it is not a beneficial approach to implement these 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 towards 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, and the Final Pathogen TMDL for this impaired water body segment, 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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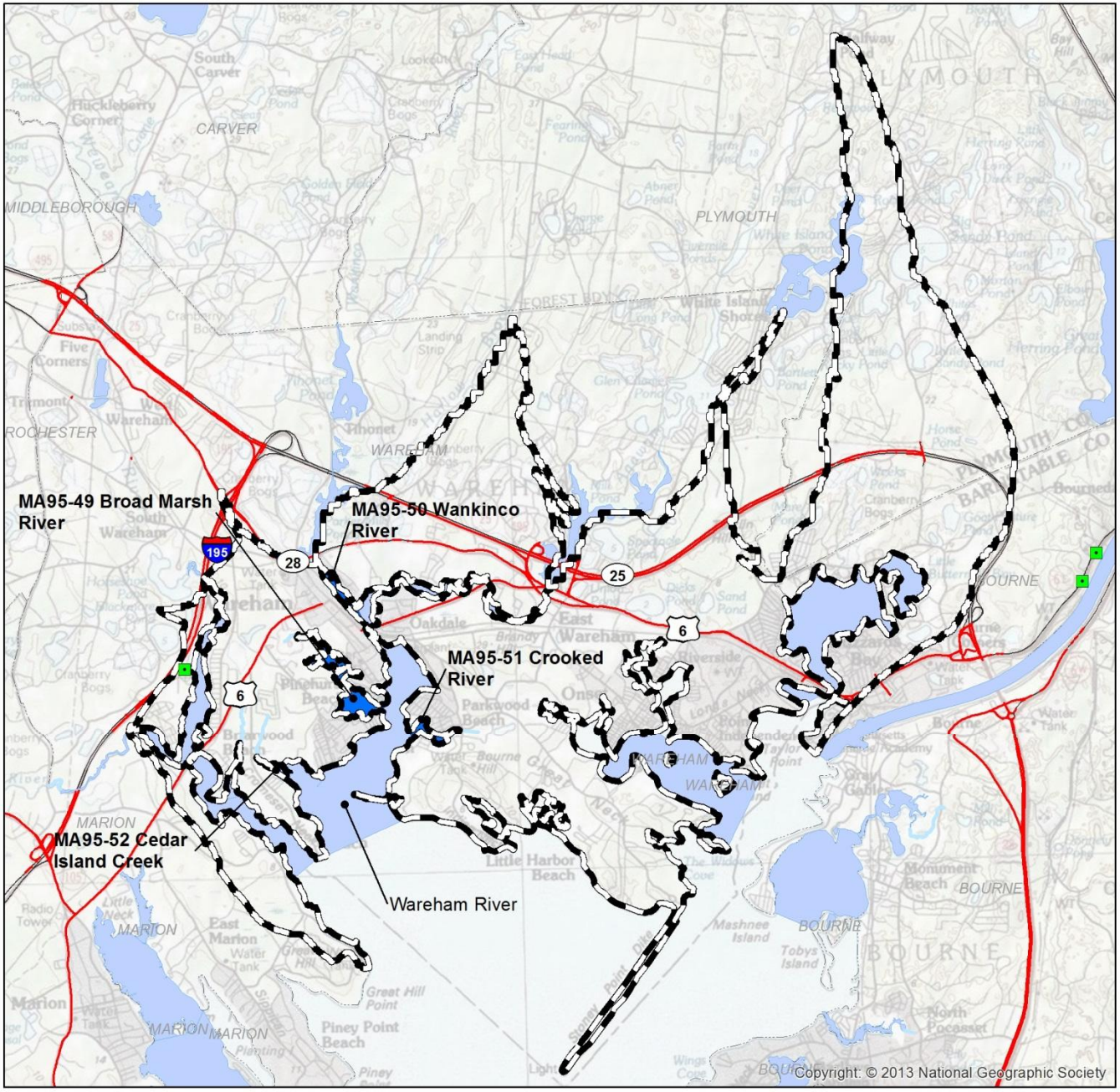
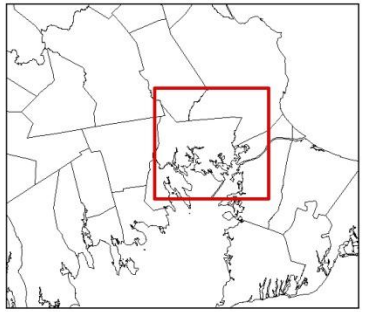




MassDOT Targeted Rest Stops

Groundwatersheds

MassDOT Roads in Urban Areas

Impaired Streams

Assessment Water Bodies

Impaired Water Bodies

MassDOT Roads

Town Boundaries

N

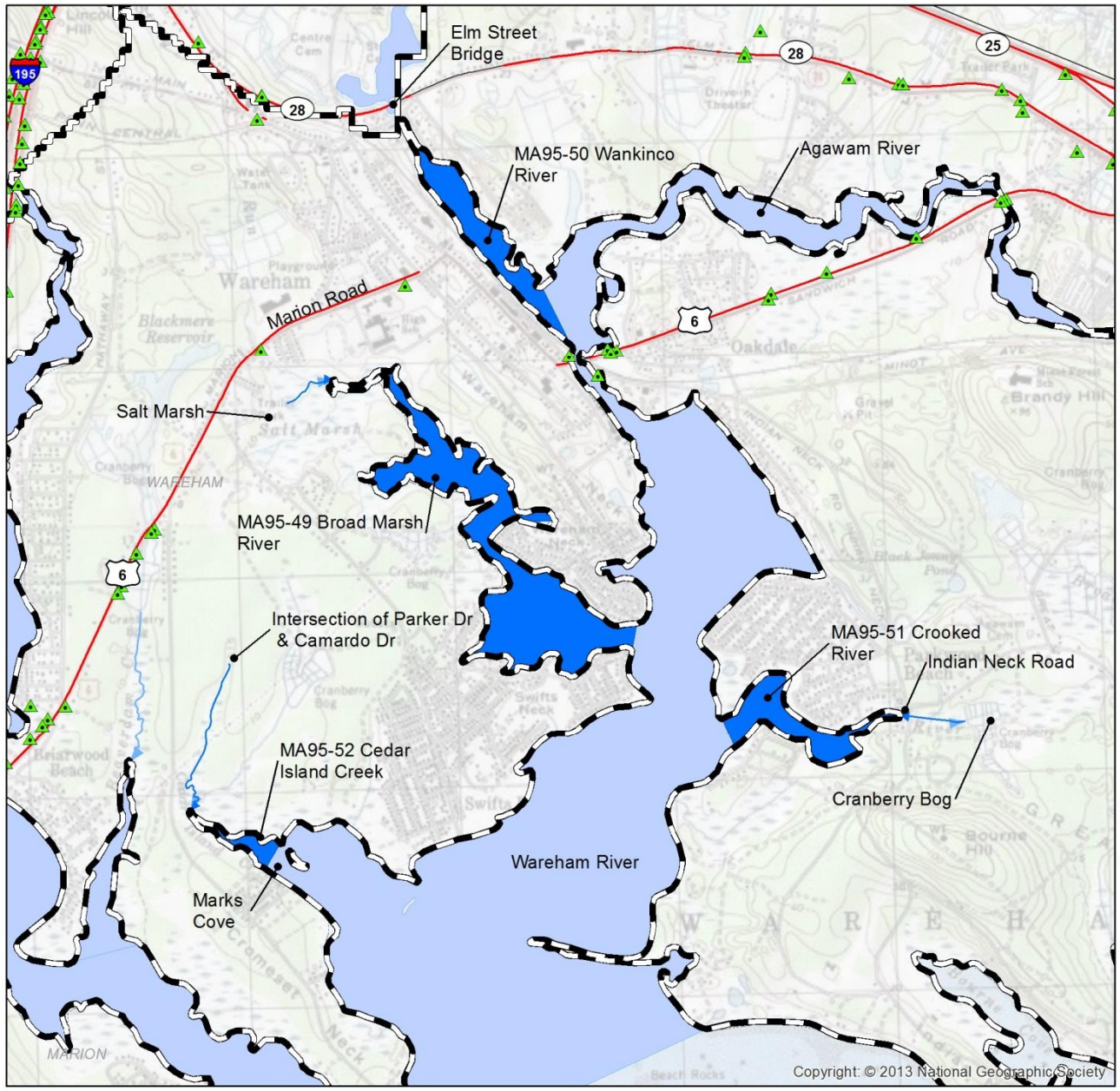
0 0.5 1 2 Miles

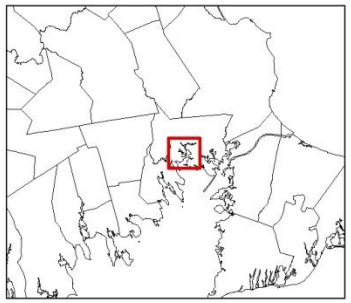
Figure 1

Broad Marsh River (MA95-49), Wankinco River (MA95-50), Crooked River (MA95-51), and Cedar Island Creek (MA95-52) Groundwatersheds

June 2014

massDOT Massachusetts Department of Transportation Highway Division





MassDOT Outfalls
Groundwatersheds
MassDOT Roads in Urban Areas
Assessment Stream Segments
Impaired Streams
Assessment Water Bodies
Impaired Water Bodies
MassDOT Roads
Town Boundaries

N

0 0.15 0.3 0.6 Miles

Figure 2

Broad Marsh River (MA95-49), Wankinco River (MA95-50), Crooked River (MA95-51), and Cedar Island Creek (MA95-52) Groundwatersheds

June 2014

massDOT
Massachusetts Department of Transportation
Highway Division

Impaired Waters Assessment for Bread and Cheese Brook (MA95-58)

Impaired Water Body

Name: Bread and Cheese Brook

Location: Westport, MA

Water Body ID: MA95-58

Impairments

Bread and Cheese Brook (MA95-58) is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Bread and Cheese Brook is impaired for the following:

- Fecal Coliform

According to MassDEP's *Buzzards Bay* Watershed 2000 Water Quality Assessment Report (MassDEP, 2003), Bread and Cheese Brook (MA95-58) is impaired for Primary Contact Recreational Use and Secondary Contact Recreational use due to elevated total fecal coliform bacteria; however, the source is unknown. The aquatic life use has not been assessed due to lack of sufficient data. Bread and Cheese Brook is covered by the *Final Pathogen Total Maximum Daily Load (TMDL) for the Buzzards* Bay Watershed (MassDEP, 2009a).

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

Bread and Cheese Brook is a 4.9 mile long Class B river segment in Westport, running from the headwaters, north of Old Bedford Road, to the brook's confluence with East Branch Westport River (MA21-02).

The Westport River Watershed Association (WRWA) collected bacteria samples from Bread and Cheese Brook at Route 177 between March and October 2001 (MassDEP, 2003). The report states two of 29 total sampling events found high bacterial counts. These sampling events were associated with significant rain events.

Approximately 67% of the drainage area of Bread and Cheese Brook is forest, 20% residential areas, and 5% for agricultural uses (MassDEP, 2003). Livestock pastures were also noted within 200 feet of the brook. Refer to Figure 1 for the total watershed and subwatershed to Bread and Cheese Brook.

MassDOT's property with the potential to directly contribute stormwater runoff to Bread and Cheese Brook is comprised of portions of Route 6, Route 88, Route 177, and I-495. Refer to Figure 1 for the location of these roadways within the watershed to Bread and Cheese Brook.

BMP 7R for Pathogen TMDL (CN 251.1)

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP), which applies to impairments that have been assigned to a water body covered by a final TMDL. Bread and Cheese Brook is covered by the *Final Pathogen TMDL for the Buzzards* Bay Watershed (MassDEP, 2009a).

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 (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, 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 *Final Pathogen Total Maximum Daily Load (TMDL) for the Buzzards Bay Watershed (CN: 251.1)* covers the rivers, estuary areas, and tributaries of the Buzzards Bay Watershed, including the Bread and Cheese Brook. Groundwater seepage also enters the Bay (MassDEP, 2009a).

The Bread and Cheese Brook has no documented point sources of bacteria pollution but numerous non-point contributions are identified as suspects in the TMDL report (Mass DEP, 2009a). Three suspected bacteria sources are identified in the TMDL: agricultural runoff (due to livestock contributions), municipal separate storm sewer systems, and highway/ road runoff. The report states that there were 2 sampling events (of the 29 total sampling events) that found high bacterial counts. These sampling events were associated with significant rain events.

In an effort to eliminate bacteria sources, segments of the Buzzards Bay Watershed were prioritized based on a number of considerations, including value as a shellfish resource, existing fecal coliform concentration in receiving water, and proximity to swimming beaches. Bread and Cheese Brook is listed as a medium priority. It is suspected that elevated dry-weather bacteria concentrations indicate illicit sewer connections or failing septic systems, and these sources should be eliminated (MassDEP, 2009a).The *Bacteria Total Maximum Daily Load (TMDL) for the Buzzards Bay Watershed (CN 251.1)* covers the Bread and Cheese Brook and surrounding streams (Mass DEP, 2009a).

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.

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 *Final Pathogen TMDL for the Buzzards Bay Watershed* (Section 8.0-8.9) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems
- Non-structural practices (street sweeping and/or managerial strategies)
- Controls for agricultural runoff, such as improved grazing management

The 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 specifically identified as being ongoing and/or planned in order to meet the *Final Pathogen TMDL for the Buzzards Bay Watershed*:

- Agricultural BMPs
- Septic tank controls
- Documentation of storm drain outfall locations
- Recreational Waters use management
- Watershed resident education

- Additional monitoring

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:

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- BMP 3C-2: Drainage Tie-In Standard Operating Procedure
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- BMP 5H-1: Post Construction Runoff Enforcement – Illicit Discharge Prohibition
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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 accordance with the BMPs identified in the TMDL report as planned measures to reach compliance with the Buzzards Bay pathogen TMDL report, 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 targeted 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.

Although the TMDL report also identifies the benefits of structural BMPs to address runoff from impervious areas in some instances, MassDOT feels that it is not a beneficial approach to implement these 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 towards 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, and the Final Bacteria TMDL for this impaired water body segment 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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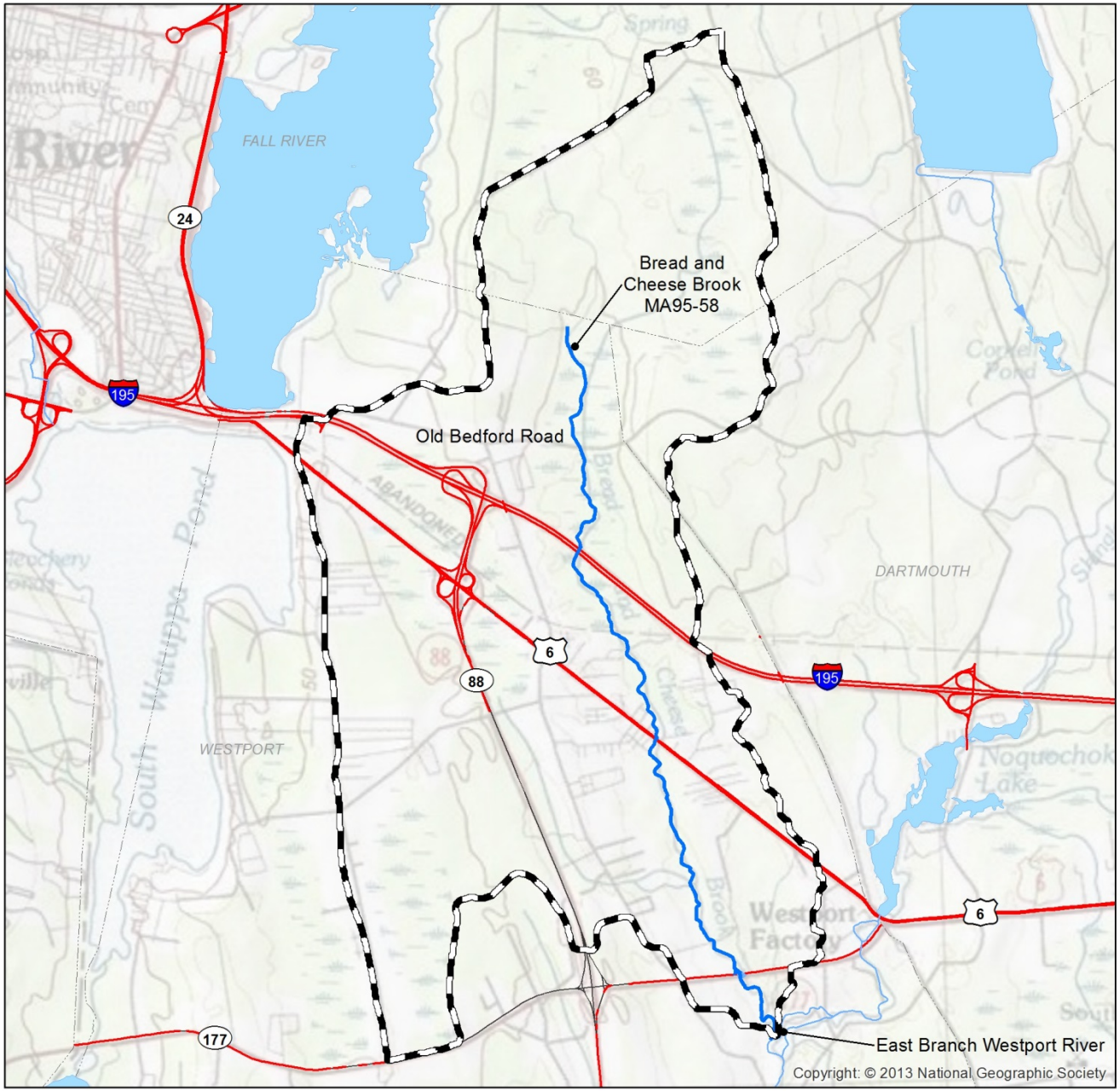

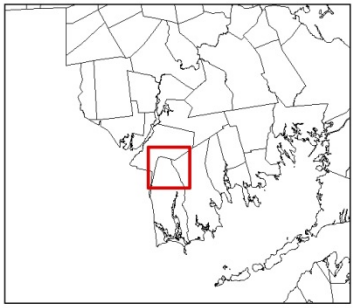

Total and Subwatershed
Bread and Cheese Brook
Impaired Streams
Impaired Water Bodies
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

N

0 0.25 0.5 1 Miles

Figure 1

Bread and Cheese Brook (MA95-58) Watersheds

June 2014

massDOT Massachusetts Department of Transportation Highway Division

Impaired Waters Assessment for Mattapoisett River (MA95-60)

Impaired Water Body

Name: Mattapoisett River

Location: Mattapoisett, MA

Water Body ID: MA95-60

Impairments

Mattapoisett River (MA95-60) is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Mattapoisett River is impaired for the following:

- Fecal Coliform

According to MassDEP's *Buzzards Bay* Watershed 2000 Water Quality Assessment Report (MassDEP, 2003), Mattapoisett River (MA95-60) is impaired for Shellfish Harvesting due to elevated total fecal coliform bacteria; the source is unknown, but is suspected to be illicit discharges from municipal separate storm sewer systems. The aquatic life use has not been assessed due to lack of sufficient data. Mattapoisett River is covered by the *Final Pathogen Total Maximum Daily Load (TMDL) for the Buzzards* Bay Watershed (MassDEP, 2009a).

Relevant Water Quality Standards

Water Body Classification: Class SA

Applicable State Regulations:

- 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

Mattapoisett River (MA95-60) is a 0.05 square mile, Class SA Shellfishing estuary segment in Mattapoisett that extends from the River Road Bridge to the mouth at Mattapoisett Harbor.

Approximately 67% of the drainage area of Mattapoisett River (MA95-60) is forest, 10% is residential areas, and 8% is for agricultural use. The drainage area is approximately 24.7 square miles (MassDEP, 2003). Refer to Figure 1 for the total watershed and subwatershed to this segment of the Mattapoisett River.

MassDOT's property with the potential to contribute stormwater runoff to this portion of Mattapoisett River is comprised of portions of Route 6 and I-195. Refer to Figure 1 for the location of these roadways within the watershed to this segment.

BMP 7R for Pathogen TMDL (CN 251.1)

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP), which applies to impairments that have been assigned to a water body covered by a final TMDL (MassDOT, 2012). This segment of the Mattapoisett River (MA95-60) is covered by the *Final Pathogen TMDL for the Buzzards* Bay Watershed (MassDEP, 2009a).

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 (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, 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 *Final Pathogen Total Maximum Daily Load (TMDL) for the Buzzards Bay Watershed (CN: 251.1)* covers the rivers, estuary areas, and tributaries of the Buzzards Bay Watershed, including this segment of the Mattapoisett River (MA95-60). Groundwater seepage also enters the Bay (MassDEP, 2009a).

According to MassDEP's Final Pathogen TMDL for the Buzzards Bay Watershed (MassDEP, 2009a), the Mattapoisett River has no documented point sources of bacteria pollution but numerous be municipal separate storm sewer systems is identified as a suspect. This segment is listed as

impaired because the DMF Shellfishing Status Report of July 2000 indicates that shellfishing area BB26.1 is conditionally approved, and BB26.2 is restricted. Therefore the entire 0.05 square mile segment is assessed as impaired. This segment has periodically excessive concentrations of fecal coliform.

The Buzzards Bay watershed has no documented point sources of bacteria pollution. Suspected dry-weather sources of bacteria reported in the TMDL report include illicit sewer connections, failing septic systems, and direct wildlife, while suspected and known wet-weather sources reported include sanitary sewer overflows, combined sewer overflows, failing septic systems, and stormwater runoff including MS4 (MassDEP, 2009a). Illicit connections of municipal separate storm sewer systems are identified as a suspected source of bacteria to this segment in the TMDL report (Mass DEP, 2009a). This segment and the adjacent Mattapoisett Harbor segment (MA95-35) have been sampled 1614 times for fecal coliform by the Massachusetts Division of Marine Fisheries from 1985 to 2001. These count values ranged from 1-3,200 cfu/100 mL. The mean counts from 1997 to 2001 was 13 cfu/100 mL.

In an effort to eliminate bacteria sources, segments of the Buzzards Bay Watershed were prioritized based on a number of considerations, including value as a shellfish resource, existing fecal coliform concentration in receiving water, and proximity to swimming beaches. Mattapoisett River is listed as a medium priority due to its value as a resource for shellfishing (MassDEP, 2009a).

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.

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 *Final Pathogen TMDL for the Buzzards Bay Watershed* (Section 8.0-8.9) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems
- Non-structural practices (street sweeping and/or managerial strategies)
- Controls for agricultural runoff, such as improved grazing management

The 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 specifically identified as being ongoing and/or planned in order to meet the *Final Pathogen TMDL for the Buzzards Bay Watershed*:

- Agricultural BMPs
- Septic tank controls

- Documentation of storm drain outfall locations
- Recreational Waters use management
- Watershed resident education
- Additional monitoring

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 accordance with the BMPs identified in the TMDL report as planned measures to reach compliance with the Buzzards Bay pathogen TMDL report, 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 targeted 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.

Although the TMDL report also identifies the benefits of structural BMPs to address runoff from impervious areas in some instances, MassDOT feels that it is not a beneficial approach to implement these 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 towards 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, and the Final Bacteria TMDL for this impaired water body segment 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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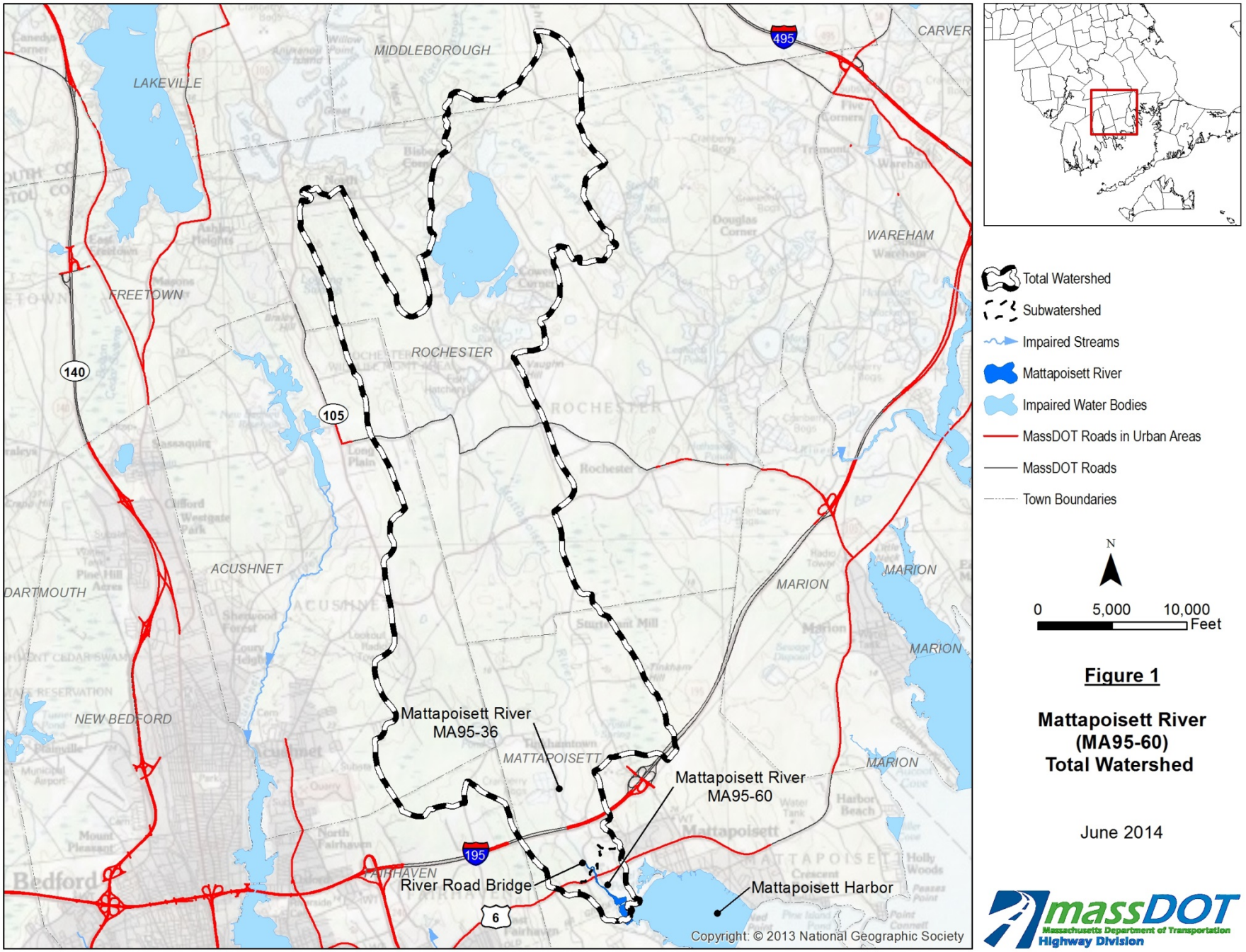
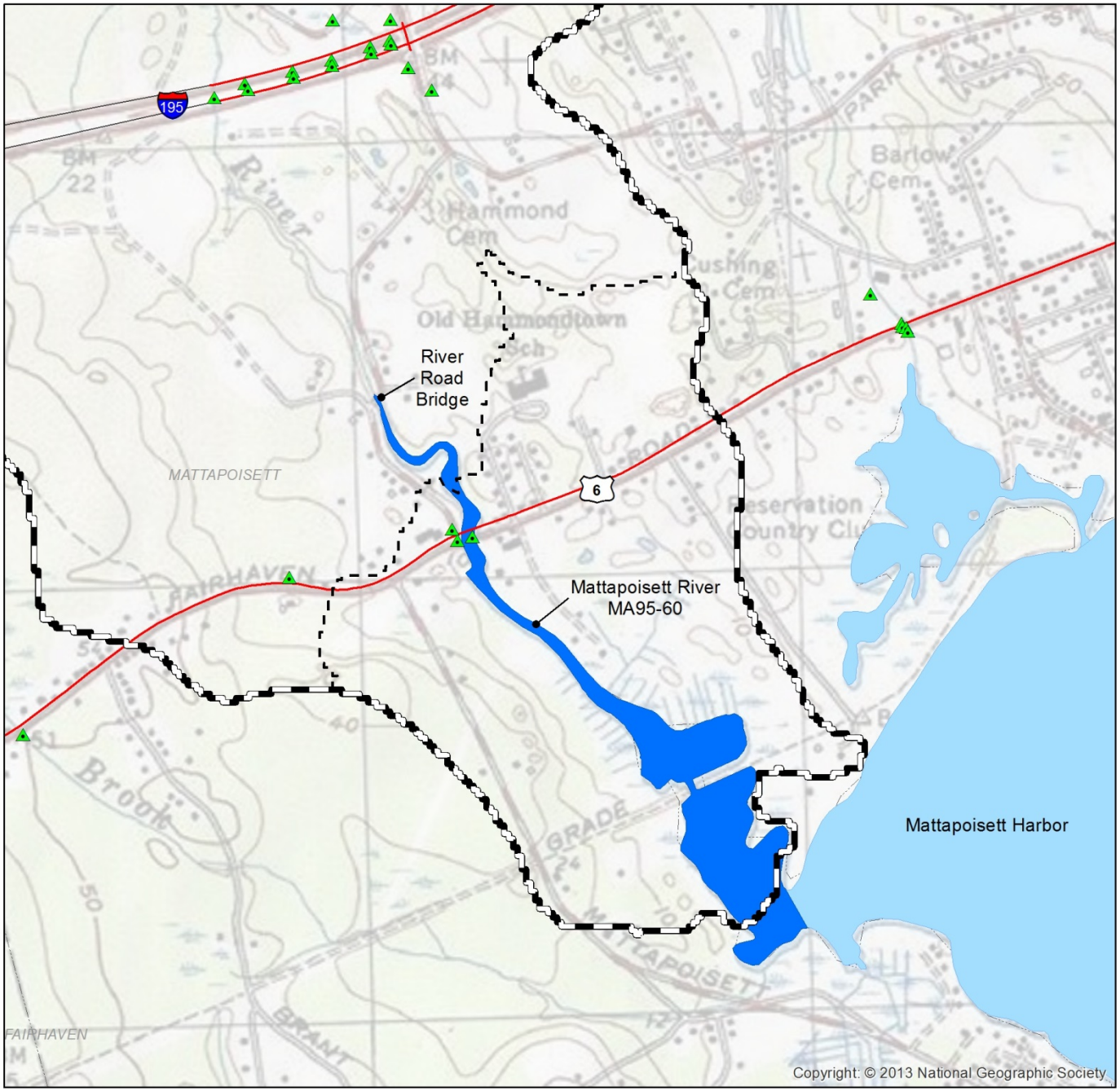
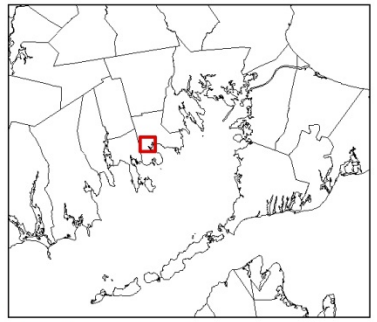


Figure 1

Mattapoisett River (MA95-60) Total Watershed

June 2014





MassDOT Outfalls
Total Watershed
Subwatershed
MassDOT Roads in Urban Areas
Mattapoisett River
Impaired Streams
Impaired Water Bodies
MassDOT Roads
Town Boundaries

N

0 500 1,000 Feet

Figure 2

Mattapoisett River (MA95-60) Subwatershed

June 2014

massDOT
Massachusetts Department of Transportation
Highway Division

Impaired Waters Assessment for Hyannis Harbor (MA96-05)

Impaired Water Body

Name: Hyannis Harbor

Location: Barnstable, MA

Water Body ID: MA96-05

Impairments

Hyannis Harbor (MA96-05) is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Hyannis Harbor is impaired for the following:

- Fecal Coliform

According to MassDEP's *Cape Cod Coastal Drainage Areas 2004-2008 Surface Water Quality Assessment Report* (MassDEP, 2011), Hyannis Harbor (MA96-05) is impaired for shellfish harvesting due to elevated total fecal coliform bacteria. The sources of the impacts are due to waterfowl, waste from pets and/or stormwater discharges from municipal stormwater systems. The aquatic life, primary contact and secondary contact have been assessed as support. Fish consumption and aesthetics have not been assessed. Hyannis Harbor is covered by the *Final Pathogen Total Maximum Daily Load (TMDL) for the Cape Cod Watershed* (MassDEP, 2009b).

Relevant Water Quality Standards

Water Body Classification: Class SA

Applicable State Regulations:

- 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 Hyannis Harbor MA96-05 segment area is approximately 0.68 square miles (MassDEP, 2011). The watersheds and subwatersheds for Cape Cod were provided by USGS based on groundwater modeling developed under the Massachusetts Estuary Program (MEP) and contributing groundwater areas as delineated and published in the USGS 451 groundwater contributing areas data (Walter, et al., 2004; USGS 2009). The Cape Cod watersheds are based on groundwater delineations and not ground surface topography (USGS, 2009). Refer to Figure 1 for the watershed to Hyannis Harbor MA96-05.

A small section of MassDOT's properties (Route 28) has the potential to contribute stormwater runoff to Hyannis Harbor MA96-05. Refer to Figure 1 for the location of these roadways within the watershed to MA96-05. The property in the northernmost portion of MA96-05's watershed is a wastewater treatment facility. This facility has several acres of sewage drying beds.

BMP 7R for Pathogen TMDL (CN 252.0)

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP), which applies to impairments that have been assigned to a water body covered by a final TMDL (MassDOT, 2012).

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 (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, 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 *Final Pathogen Total Maximum Daily Load (TMDL) for the Cape Cod Watershed (CN 252.0)* covers the Hyannis Harbor watershed.

According to the *Final Pathogen TMDL for the Cape Cod Watershed* report (MassDEP, 2009b), sources of indicator bacteria in the Cape Cod watershed are believed to be primarily from boat wastes, failing septic systems, pets, wildlife, birds, and stormwater. The report states that 253 samples, including 2 outfall samples, were collected for fecal coliform analysis between 1996 and 2004. The results ranged from 1.9 to 410 CFU/100 ml (collected at Ocean Street Culvert). During

2006 the Massachusetts Department of Public Health collected 13 samples for enterococcus within the Hyannis Harbor segment. The sampling results ranged from <2 to 56 CFU/100 ml from Estey Avenue Beach and 2 to 122 CFU/100 ml from Keyes Beach. Keyes Beach was closed two times due to elevated concentrations of enterococcus. The Hyannis Harbor watershed has no documented point sources of pathogen pollution; however, the Town of Barnstable was in the process of applying for NPDES permit for the municipal separate storm sewer systems (MS4s) at the time the TMDL report was written. Based on information on the U.S. EPA Region 1 website, stormwater discharges from the town are now covered under the Phase II NPDES general permit. Suspected and known dry-weather sources evaluated in the TMDL include failing septic systems, direct wildlife, recreational activities, stormwater drainage systems, leaking sewer pipes, and illicit boat discharges. Suspected and known wet weather sources include wildlife and domesticated animals, stormwater runoff (including MS4s), and sanitary sewer overflows.

The TMDL states that several impaired segments carry a higher priority due to their location, use, and risk to human health. The higher priority areas in the Cape Cod watershed stand out as likely priority areas to address bacteria pollution sources. These segments tend to be located nearest to sensitive areas such as Outstanding Resource Waters or designated uses that require higher water quality standards than Class B. Hyannis Habor is listed as a medium priority for both wet and dry weather due to its designation as SA and its value as a resource for shellfishing and public swimming (MassDEP, 2009b).

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.

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 Cape Cod Watershed TMDL report (Section 8.0) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems
- Public education regarding illicit sewer connection and failing infrastructure, as well as stormwater runoff and boat wastes
- Identification and elimination of prohibited sources such as leaky or improperly connected sanitary sewer flows
- Best management practices to mitigate storm water runoff volume.

The TMDL report also indicates that structural BMPs may be appropriate if less costly non-structural BMPs are not effective. Many non-structural BMPs are in place, including public education and outreach, street sweeping, and catch basin cleanouts. In addition to practices like these, many communities have formed advisory committees to help resolve existing stormwater issues. Many of the communities on Cape Cod practice their own stormwater BMPs. Additionally, the TMDL states that implementation to achieve the TMDL goals should be an iterative process with selection and implementation of mitigation measures followed by monitoring to determine the extent of water quality improvement realized. Recommended TMDL implementation measures

The following BMPs are specifically identified as being ongoing and/or planned in order to meet the bacteria TMDL for the Cape Cod Watershed:

- Septic tank controls

- Documentation of storm drain outfall locations
- Resident education
- Additional water quality monitoring
- Designation of “No Discharge” areas in high priority coastal waters

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 accordance with the BMPs identified in the TMDL report as planned measures to reach compliance with the Cape Cod Watershed bacteria TMDL report, MassDOT has documented the locations of its stormwater outfalls. 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.

Although the TMDL report also identifies the benefits of structural BMPs to address runoff from impervious areas in some instances, MassDOT feels that it is not a beneficial approach to implement these 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 towards 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, and the Final Bacteria TMDL for this impaired water body segment 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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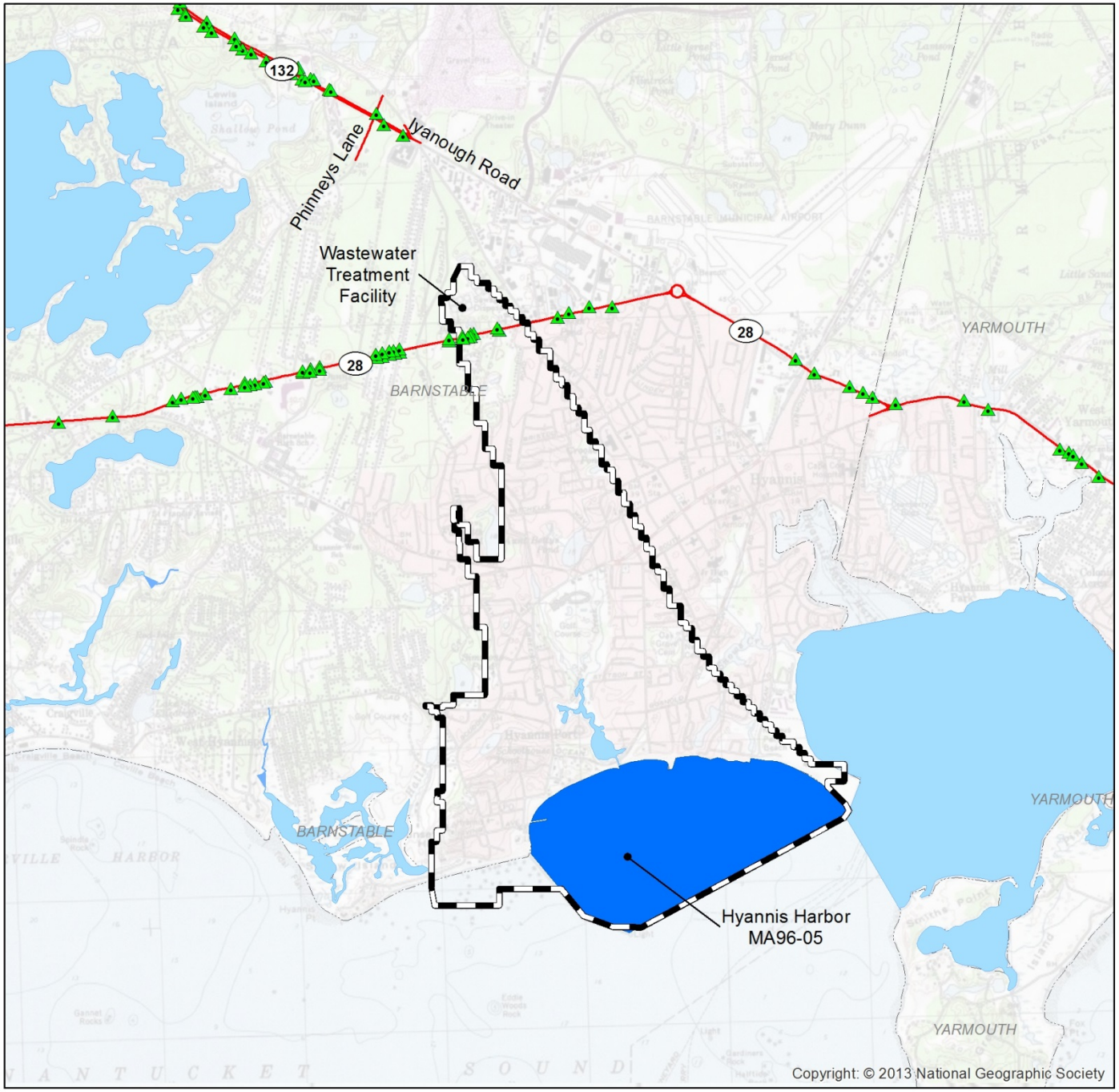

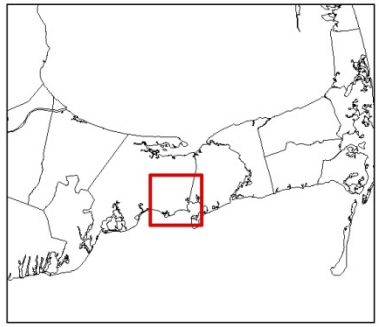

MassDOT Outfalls
Groundwatershed
Hyannis Harbor (MA96-05)
Impaired Streams
Impaired Water Bodies
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

N

0 2,000 4,000 Feet

Figure 1

Hyannis Harbor (MA96-05) Groundwatershed

June 2014

massDOT
Massachusetts Department of Transportation
Highway Division

massDOT Massachusetts Department of Transportation Highway Division

06/08/2014

Impaired Waters Assessment for Maraspin Creek (MA96-06)

Impaired Water Body

Name: Maraspin Creek

Location: Barnstable, MA

Water Body ID: MA96-06

Impairments

Maraspin Creek (MA96-06) is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Maraspin Creek is impaired for the following:

- Fecal Coliform

According to MassDEP's *Cape Cod Watershed 2002 Water Quality Assessment Report* (MassDEP, 2002a), Maraspin Creek (MA96-06) is impaired for shellfish harvesting due to elevated total fecal coliform bacteria; however, the source is unknown. The aquatic life use has not been assessed due to limited data being available. Maraspin Creek is covered by the *Final Pathogen Total Maximum Daily Load (TMDL) for the Cape Cod Watershed* (MassDEP, 2009b).

Relevant Water Quality Standards

Water Body Classification: Class SA

Applicable State Regulations:

- 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 Maraspin Creek (MA96-06) is a segment covering 0.03 square miles. It extends from its headwaters, south of Route 6A, to its confluence with Barnstable Harbor. The recharge area for Maraspin Creek is a portion of the recharge area for Barnstable Harbor. There are no regulated wastewater dischargers in this segment. The Town of Barnstable was in the process of applying for a NPDES permit for the MS4 at the time the TMDL report was written. Based on information on the U.S. EPA Region 1 website, stormwater discharges from the town are now covered under the Phase II NPDES general permit.

The watersheds and subwatersheds for Cape Cod were provided by USGS based on groundwater modeling developed under the Massachusetts Estuary Program (MEP) and contributing groundwater areas as delineated and published in the USGS 451 groundwater contributing areas data (Walter, et al., 2004; USGS 2009). The Cape Cod watersheds are based on groundwater delineations and not ground surface topography (USGS, 2009). Land use estimates for Maraspin Creek (MA96-06) are not available (MassDEP, 2002a). The DMF report designates this segment as a prohibited area for shellfish growth. Refer to Figure 1 for the watershed to Segment MA96-06 of Maraspin Creek.

MassDOT's property with the potential to contribute stormwater runoff to Segment MA96-06 of Maraspin Creek is comprised of portions of Route 6A, Route 6, and Phinneys Lane. Refer to Figure 1 for the location of these roadways within the watershed to Segment MA96-06 of Maraspin Creek.

BMP 7R for Pathogen TMDL (CN 252.0)

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP), which applies to impairments that have been assigned to a water body covered by a final TMDL (MassDOT, 2012). Maraspin Creek is covered by the *Final Pathogen TMDL for the Cape Cod Watershed* (MassDEP, 2009b).

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, 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 *Bacteria Total Maximum Daily Load (TMDL) for the Cape Cod Watershed (CN 252.0)* covers the Maraspin Creek.

According to the Final TMDL, sources of indicator bacteria in the Cape Cod watershed are believed to be primarily from boat wastes; failing septic systems; pets, wildlife, and birds; and stormwater. It should be noted that bacteria from wildlife would be considered a natural condition unless some form of human inducement, such as feeding, is causing congregation of wild birds or animals. Suspected and known dry-weather sources evaluated in the TMDL include failing septic systems, direct wildlife, recreational activities, stormwater drainage systems, leaking sewer pipes, and illicit boat discharges. Suspected and known wet weather sources include wildlife and domesticated animals, stormwater runoff (including municipal separate storm sewer systems), and sanitary sewer overflows.

The TMDL states that several impaired segments carry a higher priority due to their location, use, and risk to human health. The higher priority areas in the Cape Cod watershed stand out as likely priority areas to address bacteria pollution sources. These segments tend to be located nearest to sensitive areas such as Outstanding Resource Waters or designated uses that require higher water quality standards than Class B. Maraspin Creek is not prioritized due to insufficient data. It is noted that Maraspin Creek is designated as SA and is a resource for shellfishing (MassDEP, 2009b).

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.

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

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In addition to the generic recommendations provided in the draft MS4 permits for Massachusetts, the Cape Cod Watershed TMDL report (Section 8.0) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems
- Public education regarding illicit sewer connection and failing infrastructure, as well as stormwater runoff and boat wastes
- Identification and elimination of prohibited sources such as leaky or improperly connected sanitary sewer flows

Best management practices to mitigate storm water runoff volume.

The TMDL report also indicates that structural BMPs may be appropriate if less costly non-structural BMPs are not effective. Many non-structural BMPs are in place, including public education and outreach, street sweeping, and catch basin cleanouts. In addition to practices like these, many communities have formed advisory committees to help resolve existing stormwater issues. Many of the communities on Cape Cod practice their own stormwater BMPs. Additionally, the TMDL states that implementation to achieve the TMDL goals should be an iterative process with selection and implementation of mitigation measures followed by monitoring to determine the extent of water quality improvement realized. Recommended TMDL implementation measures

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- Documentation of storm drain outfall locations
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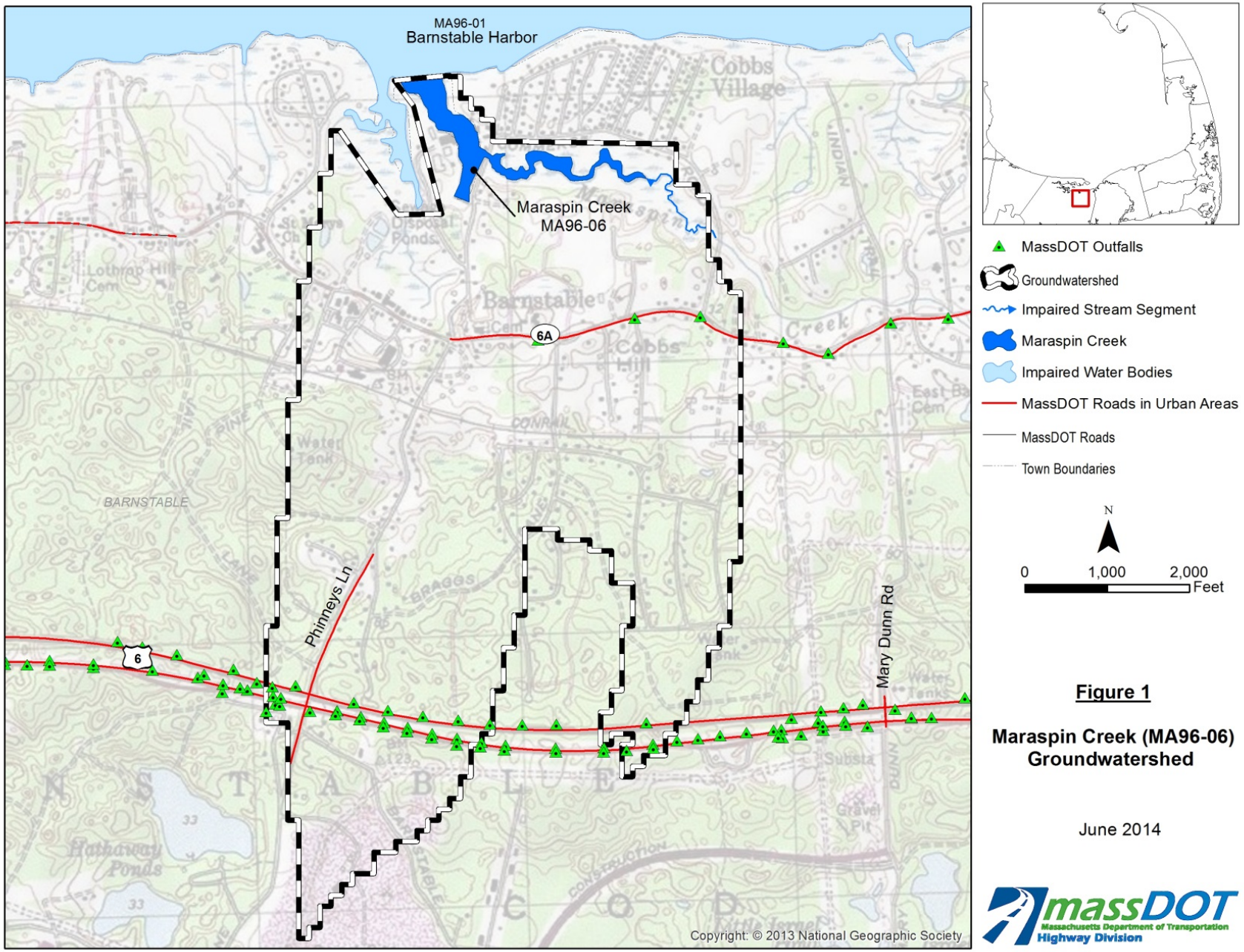

Figure 1

Maraspin Creek (MA96-06) Groundwatershed

June 2014

Impaired Waters Assessment for Quivett Creek (MA96-09)

Impaired Water Body

Name: Quivett Creek

Location: Dennis/Brewster, MA

Water Body ID: MA96-09

Impairments

Quivett Creek (MA96-09) is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Quivett Creek is impaired for the following:

- Fecal Coliform

According to MassDEP's *Cape Cod Watershed 2002 Water Quality Assessment Report* (MassDEP, 2002a), Quivett Creek (MA96-09) is impaired for shellfish harvesting due to elevated total fecal coliform bacteria; however, the source is unknown. The aquatic life use has not been assessed due to limited data being available. Quivett Creek is covered by the *Final Pathogen Total Maximum Daily Load (TMDL) for the Cape Cod Watershed* (MassDEP, 2009b).

Relevant Water Quality Standards

Water Body Classification: Class SA

Applicable State Regulations:

- 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 Quivett Creek (MA96-09) is a segment covering approximately 0.04 square miles. It extends from its headwaters at the outlet of an unnamed pond just south of Route 6A, to the mouth at Cape Cod Bay. There are no regulated wastewater dischargers in this segment. The Town of Dennis was in the process of applying for a NPDES permit for the MS4 at the time the TMDL report was written. Based on information on the U.S. EPA Region 1 website, stormwater discharges from the town are now covered under the Phase II NPDES general permit.

Land use estimates for Quivett Creek (MA96-09) show that the majority of the land is forest and wetlands, while 32% is residential. The Division of Marine Fisheries report designates this segment as a prohibited area for shellfish growth.

The watersheds and subwatersheds for Cape Cod were provided by USGS based on groundwater modeling developed under the Massachusetts Estuary Program (MEP) and contributing groundwater areas as delineated and published in the USGS 451 groundwater contributing areas data (Walter, et al., 2004; USGS 2009). The Cape Cod watersheds are based on groundwater delineations and not ground surface topography (USGS, 2009). Refer to Figure 1 for the watershed to Segment MA96-09 of Quivett Creek.

MassDOT's property with the potential to contribute stormwater runoff to Segment MA96-09 of Quivett Creek is comprised of portions of Route 6A. Refer to Figure 1 for the location of this roadway within the watershed to Segment MA96-09 of Quivett Creek.

BMP 7R for Pathogen TMDL (CN 252.0)

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP), which applies to impairments that have been assigned to a water body covered by a final TMDL (MassDOT, 2012). Quivett Creek is covered by the *Final Pathogen TMDL for the Cape Cod Watershed* (MassDEP, 2009b).

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, 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 *Bacteria Total Maximum Daily Load (TMDL) for the Cape Cod Watershed (CN 252.0)* covers the Quivett Creek. According to the Final TMDL, sources of indicator bacteria in the Cape Cod watershed are believed to be primarily from boat wastes; failing septic systems; pets, wildlife, and birds; and stormwater. It should be noted that bacteria from wildlife would be considered a natural condition unless some form of human inducement, such as feeding, is causing congregation of wild birds or animals. Suspected and known dry-weather sources evaluated in the TMDL include failing septic systems, direct wildlife, recreational activities, stormwater drainage systems, leaking sewer pipes, and illicit boat discharges. Suspected and known wet weather sources include wildlife and domesticated animals, stormwater runoff (including municipal separate storm sewer systems), and sanitary sewer overflows (MassDEP, 2009b).

The TMDL states that several impaired segments carry a higher priority due to their location, use, and risk to human health. The higher priority areas in the Cape Cod watershed stand out as likely priority areas to address bacteria pollution sources. These segments tend to be located nearest to sensitive areas such as Outstanding Resource Waters or designated uses that require higher water quality standards than Class B. Quivett Creek (MA96-09) is listed as a medium priority due to its designation as Class SA and its uses for public swimming and shellfishing (MassDEP, 2009b).

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.

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, 2002b).

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 Cape Cod Watershed TMDL report (Section 8.0) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems
- Public education regarding illicit sewer connection and failing infrastructure, as well as stormwater runoff and boat wastes
- Identification and elimination of prohibited sources such as leaky or improperly connected sanitary sewer flows
- Best management practices to mitigate storm water runoff volume.

The TMDL report also indicates that structural BMPs may be appropriate if less costly non-structural BMPs are not effective. Many non-structural BMPs are in place, including public education and outreach, street sweeping, and catch basin cleanouts. In addition to practices like these, many communities have formed advisory committees to help resolve existing stormwater issues. Many of the communities on Cape Cod practice their own stormwater BMPs. Additionally, the TMDL states that implementation to achieve the TMDL goals should be an iterative process with selection and implementation of mitigation measures followed by monitoring to determine the extent of water quality improvement realized.

The following BMPs are specifically identified as being ongoing and/or planned in order to meet the bacteria TMDL for the Cape Cod Watershed:

- Septic tank controls

- Documentation of storm drain outfall locations
- Resident education
- Additional water quality monitoring
- Designation of “No Discharge” areas in high priority coastal waters

The Town of Dennis has a pet waste disposal program and active IDDE program in place.

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 accordance with the BMPs identified in the TMDL report as planned measures to reach compliance with the Cape Cod Watershed bacteria TMDL report, MassDOT has documented the locations of its stormwater outfalls. 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.

Although the TMDL report also identifies the benefits of riparian restoration and structural BMPs to address runoff from impervious areas in some instances, MassDOT feels that it is not a beneficial approach to implement these 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 towards 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, and the Final Bacteria TMDL for this impaired water body segment 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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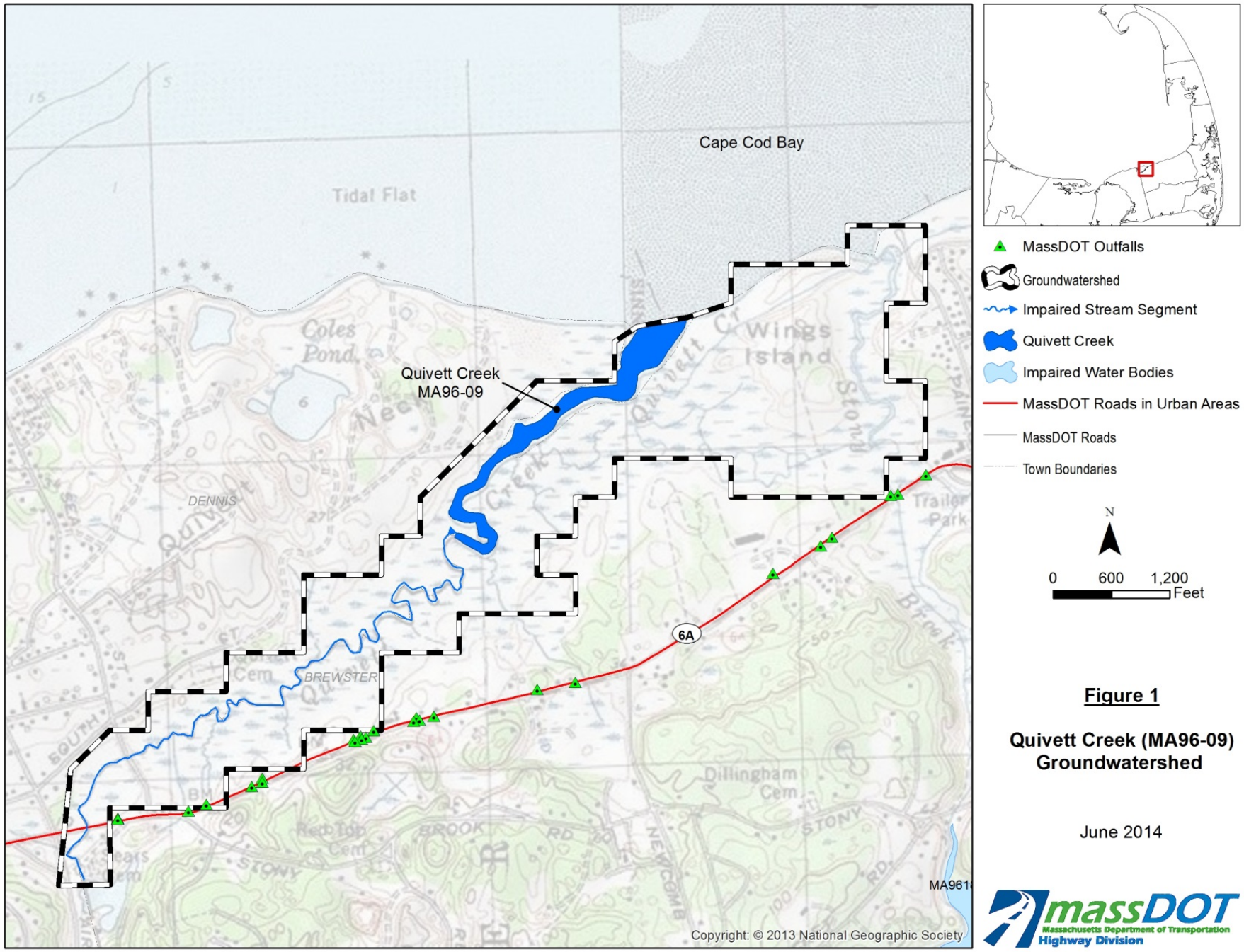

Figure 1

Quivett Creek (MA96-09) Groundwatershed

June 2014

massDOT
Massachusetts Department of Transportation
Highway Division

massDOT Massachusetts Department of Transportation Highway Division

06/08/2014

Impaired Waters Assessment for Sesuit Creek (MA96-13)

Impaired Water Body

Name: Sesuit Creek

Location: Dennis, MA

Water Body ID: MA96-13

Impairments

Sesuit Creek (MA96-13) is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Sesuit Creek is impaired for the following:

- Fecal Coliform

According to MassDEP's *Cape Cod Watershed 2002 Water Quality Assessment Report* (MassDEP, 2002a), Sesuit Creek (MA96-13) is impaired for shellfish harvesting due to elevated total fecal coliform bacteria; however, the source is unknown. The aquatic life use has not been assessed due to limited data being available. Sesuit Creek is covered by the *Final Pathogen Total Maximum Daily Load (TMDL) for the Cape Cod Watershed* (MassDEP, 2009b).

Relevant Water Quality Standards

Water Body Classification: Class SA

Applicable State Regulations:

- 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 Sesuit Creek (MA96-13) is a segment covering approximately 0.06 square miles. It extends from its headwaters very near Route 6A, to the mouth at Cape Cod Bay in Dennis. The recharge area for Sesuit Creek is a portion of the recharge area for Barnstable Harbor. There are no regulated wastewater dischargers in this segment. The Town of Dennis was in the process of applying for a NPDES permit for the MS4 at the time the TMDL report was written. Based on information on the the U.S. EPA Region 1 website, stormwater discharges from the town are now covered under the Phase II NPDES general permit. Dennis Water District, Dennis Pines Golf Course, and Dennis Highlands Golf Course all withdraw water from this subwatershed. Available data shows that there are no cranberry bogs in the recharge area of this segment.

Land use estimates for Sesuit Creek (MA96-13) show that the majority of the land in the recharge area is residential at 47%. The remainder is forest, open space, or water. The Division of Marine Fisheries report designates this segment as conditionally approved for shellfish growth. Both primary and secondary recreation use in this segment are supported (MassDEP, 2002a).

The watersheds and subwatersheds for Cape Cod were provided by USGS based on groundwater modeling developed under the Massachusetts Estuary Program (MEP) and contributing groundwater areas as delineated and published in the USGS 451 groundwater contributing areas data (Walter, et al., 2004; USGS 2009). The Cape Cod watersheds are based on groundwater delineations and not ground surface topography. The Sesuit Creek watershed used for this assessment is based on the (USGS, 2009). Refer to Figure 1 for the watershed to Segment MA96-13 of Sesuit Creek.

MassDOT's property with the potential to contribute stormwater runoff to Segment MA96-13 of Sesuit Creek is comprised of a portion of Route 6A. Refer to Figure 1 for the location of this roadway within the watershed to Segment MA96-13 of Sesuit Creek.

BMP 7R for Pathogen TMDL (CN 252.0)

MassDOT assessed the indicator bacteria (fecal coliform) using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP), which applies to impairments that have been assigned to a water body covered by a final TMDL (MassDOT 2012). Sesuit Creek is covered by the *Final Pathogen TMDL for the Cape Cod Watershed* (MassDEP, 2009b).

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, 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 *Bacteria Total Maximum Daily Load (TMDL) for the Cape Cod Watershed (CN 252.0)* covers the Sesuit Creek. According to the Final TMDL, sources of indicator bacteria in the Cape Cod watershed are believed to be primarily from boat wastes; failing septic systems; pets, wildlife, and birds; and stormwater. It should be noted that bacteria from wildlife would be considered a natural condition unless some form of human inducement, such as feeding, is causing congregation of wild birds or animals. Suspected and known dry-weather sources evaluated in the TMDL include failing septic systems, direct wildlife, recreational activities, stormwater drainage systems, leaking sewer pipes, and illicit boat discharges. Suspected and known wet weather sources include wildlife and domesticated animals, stormwater runoff (including municipal separate storm sewer systems), and sanitary sewer overflows. Sesuit Creek (MA96-13) is listed as a medium priority due to its designation as Class SA and its uses for public swimming and shellfishing.

The TMDL states that several impaired segments carry a higher priority due to their location, use, and risk to human health. The higher priority areas in the Cape Cod watershed stand out as likely priority areas to address bacteria pollution sources. These segments tend to be located nearest to sensitive areas such as Outstanding Resource Waters or designated uses that require higher water quality standards than Class B.

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.

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, 2002b).

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 Cape Cod Watershed TMDL report (Section 8.0) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems
- Public education regarding illicit sewer connection and failing infrastructure, as well as stormwater runoff and boat wastes
- Identification and elimination of prohibited sources such as leaky or improperly connected sanitary sewer flows
- Best management practices to mitigate storm water runoff volume.

The TMDL report also indicates that structural BMPs may be appropriate if less costly non-structural BMPs are not effective. Many non-structural BMPs are in place, including public education and outreach, street sweeping, and catch basin cleanouts. In addition to practices like these, many communities have formed advisory committees to help resolve existing stormwater issues. Many of the communities on Cape Cod practice their own stormwater BMPs. Additionally, the TMDL states that implementation to achieve the TMDL goals should be an iterative process with selection and implementation of mitigation measures followed by monitoring to determine the extent of water quality improvement realized

The following BMPs are specifically identified as being ongoing and/or planned in order to meet the bacteria TMDL for the Cape Cod Watershed:

- Septic tank controls
- Documentation of storm drain outfall locations
- Resident education
- Additional water quality monitoring
- Designation of “No Discharge” areas in high priority coastal waters

The Town of Dennis has a pet waste disposal program and active IDDE program in place.

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 accordance with the BMPs identified in the TMDL report as planned measures to reach compliance with the Cape Cod Watershed bacteria TMDL report, MassDOT has documented the locations of its stormwater outfalls. 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.

Although the TMDL report also identifies the benefits of riparian restoration and structural BMPs to address runoff from impervious areas in some instances, MassDOT feels that it is not a beneficial approach to implement these 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 towards 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, and the Final Bacteria TMDL for this impaired water body segment 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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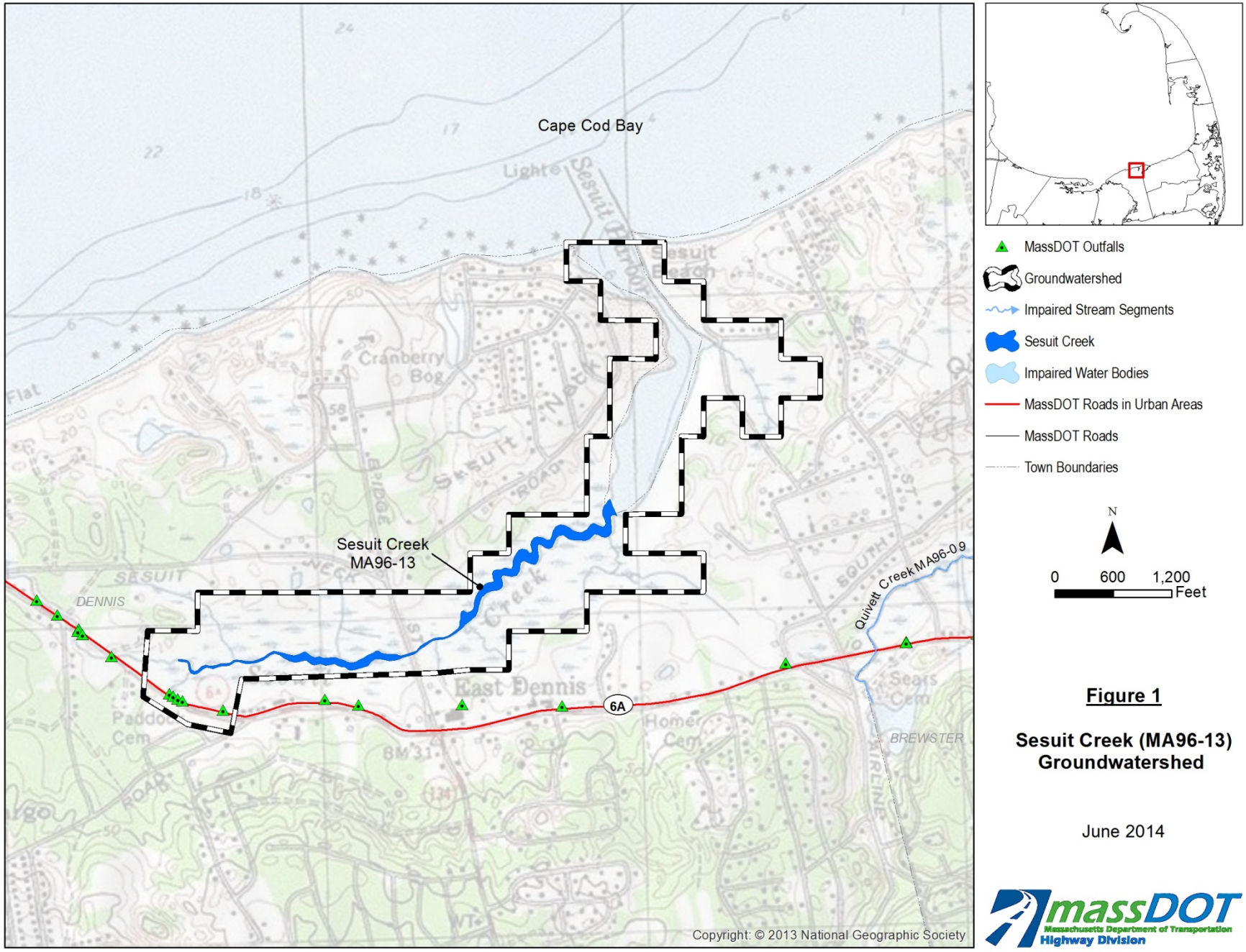

Figure 1

Sesuit Creek (MA96-13) Groundwatershed

June 2014

Impaired Waters Assessment for Rock Harbor Creek (MA96-16)

Impaired Water Body

Name: Rock Harbor Creek

Location: Eastham/Orleans, MA

Water Body ID: MA96-16

Impairments

Rock Harbor Creek (MA96-16) is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Rock Harbor Creek is impaired for the following:

- Fecal Coliform

According to MassDEP's *Cape Cod Watershed 2002 Water Quality Assessment Report* (MassDEP, 2002a), Rock Harbor Creek (MA96-16) is impaired for shellfish harvesting due to elevated total fecal coliform bacteria; however, the source is unknown. The aquatic life use has not been assessed due to limited data being available. Rock Harbor Creek is covered by the *Final Pathogen Total Maximum Daily Load (TMDL) for the Cape Cod Watershed* (MassDEP, 2009b).

Relevant Water Quality Standards

Water Body Classification: Class SA

Applicable State Regulations:

- 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 Rock Harbor Creek (MA96-16) is an Outstanding Resource Water (ORW) covering approximately 1.2 acres. It extends from outlet of Cedar Pond, to the creek's mouth at Cape Cod Bay in Eastham/Orleans. There are no regulated NPDES discharge permits in this segment. There are also no cranberry bogs or Water Management Act (WMA) regulated water withdrawals in the recharge area for this segment (MassDEP, 2002a).

Land use estimates for Rock Harbor Creek (MA96-16) show that the majority of the land in the recharge area is residential at 38%. The remainder is forest, commercial, or water. The Division of Marine Fisheries (DMF) report designates that only 0.1 square miles of this segment are approved for shellfish growth. Both primary and secondary recreation uses in this segment are supported (MassDEP, 2002a).

The watersheds and subwatersheds for Cape Cod were provided by USGS based on groundwater modeling developed under the Massachusetts Estuary Program (MEP) and contributing groundwater areas as delineated and published in the USGS 451 groundwater contributing areas data (Walter, et al., 2004; USGS 2009). The Cape Cod watersheds are based on groundwater delineations and not ground surface topography (USGS, 2009). Refer to Figure 1 for the watershed to Segment MA96-16 of Rock Harbor Creek.

MassDOT's property with the potential to contribute stormwater runoff to Segment MA96-16 of Rock Harbor Creek is comprised of portions of Route 6 and Route 6A. Refer to Figure 1 for the location of these roadways within the watershed to Segment MA96-16 of Rock Harbor Creek.

BMP 7R for Pathogen TMDL (CN 252.0)

MassDOT assessed the indicator bacteria (fecal coliform) using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP), which applies to impairments that have been assigned to a water body covered by a final TMDL (MassDOT, 2012). Rock Harbor Creek is covered by the *Final Pathogen TMDL for the Cape Cod Watershed* (MassDEP, 2009b).

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, 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 *Bacteria Total Maximum Daily Load (TMDL) for the Cape Cod Watershed (CN 252.0)* covers the Rock Harbor Creek.

According to the Final TMDL, sources of indicator bacteria in the Cape Cod watershed are believed to be primarily from boat wastes; failing septic systems; pets, wildlife, and birds; and stormwater. It should be noted that bacteria from wildlife would be considered a natural condition unless some form of human inducement, such as feeding, is causing congregation of wild birds or animals. Suspected and known dry-weather sources evaluated in the TMDL include failing septic systems, direct wildlife, recreational activities, stormwater drainage systems, leaking sewer pipes, and illicit boat discharges. Suspected and known wet weather sources include wildlife and domesticated animals, stormwater runoff (including municipal separate storm sewer systems), and sanitary sewer overflows (MassDEP, 2009b).

The TMDL states that several impaired segments carry a higher priority due to their location, use, and risk to human health. The higher priority areas in the Cape Cod watershed stand out as likely priority areas to address bacteria pollution sources. These segments tend to be located nearest to sensitive areas such as Outstanding Resource Waters or designated uses that require higher water quality standards than Class B. Rock Habor Creek (MA96-16) is listed as a medium priority due to its designation as an ORW and Class SA, as well as its uses for public swimming and shellfishing (MassDEP, 2009b).

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.

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 Cape Cod Watershed TMDL report (Section 8.0) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems
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- Identification and elimination of prohibited sources such as leaky or improperly connected sanitary sewer flows
- Best management practices to mitigate storm water runoff volume.

The TMDL report also indicates that structural BMPs may be appropriate if less costly non-structural BMPs are not effective. Many non-structural BMPs are in place, including public education and outreach, street sweeping, and catch basin cleanouts. In addition to practices like these, many communities have formed advisory committees to help resolve existing stormwater issues. Many of the communities on Cape Cod practice their own stormwater BMPs. Additionally, the TMDL states that implementation to achieve the TMDL goals should be an iterative process with selection and implementation of mitigation measures followed by monitoring to determine the extent of water quality improvement realized

The following BMPs are specifically identified as being ongoing and/or planned in order to meet the bacteria TMDL for the Cape Cod Watershed:

- Septic tank controls
- Documentation of storm drain outfall locations
- Resident education
- Additional water quality monitoring
- Designation of “No Discharge” areas in high priority coastal waters

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
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- 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 accordance with the BMPs identified in the TMDL report as planned measures to reach compliance with the Cape Cod Watershed bacteria TMDL report, MassDOT has documented the locations of its stormwater outfalls. 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.

Although the TMDL report also identifies the benefits of riparian restoration and structural BMPs to address runoff from impervious areas in some instances, MassDOT feels that it is not a beneficial approach to implement these 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 towards 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, and the Final Bacteria TMDL for this impaired water body segment 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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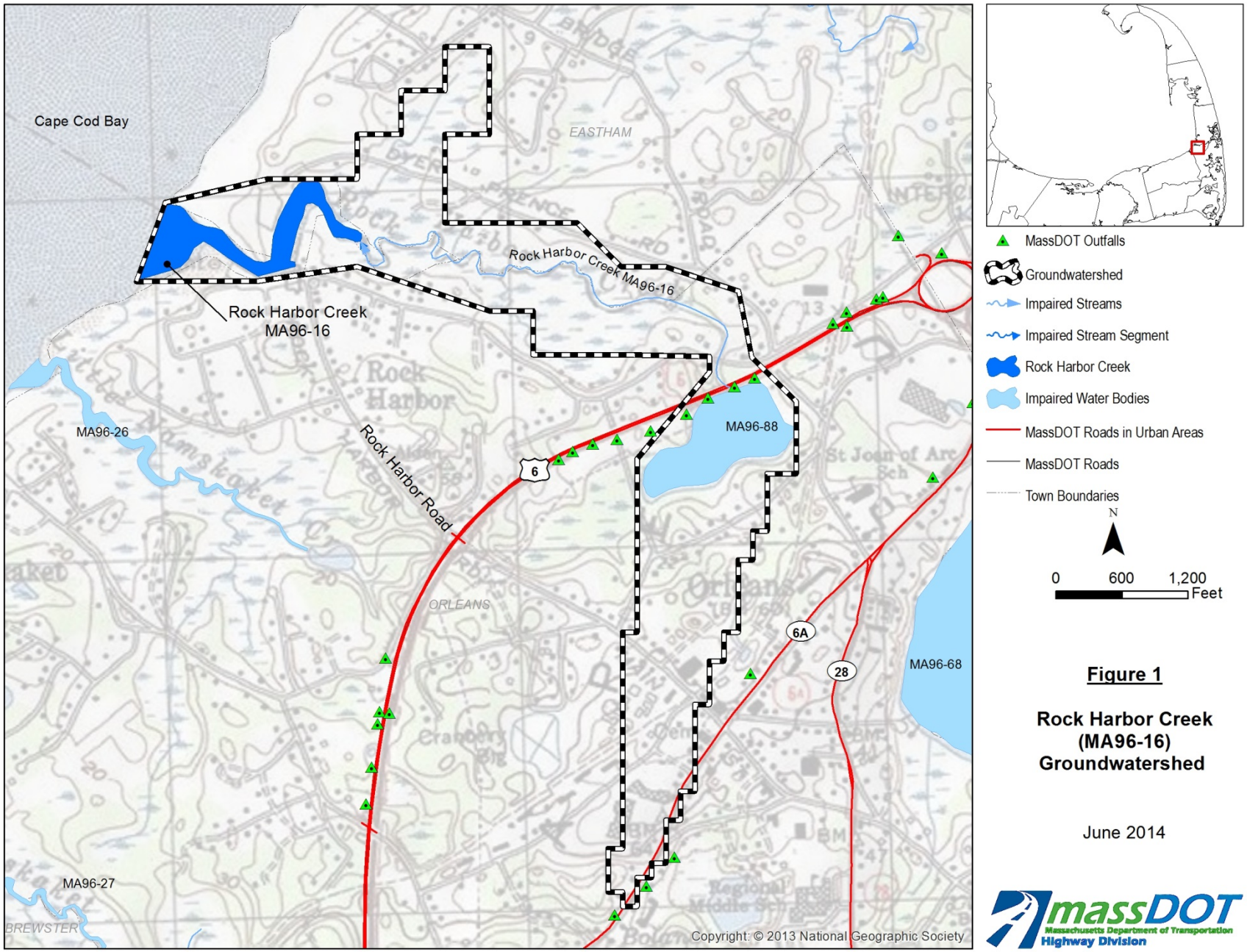

Figure 1

Rock Harbor Creek (MA96-16) Groundwatershed

June 2014

Impaired Waters Assessment for Little Harbor (MA96-19)

Impaired Water Body

Name: Little Harbor

Location: Falmouth, MA

Water Body ID: MA96-19

Impairments

Little Harbor (MA96-319) is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Little Harbor is impaired for the following:

- Fecal Coliform

According to MassDEP's *Cape Cod Coastal Drainage Areas 2004-2008 Surface Water Quality Assessment Report* (MassDEP, 2011), there is no discharge to Little Harbor covered by an NPDES permit. The Massachusetts Division of Marine Fisheries (DMF) indicates that shellfish harvesting in Little Harbor is approved for 0.02 mi^2, conditionally approved for 0.02 mi^2 and prohibited for 0.01 mi^2; cause is indicated as elevated fecal coliform bacteria, source is cited as marina/boating pumpout releases, waterfowl, pet waste, on-site (septic) systems, and/or unspecified urban stormwater. Little Harbor is covered by the *Final Pathogen Total Maximum Daily Load (TMDL) for the Cape Cod Watershed* report (MassDEP, 2009b).

Relevant Water Quality Standards

Water Body Classification: Class SA

Applicable State Regulations:

- 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

Little Harbor (MA96-19) is a water body in Falmouth, Massachusetts that covers approximately 32 acres. The water body extends north of an imaginary line drawn from Juniper point east to Nobska Beach, Falmouth.

The watersheds and subwatersheds for Cape Cod were provided by USGS based on groundwater modeling developed under the Massachusetts Estuary Program (MEP) and contributing groundwater areas as delineated and published in the USGS 451 groundwater contributing areas data (Walter, et al., 2004; USGS 2009). The Cape Cod watersheds are based on groundwater delineations and not ground surface topography (USGS, 2009). Refer to Figure 1 for the watershed to Segment MA96-19 of Little Harbor.

The closest MassDOT roadway with the potential to contribute stormwater via the groundwatershed is Woods Hole Road. This assessment has been completed as a pathogen-only assessment. The MassDOT roadway is outside of the groundwatershed area, but completing the assessment as a pathogen-only, was considered a conservative approach, with Woods Hole Road within 500 feet south of Little Harbor. Refer to Figure 1 for the location of this roadway in relation to the watershed to Segment MA96-19.

BMP 7R for Pathogen TMDL (CN 252.0)

MassDOT assessed the indicator bacteria (fecal coliform) using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP), which applies to impairments that have been assigned to a water body covered by a final TMDL (MassDOT, 2012). Little Harbor is covered by the *Final Pathogen TMDL for the Cape Cod Watershed* report (MassDEP, 2009b).

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, 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

According to the *Final Pathogen TMDL for the Cape Cod Watershed* report (MassDEP, 2009b), sources of indicator bacteria in the Cape Cod watershed are believed to be primarily from boat wastes, failing septic systems, pets, wildlife, birds, and stormwater. The report contains bacteria

sampling results and shoreline survey data collected by the DMF. Within MA96-19, DMF data reports that fecal coliform bacteria data was collected from 178 samples collected between the years 1996-2003; results ranged from 1.9 – >51 CFU/100ml with a geometric mean range of 2.64 - 3.39. The only indication as to pollution sources in DMF reports are the presence of large numbers of birds from time to time. Species include several varieties of ducks, as well as Canadian geese, Cormorants, Seagulls, and Terns. A sanitary survey conducted in 2001, and a triennial report in 2005 both indicate the possibility of bacteria sources from outhouses, cesspools or septic systems throughout the entire Barnstable Harbor area (including Scorton Creek). DMF recommends that the town of Barnstable Board of Health should check out these possible sources (MassDEP, 2009b).

The TMDL Report summarized sampling results from the MA Department of Public Health (DPH). DPH sampled for enterococcus levels at Nobska Beach at least 12 times during 2006. At Nobska Beach results ranged between <2 and 12 CFU/100 ml with no closures (MassDEP, 2009b).

The TMDL states that several impaired segments carry a higher priority due to their location, use, and risk to human health. The higher priority areas in the Cape Cod watershed stand out as likely priority areas to address bacteria pollution sources. These segments tend to be located nearest to sensitive areas such as Outstanding Resource Waters or designated uses that require higher water quality standards than Class B. Little Harbor (MA96-19) is listed as a medium priority due to its designation as Class SA and its uses for public swimming and shellfishing (MassDEP, 2009b).

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.

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 Cape Cod Watershed TMDL report (Section 8.0) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems
- Public education regarding illicit sewer connection and failing infrastructure, as well as stormwater runoff and boat wastes
- Identification and elimination of prohibited sources such as leaky or improperly connected sanitary sewer flows
- Best management practices to mitigate storm water runoff volume.

The TMDL report also indicates that structural BMPs may be appropriate if less costly non-structural BMPs are not effective. Many non-structural BMPs are in place, including public education and outreach, street sweeping, and catch basin cleanouts. In addition to practices like these, many communities have formed advisory committees to help resolve existing stormwater issues. Many of the communities on Cape Cod practice their own stormwater BMPs. Additionally, the TMDL states that implementation to achieve the TMDL goals should be an iterative process with selection and implementation of mitigation measures followed by monitoring to determine the extent of water quality improvement realized.

The following BMPs are specifically identified as being ongoing and/or planned in order to meet the bacteria TMDL for the Cape Cod Watershed:

- Septic tank controls
- Documentation of storm drain outfall locations
- Resident education
- Additional water quality monitoring
- Designation of “No Discharge” areas in high priority coastal waters

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 accordance with the BMPs identified in the TMDL report as planned measures to reach compliance with the Cape Cod Watershed bacteria TMDL report, MassDOT has documented the locations of its stormwater outfalls. 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.

Although the TMDL report also identifies the benefits of structural BMPs to address runoff from impervious areas in some instances, MassDOT feels that it is not a beneficial approach to implement these 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 towards 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, and the Final Bacteria TMDL for this impaired water body segment 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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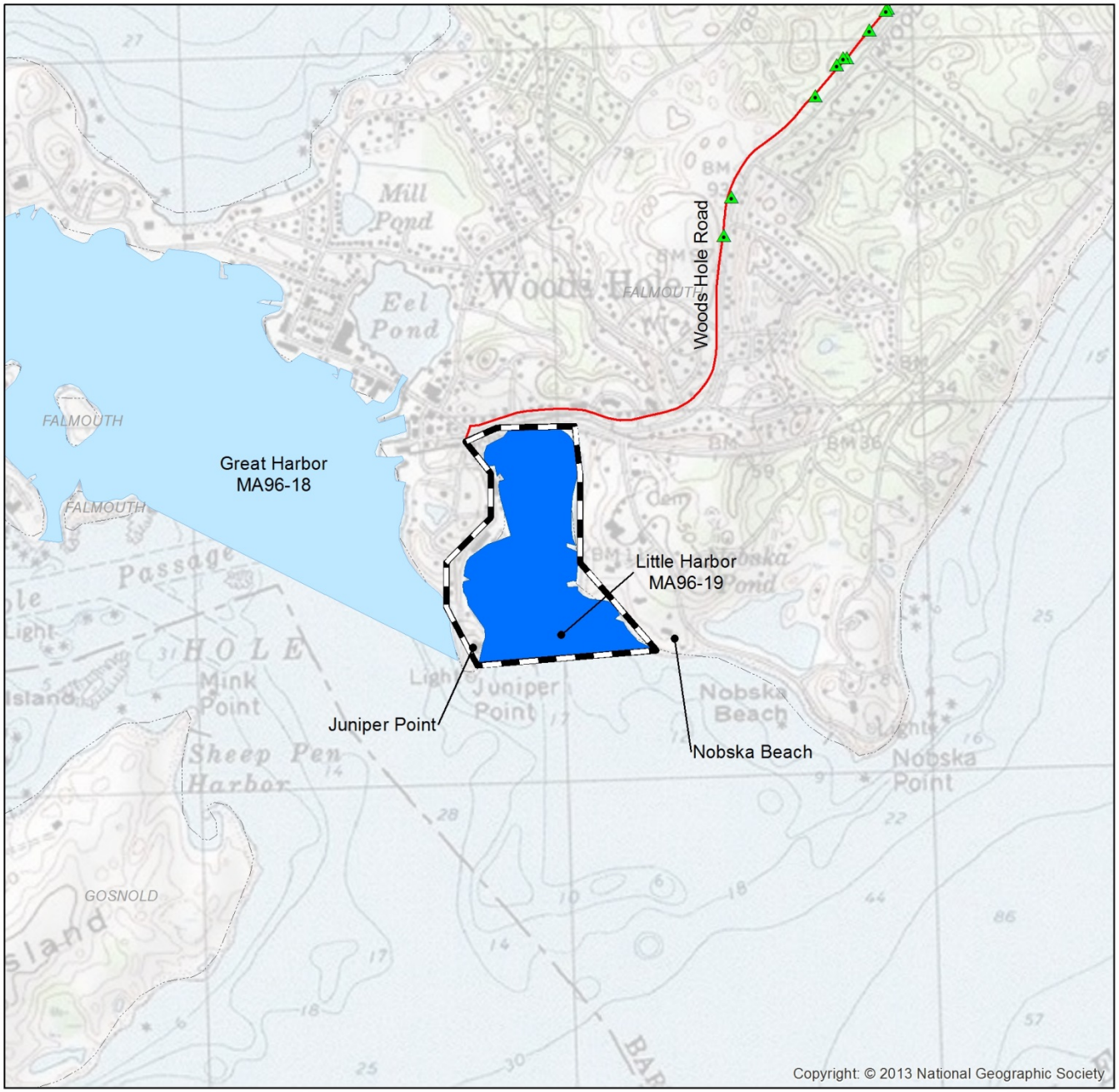

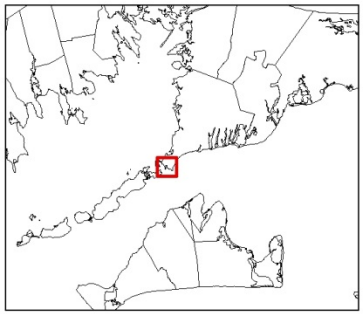

MassDOT Outfalls
Groundwatershed
Impaired Stream Segment
Little Harbor
Impaired Water Bodies
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

N

0 600 1,200 Feet

Figure 1

Little Harbor (MA96-19) Groundwatershed

June 2014

massDOT
Massachusetts Department of Transportation
Highway Division

Impaired Waters Assessment for Herring River (MA96-22)

Impaired Water Body

Name: Herring River

Location: Harwich, MA

Water Body ID: MA96-22

Impairments

Herring River (MA96-22) is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Herring River is impaired for the following:

- Fecal Coliform

According to MassDEP's *Cape Cod Coastal Drainage Areas 2004-2008 Surface Water Quality Assessment Report* (MassDEP, 2011), there is one discharge to Herring River covered by an NPDES permit: Town of Sandwich (MAR041155). The Massachusetts Division of Marine Fisheries (DMF) indicates that shellfish harvesting in Herring River is prohibited; cause is indicated as elevated fecal coliform bacteria, source is cited as waterfowl, on-site (septic) systems, and/or stormwater discharges from the municipal stormwater systems. Herring River is covered by the *Final Pathogen Total Maximum Daily Load (TMDL) for the Cape Cod Watershed* report (MassDEP, 2009b).

Relevant Water Quality Standards

Water Body Classification: Class SA

Applicable State Regulations:

- 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

Herring River (MA96-22) is a water body in Harwich, Massachusetts that covers approximately 19 acres. The water body extends from Harwich Reservoir Dam west of Bells Neck Road, Harwich to the mouth at Nantucket Sound.

The watersheds and subwatersheds for Cape Cod were provided by USGS based on groundwater modeling developed under the Massachusetts Estuary Program (MEP) and contributing groundwater areas as delineated and published in the USGS 451 groundwater contributing areas data (Walter, et al., 2004; USGS 2009). The Cape Cod watersheds are based on groundwater delineations and not ground surface topography (USGS, 2009). The closest MassDOT roadway with the potential to contribute stormwater runoff to Herring River is Route 28 which crosses over MA96-22 Herring River. Refer to Figure 1 for the location of these roadways in relation to Segment MA96-22 of Herring River.

BMP 7R for Pathogen TMDL (CN 252.0)

MassDOT assessed the indicator bacteria (fecal coliform) using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP), which applies to impairments that have been assigned to a water body covered by a final TMDL (MassDOT, 2012). Herring River is covered by the *Final Pathogen TMDL for the Cape Cod Watershed* report (MassDEP, 2009b).

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).

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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.
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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

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sampling results and shoreline survey data collected by the DMF. Within MA96-30, DMF data reports that fecal coliform bacteria data was collected from 90 samples collected between the years 1996-2004; results ranged from 1.9 – >28 CFU/100ml with a geometric mean range of 3.0 – 10.9. The only indication as to pollution sources in DMF reports are the presence of large numbers of birds from time to time. Species include several varieties of ducks, as well as Canadian geese, Cormorants, Seagulls, and Terns. A sanitary survey conducted in 2001, and a triennial report in 2005 both indicate the possibility of bacteria sources from outhouses, cesspools or septic systems throughout the entire Barnstable Harbor area (including Scorton Creek). DMF recommends that the town of Barnstable Board of Health should check out these possible sources.

The TMDL Report summarized sampling results from the MA Department of Public Health (DPH). DPH sampled for enterococcus levels at East Sandwich Beach and Torrey Beach Community at least 13 times during 2006. At East Sandwich Beach results ranged between <2 and 110 CFU/100 ml with one closure. At Torrey Beach Community Association Beach results ranged between <2 and 234 CFU/100 ml with one failure (MassDEP, 2009b).

The TMDL states that several impaired segments carry a higher priority due to their location, use, and risk to human health. The higher priority areas in the Cape Cod watershed stand out as likely priority areas to address bacteria pollution sources. These segments tend to be located nearest to sensitive areas such as Outstanding Resource Waters or designated uses that require higher water quality standards than Class B. Herring River (MA96-22) is listed as a medium priority due to its designation as Class SA and its uses for public swimming and shellfishing (MassDEP, 2009b).

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- “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 Cape Cod Watershed TMDL report (Section 8.0) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems
- Public education regarding illicit sewer connection and failing infrastructure, as well as stormwater runoff and boat wastes
- Identification and elimination of prohibited sources such as leaky or improperly connected sanitary sewer flows
- Best management practices to mitigate storm water runoff volume.

The TMDL report also indicates that structural BMPs may be appropriate if less costly non-structural BMPs are not effective. Many non-structural BMPs are in place, including public education and outreach, street sweeping, and catch basin cleanouts. In addition to practices like these, many communities have formed advisory committees to help resolve existing stormwater issues. Many of the communities on Cape Cod practice their own stormwater BMPs. Additionally, the TMDL states that implementation to achieve the TMDL goals should be an iterative process with selection and implementation of mitigation measures followed by monitoring to determine the extent of water quality improvement realized.

The following BMPs are specifically identified as being ongoing and/or planned in order to meet the bacteria TMDL for the Cape Cod Watershed:

- Septic tank controls
- Documentation of storm drain outfall locations
- Resident education
- Additional water quality monitoring
- Designation of “No Discharge” areas in high priority coastal waters

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 accordance with the BMPs identified in the TMDL report as planned measures to reach compliance with the Cape Cod Watershed bacteria TMDL report, MassDOT has documented the locations of its stormwater outfalls. 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.

Although the TMDL report also identifies the benefits of structural BMPs to address runoff from impervious areas in some instances, MassDOT feels that it is not a beneficial approach to implement these 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 towards 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, and the Final Bacteria TMDL for this impaired water body segment 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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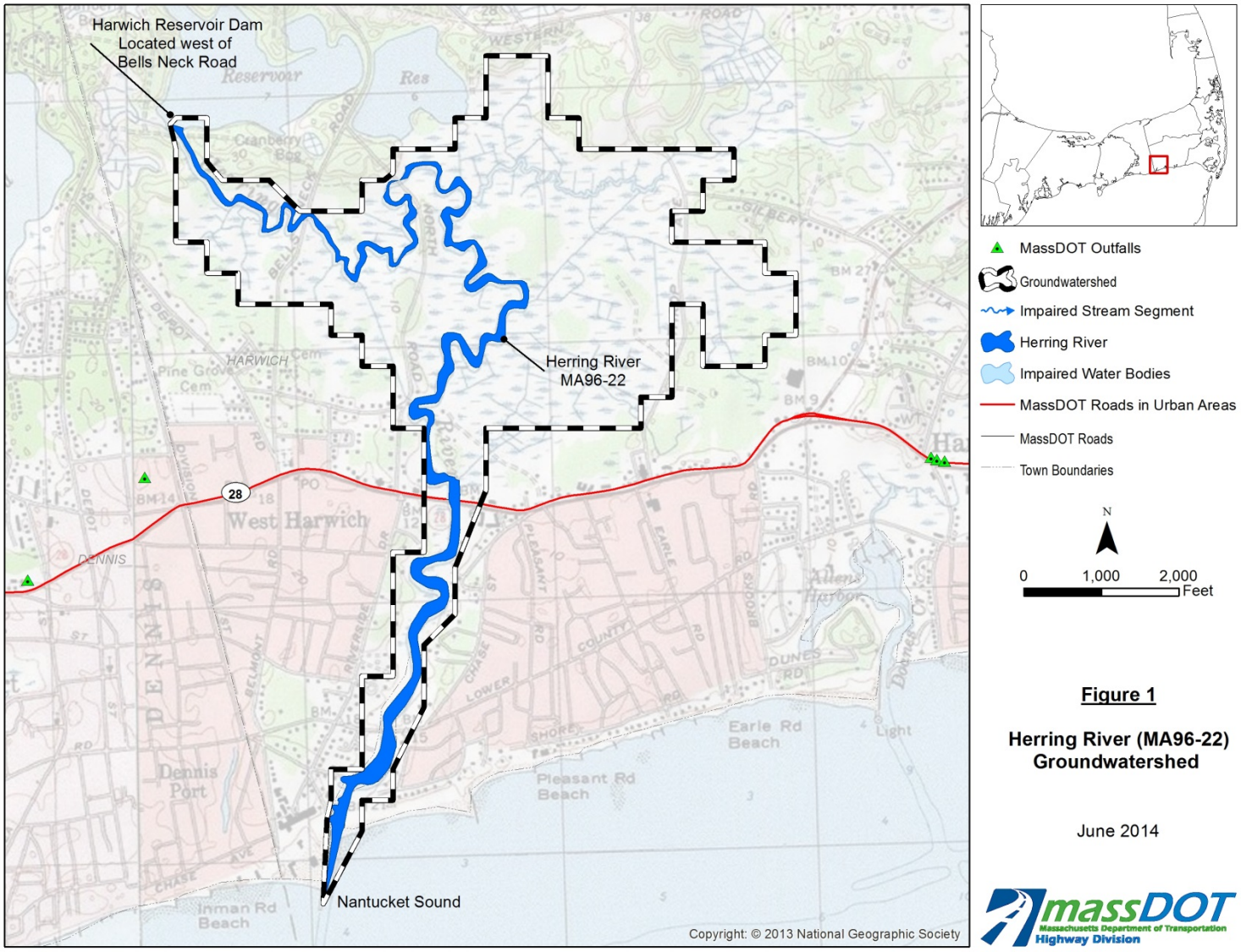

Figure 1

Herring River (MA96-22) Groundwatershed

June 2014

Impaired Waters Assessment for Saquatucket Harbor (MA96-23)

Impaired Water Body

Name: Saquatucket Harbor

Location: Harwich, MA

Water Body ID: MA96-23

Impairments

Saquatucket Harbor (MA96-23) is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Saquatucket Harbor is impaired for the following:

- Fecal Coliform

According to MassDEP's *Cape Cod Coastal Drainage Areas 2004-2008 Surface Water Quality Assessment Report* (MassDEP, 2011), the Massachusetts Division of Marine Fisheries (DMF) indicates that shellfish harvesting in Saquatucket Harbor is prohibited; cause is indicated as elevated fecal coliform bacteria, source is cited as waterfowl, on-site (septic) systems, and/or stormwater discharges from the municipal stormwater systems. Saquatucket Harbor is covered by the *Final Pathogen Total Maximum Daily Load (TMDL) for the Cape Cod Watershed* report (MassDEP, 2009b).

Relevant Water Quality Standards

Water Body Classification: Class SA

Applicable State Regulations:

- 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

Saquatucket Harbor (MA96-23) is a water body in Harwich, Massachusetts that covers approximately 19 acres, or 0.02 square miles. According to MassDEP's *Cape Cod Coastal Drainage Areas 2004-2008 Surface Water Quality Assessment Report* (MassDEP, 2011), there is one discharge to Saquatucket Harbor covered by an NPDES permit: Town of Sandwich (MAR041155).The water body extends south of Route 28, Harwich to confluence with Nantucket Sound. The watersheds and subwatersheds for Cape Cod were provided by USGS based on groundwater modeling developed under the Massachusetts Estuary Program (MEP) and contributing groundwater areas as delineated and published in the USGS 451 groundwater contributing areas data (Walter, et al., 2004; USGS 2009). The Cape Cod watersheds are based on groundwater delineations and not ground surface topography (USGS, 2009).

The closest MassDOT roadway to the Saquatucket Harbor is Route 28. The roadway is on the boundary of the groundwatershed, and therefore has the potential for stormwater to discharge to the groundwatershed. Refer to Figure 1 for the location of this roadway in relation to the watershed boundary.

BMP 7R for Pathogen TMDL (CN 252.0)

MassDOT assessed the bacteria (fecal coliform) pathogen impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP), which applies to impairments that have been assigned to a water body covered by a final TMDL (MassDOT, 2012). Saquatucket Harbor is covered by the *Final Pathogen TMDL for the Cape Cod Watershed* report (MassDEP, 2009b).

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, 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 *Bacteria Total Maximum Daily Load (TMDL) for the Cape Cod Watershed (CN 252.0)* covers the Saquatucket Harbor.

According to the *Final Pathogen TMDL for the Cape Cod Watershed* report (MassDEP, 2009b), sources of indicator bacteria in the Cape Cod watershed are believed to be primarily from boat wastes, failing septic systems, pets, wildlife, birds, and stormwater. The report contains bacteria sampling results and shoreline survey data collected by the DMF. Within MA96-30, DMF data reports that fecal coliform bacteria data was collected from 90 samples collected between the years 1996-2004; results ranged from 1.9 – >28 CFU/100ml with a geometric mean range of 3.0 – 10.9. The only indication as to pollution sources in DMF reports are the presence of large numbers of birds from time to time. Species include several varieties of ducks, as well as Canadian geese, Cormorants, Seagulls, and Terns. A sanitary survey conducted in 2001, and a triennial report in 2005 both indicate the possibility of bacteria sources from outhouses, cesspools or septic systems throughout the entire Barnstable Harbor area (including Scorton Creek). DMF recommends that the town of Barnstable Board of Health should check out these possible sources.

The MA Department of Public Health (DPH) sampled for enterococcus levels at East Sandwich Beach and Torrey Beach Community at least 13 times during 2006. At East Sandwich Beach results ranged between <2 and 110 CFU/100 ml with one closure. At Torrey Beach Community Association Beach results ranged between <2 and 234 CFU/100 ml with one failure (MDPH 2006).

Suspected and known dry-weather sources evaluated in the TMDL include failing septic systems, direct wildlife, recreational activities, stormwater drainage systems, leaking sewer pipes, and illicit boat discharges. Suspected and known wet weather sources include wildlife and domesticated animals, stormwater runoff (including municipal separate storm sewer systems), and sanitary sewer overflows.

The TMDL states that several impaired segments carry a higher priority due to their location, use, and risk to human health. The higher priority areas in the Cape Cod watershed stand out as likely priority areas to address bacteria pollution sources. These segments tend to be located nearest to sensitive areas such as Outstanding Resource Waters or designated uses that require higher water quality standards than Class B. Saquatucket Harbor (MA96-23) is listed as a medium priority due to its designation as Class SA and its uses for public swimming and shellfishing (MassDEP, 2009b)

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.

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 Cape Cod Watershed TMDL report (Section 8.0) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems
- Public education regarding illicit sewer connection and failing infrastructure, as well as stormwater runoff and boat wastes
- Identification and elimination of prohibited sources such as leaky or improperly connected sanitary sewer flows
- Best management practices to mitigate storm water runoff volume.

The TMDL report also indicates that structural BMPs may be appropriate if less costly non-structural BMPs are not effective. Many non-structural BMPs are in place, including public education and outreach, street sweeping, and catch basin cleanouts. In addition to practices like these, many communities have formed advisory committees to help resolve existing stormwater issues. Many of the communities on Cape Cod practice their own stormwater BMPs. Additionally, the TMDL states that implementation to achieve the TMDL goals should be an iterative process with selection and implementation of mitigation measures followed by monitoring to determine the extent of water quality improvement realized.

The following BMPs are specifically identified as being ongoing and/or planned in order to meet the bacteria TMDL for the Cape Cod Watershed:

- Septic tank controls
- Documentation of storm drain outfall locations
- Resident education
- Additional water quality monitoring
- Designation of “No Discharge” areas in high priority coastal waters
- The Town of Dennis has a pet waste disposal program and active IDDE program in place

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
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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 accordance with the BMPs identified in the TMDL report as planned measures to reach compliance with the Cape Cod Watershed bacteria TMDL report, 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 targeted 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.

Although the TMDL report also identifies the benefits of structural BMPs to address runoff from impervious areas in some instances, MassDOT feels that it is not a beneficial approach to implement these 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 towards 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, and the Final Bacteria TMDL for this impaired water body segment 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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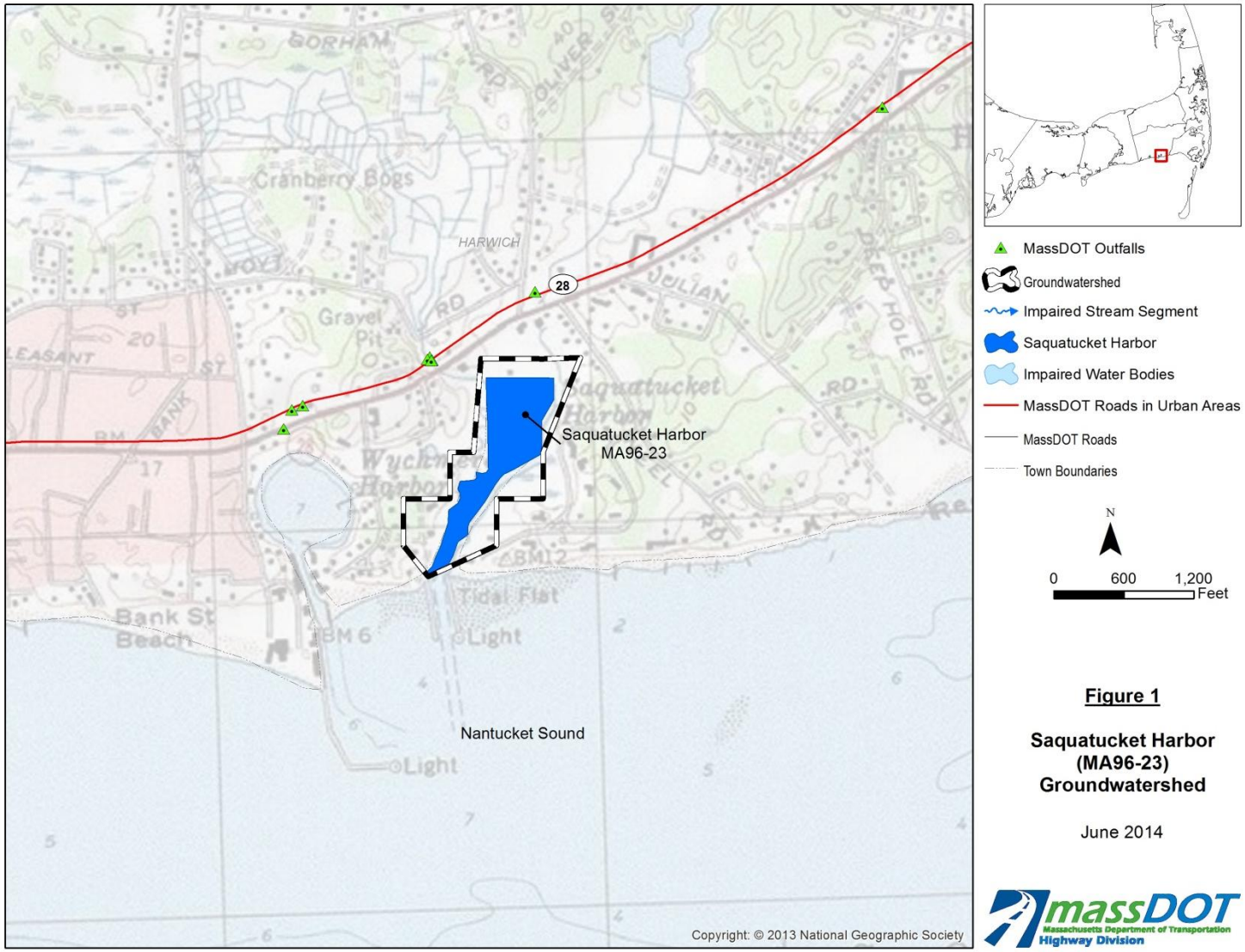

Figure 1

Saquatucket Harbor (MA96-23) Groundwatershed

June 2014

Impaired Waters Assessment for Little Namskaket Creek (MA96-26)

Impaired Water Body

Name: Little Namskaket Creek

Location: Orleans, MA

Water Body ID: MA96-26

Impairments

Little Namskaket Creek (MA96-26) is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Little Namskaket Creek is impaired for the following:

- Fecal Coliform

According to MassDEP's *Cape Cod Coastal Drainage Areas 2004-2008 Surface Water Quality Assessment Report* (MassDEP, 2011), Namskaket Creek is classified as an Outstanding Resource Water (ORW). The Massachusetts Division of Marine Fisheries (DMF) indicates that shellfish harvesting in Namskaket Creek is prohibited; cause is indicated as elevated fecal coliform bacteria, source is cited as waterfowl and/or stormwater discharges from the municipal stormwater systems. Namskaket Creek is covered by the *Final Pathogen Total Maximum Daily Load (TMDL) for the Cape Cod Watershed* report (MassDEP, 2009b).

Relevant Water Quality Standards

Water Body Classification: Class SA/ORW

Applicable State Regulations:

- 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

Little Namskaket Creek (MA96-26) is a water body in Orleans, Massachusetts that covers approximately 19 acres. The water body extends from the outlet of an unnamed pond north of Route 6A in Orleans to the creek's mouth at Cape Cod Bay in Brewster/Orleans. There are two discharges to Namskaket Creek covered by NPDES permits: Town of Brewster (MAR041096) and Town of Orleans (MAR041146).

The watersheds and subwatersheds for Cape Cod were provided by USGS based on groundwater modeling developed under the Massachusetts Estuary Program (MEP) and contributing groundwater areas as delineated and published in the USGS 451 groundwater contributing areas data (Walter, et al., 2004; USGS 2009). The Cape Cod watersheds are based on groundwater delineations and not ground surface topography (USGS, 2009).

The closest MassDOT roadways with the potential to directly contribute stormwater include Routes 6 and 6A, as well as the West Road bridge. Please refer to Figure 1 for the location of these roadways in relation to the watershed.

BMP 7R for Pathogen TMDL (CN 252.0)

MassDOT assessed the indicator bacteria (fecal coliform) pathogen impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP), which applies to impairments that have been assigned to a water body covered by a final TMDL (MassDOT, 2012). Namskaket Creek is covered by the *Final Pathogen TMDL for the Cape Cod Watershed* report (MassDEP, 2009b).

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, 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 *Bacteria Total Maximum Daily Load (TMDL) for the Cape Cod Watershed (CN 252.0)* covers the Little Namskaket Creek.

According to the *Final Pathogen TMDL for the Cape Cod Watershed* report (MassDEP, 2009b), sources of indicator bacteria in the Cape Cod watershed are believed to be primarily from boat wastes, failing septic systems, pets, wildlife, birds, and stormwater. The report contains bacteria sampling results and shoreline survey data collected by the DMF. Within MA96-27, DMF data reports that fecal coliform bacteria data was collected from 10 samples collected between the years 2000-2001; results ranged from 1.9 – 11 CFU/100ml.

The MA Department of Public Health sampled for enterococcus levels at Crosby Landing Beach and Ginnell Landing Beach at least 13 times within this segment during 2006. At Crosby Landing results ranged between <2 and 160 CFU/100 ml with one closure. At Ginnell Landing Beach results ranged between <2 and 56 CFU/100 ml with no closures.

Suspected and known dry-weather sources evaluated in the TMDL include failing septic systems, direct wildlife, recreational activities, stormwater drainage systems, leaking sewer pipes, and illicit boat discharges. Suspected and known wet weather sources include wildlife and domesticated animals, stormwater runoff (including municipal separate storm sewer systems), and sanitary sewer overflows.

The TMDL states that several impaired segments carry a higher priority due to their location, use, and risk to human health. The higher priority areas in the Cape Cod watershed stand out as likely priority areas to address bacteria pollution sources. These segments tend to be located nearest to sensitive areas such as Outstanding Resource Waters or designated uses that require higher water quality standards than Class B. Little Namskaket Creek (MA96-26) is listed as a medium priority due to its designation as Class SA and its uses for public swimming and shellfishing (MassDEP, 2009b).

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

In addition to the generic recommendations provided in the draft MS4 permits for Massachusetts, the Cape Cod Watershed TMDL report (Section 8.0) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems
- Public education regarding illicit sewer connection and failing infrastructure, as well as stormwater runoff and boat wastes
- Identification and elimination of prohibited sources such as leaky or improperly connected sanitary sewer flows
- Best management practices to mitigate storm water runoff volume.

The TMDL report also indicates that structural BMPs may be appropriate if less costly non-structural BMPs are not effective. Many non-structural BMPs are in place, including public education and outreach, street sweeping, and catch basin cleanouts. In addition to practices like these, many communities have formed advisory committees to help resolve existing stormwater issues. Many of the communities on Cape Cod practice their own stormwater BMPs. Additionally, the TMDL states that implementation to achieve the TMDL goals should be an iterative process with selection and implementation of mitigation measures followed by monitoring to determine the extent of water quality improvement realized

The following BMPs are specifically identified as being ongoing and/or planned in order to meet the bacteria TMDL for the Cape Cod Watershed:

- Septic tank controls

- Additional water quality monitoring
- Designation of “No Discharge” areas in high priority coastal waters
- The Town of Dennis has a pet waste disposal program and active IDDE program in place

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 accordance with the BMPs identified in the TMDL report as planned measures to reach compliance with the Cape Cod Watershed bacteria TMDL report, 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 targeted 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.

Although the TMDL report also identifies the benefits of structural BMPs to address runoff from impervious areas in some instances, MassDOT feels that it is not a beneficial approach to implement these 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 towards 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, and the Final Bacteria TMDL for this impaired water body segment 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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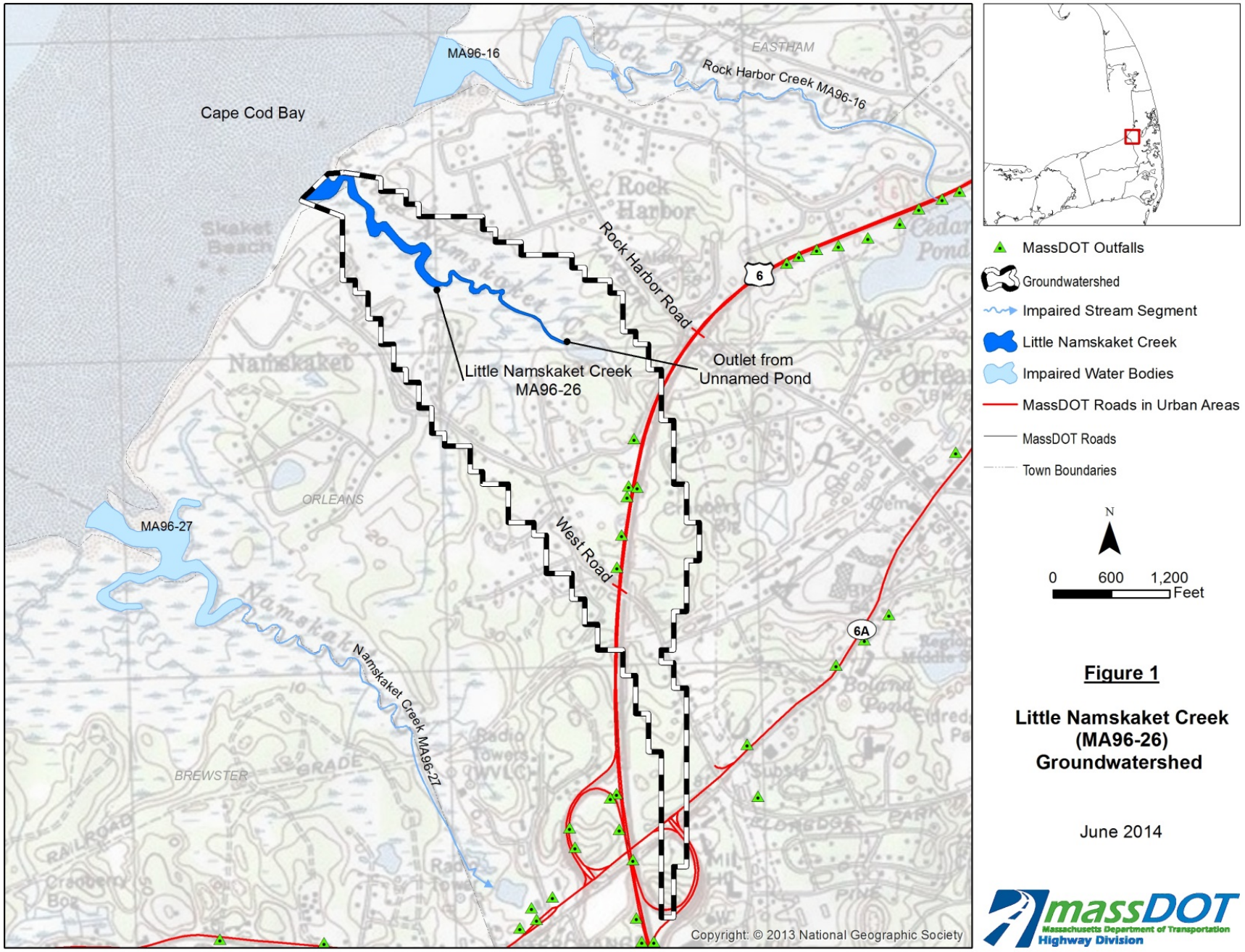

Figure 1

Little Namskaket Creek (MA96-26) Groundwatershed

June 2014

Impaired Waters Assessment for Scorton Creek (MA96-30)

Impaired Water Body

Name: Scorton Creek

Location: Sandwich, MA

Water Body ID: MA96-30

Impairments

Scorton Creek (MA96-30) is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Scorton Creek is impaired for the following:

- Fecal Coliform

According to MassDEP's *Cape Cod Coastal Drainage Areas 2004-2008 Surface Water Quality Assessment Report* (MassDEP, 2011), the Massachusetts Division of Marine Fisheries (DMF) indicates that shellfish harvesting in Scorton Creek is prohibited; cause is indicated as elevated fecal coliform bacteria, source is cited as waterfowl, on-site (septic) systems, and/or stormwater discharges from the municipal stormwater systems. Scorton Creek is covered by the *Final Pathogen Total Maximum Daily Load (TMDL) for the Cape Cod Watershed* report (MassDEP, 2009b).

Relevant Water Quality Standards

Water Body Classification: Class SA

Applicable State Regulations:

- 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

Scorton Creek (MA96-30) is a water body in Sandwich, Massachusetts that covers approximately 0.03 square miles. The water body extends from Jones Lane to the creek's mouth at Cape Cod Bay. The closest MassDOT roadway is Route 6A (Cranberry Highway), which passes through the groundwatershed. According to MassDEP's *Cape Cod Coastal Drainage Areas 2004-2008 Surface Water Quality Assessment Report* (MassDEP, 2011), there is one discharge to Scorton Creek covered by an NPDES permit: Town of Sandwich (MAR041155).

The watersheds and subwatersheds for Cape Cod were provided by USGS based on groundwater modeling developed under the Massachusetts Estuary Program (MEP) and contributing groundwater areas as delineated and published in the USGS 451 groundwater contributing areas data (Walter, et al., 2004; USGS 2009). The Cape Cod watersheds are based on groundwater delineations and not ground surface topography (USGS, 2009). Refer to Figure 1 for the watershed to Segment MA96-30 of Scorton Creek.

BMP 7R for Pathogen TMDL (CN 252.0)

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP), which applies to impairments that have been assigned to a water body covered by a final TMDL (MassDOT, 2012). Scorton Creek is covered by the *Final Pathogen TMDL for the Cape Cod Watershed* report (MassDEP, 2009b).

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, 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 Final Pathogen Total Maximum Daily Load (TMDL) for the Cape Cod Watershed (CN252.0) covers the Scorton Creek.

According to the *Final Pathogen TMDL for the Cape Cod Watershed* report (MassDEP, 2009b), sources of indicator bacteria in the Cape Cod watershed are believed to be primarily from boat wastes, failing septic systems, pets, wildlife, birds, and stormwater. The report contains bacteria sampling results and shoreline survey data collected by the DMF. Within MA96-30, DMF data reports that fecal coliform bacteria data was collected from 90 samples collected between the years 1996-2004; results ranged from 1.9 – >28 CFU/100ml with a geometric mean range of 3.0 – 10.9. The only indication as to pollution sources in DMF reports are the presence of large numbers of birds from time to time. Species include several varieties of ducks, as well as Canadian geese, Cormorants, Seagulls, and Terns. A sanitary survey conducted in 2001, and a triennial report in 2005 both indicate the possibility of bacteria sources from outhouses, cesspools or septic systems throughout the entire Barnstable Harbor area (including Scorton Creek). DMF recommends that the town of Barnstable Board of Health should check out these possible sources.

The MA Department of Public Health (DPH) sampled for enterococcus levels at East Sandwich Beach and Torrey Beach Community at least 13 times during 2006. At East Sandwich Beach results ranged between <2 and 110 CFU/100 ml with one closure. At Torrey Beach Community Association Beach results ranged between <2 and 234 CFU/100 ml with one failure (MassDEP, 2009b).

Suspected and known dry-weather sources evaluated in the TMDL include failing septic systems, direct wildlife, recreational activities, stormwater drainage systems, leaking sewer pipes, and illicit boat discharges. Suspected and known wet weather sources include wildlife and domesticated animals, stormwater runoff (including municipal separate storm sewer systems), and sanitary sewer overflows.

The TMDL states that several impaired segments carry a higher priority due to their location, use, and risk to human health. The higher priority areas in the Cape Cod watershed stand out as likely priority areas to address bacteria pollution sources. These segments tend to be located nearest to sensitive areas such as Outstanding Resource Waters or designated uses that require higher water quality standards than Class B. Scorton Creek (MA96-30) is listed as a medium priority due to its designation as Class SA and its uses for public swimming and shellfishing (MassDEP, 2009b).

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.

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 Cape Cod Watershed TMDL report (Section 8.0) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems
- Public education regarding illicit sewer connection and failing infrastructure, as well as stormwater runoff and boat wastes

- Identification and elimination of prohibited sources such as leaky or improperly connected sanitary sewer flows
- Best management practices to mitigate storm water runoff volume

The TMDL report also indicates that structural BMPs may be appropriate if less costly BMPs are not effective. Many non-structural BMPs are in place, including public education and outreach, street sweeping, and catch basin cleanouts. In addition to practices like these, many communities have formed advisory committees to help resolve existing stormwater issues. Many of the communities on Cape Cod practice their own stormwater BMPs.

The following BMPs are specifically identified as being ongoing and/or planned in order to meet the bacteria TMDL for the Cape Cod Watershed:

- Septic tank controls
- Documentation of storm drain outfall locations
- Resident education
- Additional water quality monitoring
- Designation of “No Discharge” areas in high priority coastal waters

The Town of Dennis has a pet waste disposal program and active IDDE program in place.

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 accordance with the BMPs identified in the TMDL report as planned measures to reach compliance with the Cape Cod Watershed bacteria TMDL report, MassDOT has documented the locations of its stormwater outfalls. In addition, as part of its pet waste management program, MassDOT has determined that no targeted MassDOT targeted 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.

Although the TMDL report also identifies the benefits of riparian restoration and structural BMPs to address runoff from impervious areas in some instances, MassDOT feels that it is not a beneficial approach to implement these 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 towards 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, and the Final Bacteria TMDL for this impaired water body segment 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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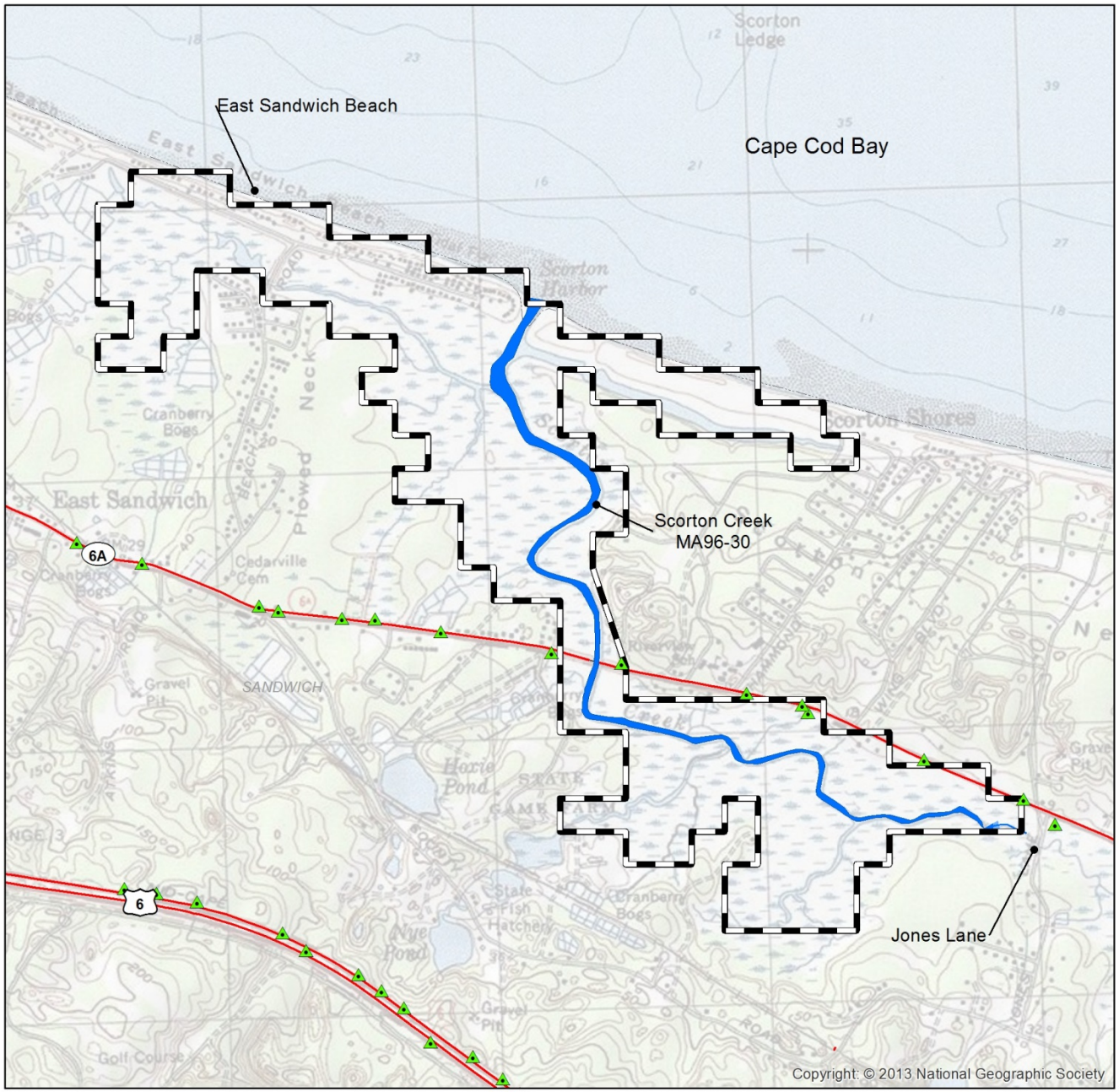

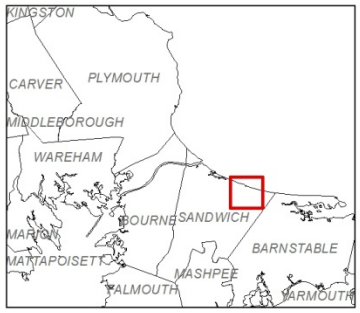

MassDOT Outfalls
Groundwatershed
Scorton Creek
Impaired Streams
Impaired Water Bodies
MassDOT Roads in Urban Areas
MassDOT Roads
Town Boundaries

N

0 1,200 2,400 Feet

Figure 1

Scorton Creek (MA96-30) Groundwatershed

June 2014

massDOT Massachusetts Department of Transportation Highway Division

Impaired Waters Assessment for Parkers River (MA96-38)

Impaired Water Body

Name: Parkers River

Location: Yarmouth, MA

Water Body ID: MA96-38

Impairments

Parkers River (MA96-38) is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Parkers River is impaired for the following:

- Fecal Coliform

According to MassDEP's *Cape Cod Coastal Drainage Areas 2004-2008 Surface Water Quality Assessment Report* (MassDEP, 2011), 0.03 square miles of Segment MA96-38 of Parkers River is impaired for shellfish harvesting, and the entire segment is supported for primary and secondary contact. The Massachusetts Division of Marine Fisheries (DMF) indicates that approximately 10% of this water body is prohibited, 66% of this water body is conditionally approved, and 24% is approved for shellfish harvesting; cause is indicated as elevated fecal coliform bacteria, source is cited as marina/boating pump out releases, waterfowl, pets, and/or stormwater discharges from the municipal stormwater systems. Parkers River is covered by the *Final Pathogen Total Maximum Daily Load (TMDL) for the Cape Cod Watershed* report (MassDEP, 2009b).

Relevant Water Quality Standards

Water Body Classification: Class SA

Applicable State Regulations:

- 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

Parkers River (MA96-38) is a water body in Yarmouth, Massachusetts that covers approximately 0.04 square miles. Parkers River flows from Long Pond through a tidal estuary called Seine Pond to the river's mouth at Nantucket Sound. Segment MA96-38 of Parkers River begins at the outlet of Seine Pond. The closest MassDOT roadway is Route 28, which crosses through the watershed. There is one discharge to Parkers River covered by an NPDES permit: Town of Yarmouth (MAR041176) (MassDEP, 2011).

The watersheds and subwatersheds for Cape Cod were provided by USGS based on groundwater modeling developed under the Massachusetts Estuary Program (MEP) and contributing groundwater areas as delineated and published in the USGS 451 groundwater contributing areas data (Walter, et al., 2004; USGS 2009). The Cape Cod watersheds are based on groundwater delineations and not ground surface topography (USGS, 2009). Refer to Figure 1 for the total and subwatershed to Segment MA96-38 of Parkers River.

BMP 7R for Pathogen TMDL (CN 252.0)

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP), which applies to impairments that have been assigned to a water body covered by a final TMDL (MassDOT, 2012). Parkers River is covered by the *Final Pathogen TMDL for the Cape Cod Watershed* (MassDEP, 2009b).

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, 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 *Bacteria Total Maximum Daily Load (TMDL) for the Cape Cod Watershed (CN 252.0)* covers Parkers River. According to the *Final Pathogen TMDL for the Cape Cod Watershed* report (MassDEP, 2009b), sources of indicator bacteria in the Cape Cod watershed are believed to be primarily from boat wastes, failing septic systems, pets, wildlife, birds, and stormwater. It should be

noted that bacteria from wildlife would be considered a natural condition unless some form of human inducement, such as feeding, is causing congregation of wild birds or animals. Suspected and known dry-weather sources evaluated in the TMDL include failing septic systems, direct wildlife, recreational activities, stormwater drainage systems, leaking sewer pipes, and illicit boat discharges. Suspected and known wet weather sources include wildlife and domesticated animals, stormwater runoff (including municipal separate storm sewer systems), and sanitary sewer overflows (MassDEP, 2009b).

The report contains bacteria sampling results and shoreline survey data collected by the DMF. Within MA96-38, DMF data reports that fecal coliform bacteria data was collected from 599 samples collected between the years 1996-2003; results ranged from 1.9 – 51 CFU/100ml. The DMF conducted a thorough shoreline survey during March 2003 and found that all residences have individual septic systems. The town of Yarmouth has strict regulations regarding septic systems and there was no documentation of system failures at the time of the survey. The survey noted five potential sources from stormwater inputs, mostly from roadways. The five out of the fifteen streams and creeks that feed Parkers River with the highest potential contribution are located between Seine Pond and Route 28. One of these water bodies is located near a zooquarium property (houses exotic birds and other wildlife) on Route 28. A marina is located nearby on the eastern shore of Parkers River, just south of Route 28. A large cranberry bog drains into Seine Pond on the north side and there are houses around the pond. The pond is the scene of large annual herring runs and numerous birds have been observed in the area. Boating activities have been observed on the pond. For these reasons, Seine Pond is also a potential contributor to Parkers River (MassDEP, 2009b).

The TMDL summarizes sampling data from MA Department of Public Health (DPH). DPH sampled for enterococcus levels at Parker's River Beach East, Parker's River Beach West, and Seagull Beach, at least 13 times 2006. Results ranged between <2 and 78 CFU/100 ml at East Beach with no closures, and between <2 and 110 CFU/100 ml at West Beach, with one closure. Results for the three locations on Seagull Beach (East, West, and Back) ranged between <2 and 40 CFU/100 ml with no closures at either of the beaches (MassDEP, 2009b).

The TMDL states that several impaired segments carry a higher priority due to their location, use, and risk to human health. The higher priority areas in the Cape Cod watershed stand out as likely priority areas to address bacteria pollution sources. These segments tend to be located nearest to sensitive areas such as Outstanding Resource Waters or designated uses that require higher water quality standards than Class B. Mill Creek (MA96-37) is not prioritized due to insufficient data. It is designated as Class SA and is a shellfishing resource (MassDEP, 2009b).

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.

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 Cape Cod Watershed TMDL report (Section 8.0) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems
- Public education regarding illicit sewer connection and failing infrastructure, as well as stormwater runoff and boat wastes
- Identification and elimination of prohibited sources such as leaky or improperly connected sanitary sewer flows
- Best management practices to mitigate storm water runoff volume.

The TMDL report also indicates that structural BMPs may be appropriate if less costly non-structural BMPs are not effective. Many non-structural BMPs are in place, including public education and outreach, street sweeping, and catch basin cleanouts. In addition to practices like these, many communities have formed advisory committees to help resolve existing stormwater issues. Many of the communities on Cape Cod practice their own stormwater BMPs. Additionally, the TMDL states that implementation to achieve the TMDL goals should be an iterative process with selection and implementation of mitigation measures followed by monitoring to determine the extent of water quality improvement realized.

The following BMPs are specifically identified as being ongoing and/or planned in order to meet the bacteria TMDL for the Cape Cod Watershed:

- Septic tank controls
- Documentation of storm drain outfall locations
- Resident education
- Additional water quality monitoring
- Designation of “No Discharge” areas in high priority coastal waters

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
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- 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 accordance with the BMPs identified in the TMDL report as planned measures to reach compliance with the Cape Cod Watershed bacteria TMDL report, MassDOT has documented the locations of its stormwater outfalls. 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.

Although the TMDL report also identifies the benefits of riparian restoration and structural BMPs to address runoff from impervious areas in some instances, MassDOT feels that it is not a beneficial approach to implement these 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 towards 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, and the Final Bacteria TMDL for this impaired water body segment 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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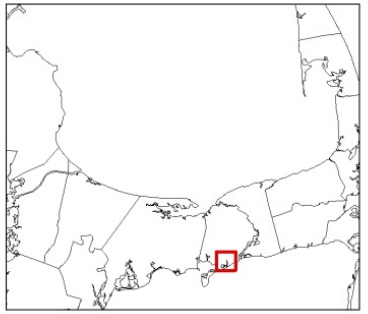

MassDOT Outfalls

Groundwatershed

Impaired Stream Segment

MassDOT Roads in Urban Areas

Parkers River

Impaired Water Bodies

MassDOT Roads

Town Boundaries

N

0 600 1,200 Feet

Figure 1

Parkers River (MA96-38) Groundwatershed

June 2014

massDOT Massachusetts Department of Transportation Highway Division

Impaired Waters Assessment for Mill Creek (MA96-41)

Impaired Water Body

Name: Mill Creek

Location: Chatham, MA

Water Body ID: MA96-41

Impairments

Mill Creek (MA96-41) is listed under Category 4A, "TMDL is Completed", on MassDEP's final *Massachusetts Year 2012 Integrated List of Waters* (MassDEP, 2013). Mill Creek is impaired for the following:

- Fecal Coliform

According to MassDEP's *Cape Cod Coastal Drainage Areas 2004-2008 Surface Water Quality Assessment Report* (MassDEP, 2011), Mill Creek is impaired for shellfish harvesting and supported for aquatic life. No other uses have been assessed. The Massachusetts Division of Marine Fisheries (DMF) indicates that shellfish harvesting in Mill Creek is conditionally approved. This restriction is likely due to elevated fecal coliform bacteria associated with waterfowl, pet waste, and/or stormwater discharges from the municipal stormwater systems. Mill Creek is covered by the *Final Pathogen Total Maximum Daily Load (TMDL) for the Cape Cod Watershed* report (MassDEP, 2009b).

Relevant Water Quality Standards

Water Body Classification: Class SA

Applicable State Regulations:

- 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

Mill Creek (MA96-41) is a water body in Chatham, Massachusetts that covers approximately 0.03 square miles. The water body extends from the outlet of Taylors Pond (MA96-42) to its confluence with Cockle Cove. There are no discharges to Mill Creek covered by an NPDES permit. The closest MassDOT roadway, Route 28 (Main Street), passes through the watershed approximately 1,500 ft northwest of Mill Creek (MassDEP, 2011).

The watersheds and subwatersheds for Cape Cod were provided by USGS based on groundwater modeling developed under the Massachusetts Estuary Program (MEP) and contributing groundwater areas as delineated and published in the USGS 451 groundwater contributing areas data (Walter, et al., 2004; USGS 2009). The Cape Cod watersheds are based on groundwater delineations and not ground surface topography (USGS, 2009). Refer to Figure 1 for the watershed to Segment MA96-41 of Mill Creek.

BMP 7R for Pathogen TMDL (CN 252.0)

MassDOT assessed the indicator bacteria (fecal coliform) impairment using the approach described in BMP 7R of MassDOT's Storm Water Management Plan (SWMP), which applies to impairments that have been assigned to a water body covered by a final TMDL (MassDOT, 2012). Mill Creek is covered by the *Final Pathogen TMDL for the Cape Cod Watershed* (MassDEP, 2009b).

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, 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 *Bacteria Total Maximum Daily Load (TMDL) for the Cape Cod Watershed (CN 252.0)* covers Mill Creek. According to the *Final Pathogen TMDL for the Cape Cod Watershed* report (MassDEP, 2009b), sources of indicator bacteria in the Cape Cod watershed are believed to be primarily from boat wastes, failing septic systems, pets, wildlife, birds, and stormwater. It should be noted that

bacteria from wildlife would be considered a natural condition unless some form of human inducement, such as feeding, is causing congregation of wild birds or animals. Suspected and known dry-weather sources evaluated in the TMDL include failing septic systems, direct wildlife, recreational activities, stormwater drainage systems, leaking sewer pipes, and illicit boat discharges. Suspected and known wet weather sources include wildlife and domesticated animals, stormwater runoff (including municipal separate storm sewer systems), and sanitary sewer overflows (MassDEP, 2009b).

The report contains bacteria sampling results and shoreline survey data collected by the DMF. Within MA96-41, DMF data reports that fecal coliform bacteria data was collected from 45 samples collected between the years 1996-2003; results ranged from 1.9 – 51 CFU/100ml with a geometric mean range of 2.2 – 2.4 CFU/100 ml. Data from a DMF shoreline survey indicated that no septic system failures were observed. They identified six stormwater runoff sites were identified and set up stations to monitor future rain events. There are several streams and creeks nearby which were not found to pose threats to Mill Creek. There are no marinas and little boating activity in the area of Mill Creek, and large numbers of geese and ducks were occasionally observed. The area was determined to have high water quality, and is conditionally approved for shellfishing (MassDEP, 2009b).

The TMDL states that several impaired segments carry a higher priority due to their location, use, and risk to human health. The higher priority areas in the Cape Cod watershed stand out as likely priority areas to address bacteria pollution sources. These segments tend to be located nearest to sensitive areas such as Outstanding Resource Waters or designated uses that require higher water quality standards than Class B. Mill Creek (MA96-41) is listed as a low “dry” weather priority and a medium “wet” weather priority. It is designated as Class SA and is a shellfishing resource (MassDEP, 2009b).

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.

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 Cape Cod Watershed TMDL report (Section 8.0) recommends the following specific BMPs to address elevated fecal coliform levels in the watershed:

- Correction of failing septic systems
- Public education regarding illicit sewer connection and failing infrastructure, as well as stormwater runoff and boat wastes
- Identification and elimination of prohibited sources such as leaky or improperly connected sanitary sewer flows
- Best management practices to mitigate storm water runoff volume.

The TMDL report also indicates that structural BMPs may be appropriate if less costly non-structural BMPs are not effective. Many non-structural BMPs are in place, including public education and

outreach, street sweeping, and catch basin cleanouts. In addition to practices like these, many communities have formed advisory committees to help resolve existing stormwater issues. Many of the communities on Cape Cod practice their own stormwater BMPs. Additionally, the TMDL states that implementation to achieve the TMDL goals should be an iterative process with selection and implementation of mitigation measures followed by monitoring to determine the extent of water quality improvement realized.

The following BMPs are specifically identified as being ongoing and/or planned in order to meet the bacteria TMDL for the Cape Cod Watershed:

- Septic tank controls
- Documentation of storm drain outfall locations
- Resident education
- Additional water quality monitoring
- Designation of “No Discharge” areas in high priority coastal waters

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 accordance with the BMPs identified in the TMDL report as planned measures to reach compliance with the Cape Cod Watershed bacteria TMDL report, MassDOT has documented the locations of its stormwater outfalls. 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.

Although the TMDL report also identifies the benefits of riparian restoration and structural BMPs to address runoff from impervious areas in some instances, MassDOT feels that it is not a beneficial approach to implement these 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 towards 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, and the Final Bacteria TMDL for this impaired water body segment 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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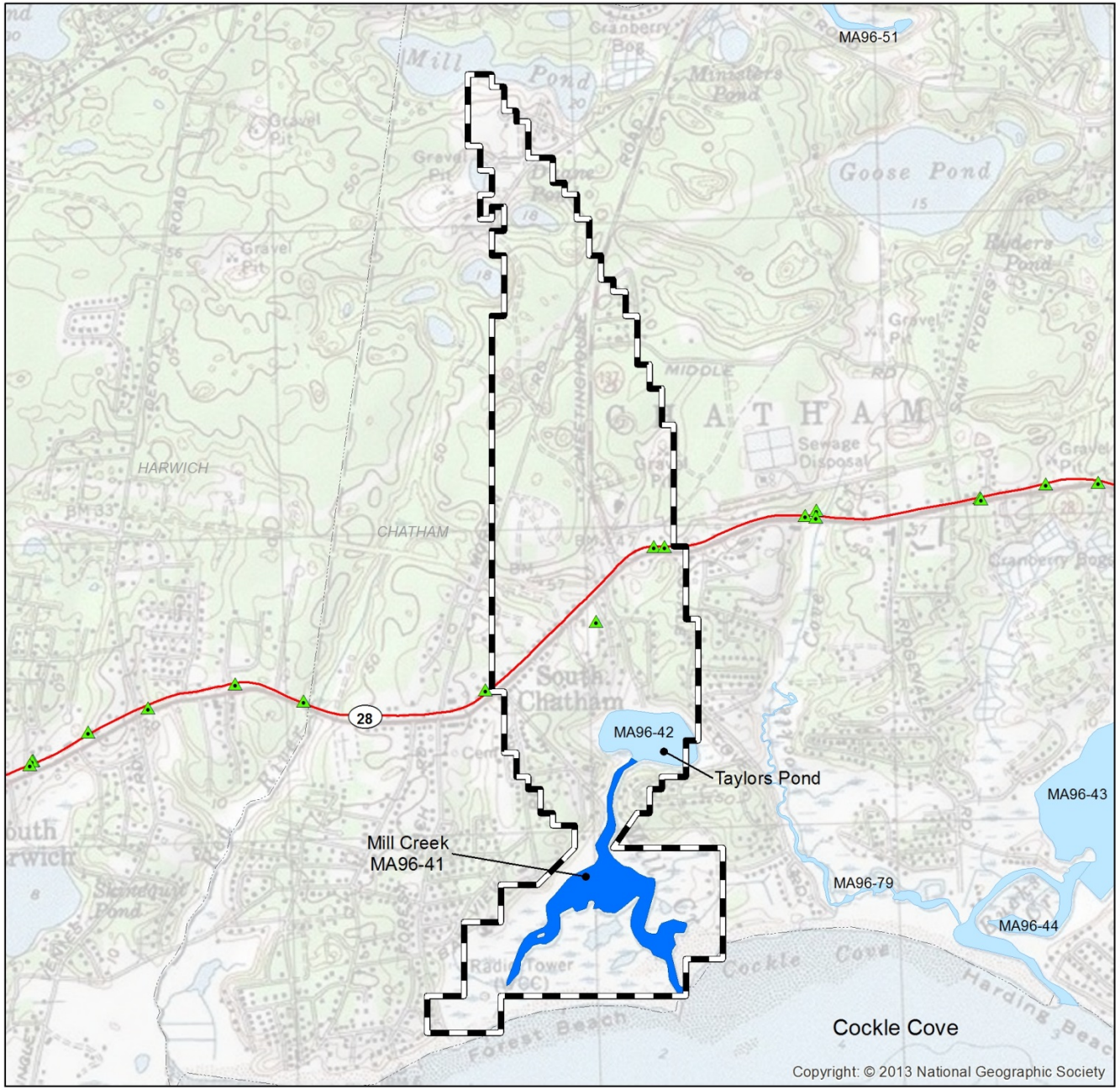

MassDOT Outfalls

Groundwatershed

Impaired Streams

Mill Creek

Impaired Water Bodies

MassDOT Roads in Urban Areas

MassDOT Roads

Town Boundaries

N

0 1,000 2,000 Feet

Figure 1

Mill Creek (MA96-41) Groundwatershed

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massDOT Massachusetts Department of Transportation Highway Division