Attachment 7:

Phosphorus Groundwater Assessments

Attachment 7 includes 2 assessments for water bodies that are phosphorous impaired and are located within a USGS delineated groundwatershed on Cape Cod or Buzzards Bay.

List of Impaired Water Bodies

MA95115	Parker Mills Pond
MA96050	Crystal Lake

massDOT Massachusetts Department of Transportation Highway Division

06/08/2015

Impaired Waters Assessment for Parker Mills Pond (MA95115)

Summary

Impaired Waters[1]	Impairments:	*Stormwater: Phosphorus (Total)*
	Non-Stormwater[2]:	*Non-native aquatic plants*
	Category:	*5 (Waters requiring a TMDL)*
	Final TMDLs:	*None*
	WQ Assessment:	*Buzzards Bay Watershed 2000 Water Quality Assessment Report*[3]
Location	Towns:	*Wareham*
	MassDOT Roads:	*I-195, I-495, Route 28*
Assessment Methods(s)	7R (TMDL Method) ☐	7U (Non-TMDL Method) ☒
BMPs	Existing:	*None*

Site Description

Parker Mills Pond (MA95115) is a 105-acre waterbody located north of Route 28 and south of I-495 in Wareham, Massachusetts. Parker Mills Pond (MA95115) receives flow from Tihonet Pond on the north side of the pond and from Harlow Brook (which is not impaired) to the northeast. The outflow from Parker Mills Pond on the south side of the pond flows to Wankinco River (MA95-50).

The groundwatersheds for portions of Buzzards Bay, including this impaired segment, were provided by the Buzzards Bay National Estuaries Program (BBNEP) [4] as modified from the USGS groundwater delineations developed under the Massachusetts Estuary Program (MEP) and contributing groundwater areas as delineated and published in the USGS 451 groundwater contributing areas data.[5,6] The watersheds for Cape Cod and adjacent Southeastern

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

[2] MassDEP, December 2012. Impaired Waters Assessment for Impaired Waters with Impairments Unrelated to Stormwater. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/impairedWaters/Year3/Year3_ImpairedWatersAssessment_1.pdf#page=308

[3] MassDEP, November 2003. Buzzards Bay Watershed 2000 Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/95wqar1.pdf

[4] BBNEP, 2014. Shapefile coverage of watershed boundaries via email from Joe Costa on September 9, 2014.

[5] USGS. (2009). Groundwater contributing areas for Cape Cod and Plymouth-Carver Regions of Massachusetts. Data Series 451 (1 of 3).

Massachusetts Communities are based on groundwater delineations and not ground surface topography. Figure 1 illustrates the groundwatershed for Parker Mills Pond.

MassDEP's *Buzzards Bay Watershed 2000 Water Quality Assessment Report*[3] identifies the Aquatic Life Use, Primary and Secondary Contact Uses, and Aesthetics with an "impaired" status based on the presence of non-aquatic plants and high concentrations of phosphate. The suspected sources of impairment include highway/road runoff and irrigated, specialty crop production related to cranberry bogs. In addition, *Buzzards Bay Watershed 2000 Water Quality Assessment Report* notes that phosphorous is contributing to the impairments for the water body.[3] Fish Consumption Use is listed as" not assessed".

MassDOT property within the groundwatershed of Parker Mills Pond includes I-195, I-495, and Route 28 (Figure 1).

Interstate 195 crosses the groundwatershed in a north-south direction, approximately 0.75 miles west of Parker Mills Pond. Runoff from I-195 is collected by catch basins discharging to depressed areas next to the road, but not directly to Parker Mills Pond. Although I-195 is a MassDOT roadway located within the groundwatershed of this waterbody, stormwater discharges from this roadway do not directly discharge to the water body and is therefore not considered to contribute to the waterbody impairment. Parker Mills Pond is an inland lake impaired for total phosphorous. Phosphorus is removed from surface runoff through infiltration, filtration and sorption processes through the natural soil before reaching groundwater.[7] Therefore, MassDOT has only considered direct surface runoff to Parker Mills Pond as a contributing cause of the impairment.

Interstate I-495 traverses the groundwatershed in an east-west direction. It should be noted that although the area between the I-495 interchange at the western edge of the groundwatershed boundary and the eastern boundary of the groundwatershed in the vicinity of Harlow Brook is not located within the urban area and therefore not within the MS4 permit area, it has been included in the assessment as road to be evaluated for direct discharges due to its close proximity to urban area immediately to the west and to the east. A portion of I-495 at the eastern boundary of the groundwatershed discharges directly to Harlow Brook (Figure 2a), upstream of the location where Harlow Brook discharges to Parker Mills Pond. This section of I-495 is considered direct discharge, due to the short distance from the discharge point to Parker Mills Pond. The remaining portion of I-495 from the north bound off-ramp west to the Harlow Brook crossing discharges stormwater runoff through paved spillways to the swales located in the median between the south and north bound of I-495, and then discharges to Parker Mills Pond. Due to the short flow path through the swales and close proximity to the point of discharge, this section of I-495 is considered direct contribution to Parker Mills Pond.

Route 28 is a MassDOT-owned two-lane roadway traversing the groundwatershed in an east-west direction. Based on field observations, runoff from a portion of Route 28 discharges directly to Parker Mills Pond via a paved spillway. The MassDOT directly discharging property extends from approximately 1,900 feet west of the western groundwatershed boundary to the east boundary of the groundwatershed, as shown on Figure 2b. A portion of this impervious cover is located outside of the groundwatershed boundary.

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[6] Walter, D.A., Masterson, J.P., and Hess, K.M., 2004, Ground-Water Recharge Areas and Travel times to Pumped Wells, Ponds, Streams, and Coastal Water Bodies, Cape Cod, Massachusetts, Scientific Investigations Map I-2857, 1 sheet. Available at: http://pubs.water.usgs.gov/sim20042857.

[7] NCHRP, 2006. Report 565: Evaluation of Best Management Practices for Highway Runoff Control. Transportation Research Board of the National Academies.

Existing BMPs

MassDOT did not identify any existing BMPs in place to treat roadway runoff from the directly discharging area before reaching the impaired water segment.

Assessment

In cases where a TMDL has been approved, MassDOT assesses the water body for the impairments covered by the TMDL under the BMP 7R methodology.[8] MassDOT separately assesses the water body for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology.[9] MassDOT assessed Parker Mills Pond (MA95115) using the methodologies described below.

MassDOT has identified a subset of water body impairments in the Parker Mills Pond watershed that are not related to stormwater runoff. These impairments include non-native aquatic plants. In accordance with MassDOT's *Impaired Waters Assessment for Impaired Waters with Impairments Unrelated to Stormwater* in the December 8, 2012 EPA submittal, the non-stormwater related impairments are not specifically addressed as part of the Impaired Waters Program.[2]

This assessment has been completed based on the Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act.[1] MassDEP has released a Proposed Massachusetts Year 2014 Integrated List[10] which has been reviewed for any proposed changes to the condition of the water bodies. The condition of Parker Mills Pond (MA95115) is not proposed to change.

BMP 7U for Highway Related Impairments

A final TMDL is not in place to address Parker Mills Pond (MA95115) following impairments: total phosphorous. Therefore, MassDOT assessed the stormwater-related impairments not addressed by a TMDL using the approach outlined in BMP 7U.[9]

MassDOT is not aware of any published literature definitively establishing a phosphorous loading goal for this waterbody. Because this assessed water body is located within a USGS delineated groundwatershed rather than surface watershed, MassDOT's IC Methodology is not applicable for establishing a target. In the absence of a credible and supportable goal for phosphorous loading for the water body, MassDOT is unable to establish a MassDOT phosphorous contribution. Therefore, MassDOT will conservatively implement BMPs to treat its stormwater runoff to the assessed segment to the maximum extent practical.

This assessment has identified locations for potential stormwater BMPs. The Proposed Mitigation Plan describes the next steps for the potential BMPs to treat MassDOT roadway runoff to the maximum extent practical before it discharges to the assessed water body.

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[8] MassDOT, July 2010. BMP 7R: TMDL Watershed Review. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7R_TMDL_WatershedReview.pdf

[9] MassDOT, April 2010. BMP 7U: Water Quality Impaired Waters Assessment and Mitigation Plan. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7U_ImpairedWaterbodiesAssessment.pdf

[10] MassDEP, June 2014. Massachusetts Year 2014 Integrated List of Waters – Proposed Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. Massachusetts. Available at: http://www.mass.gov/eea/docs/dep/water/resources/07v5/14iwlistp.pdf

Proposed Mitigation Plan

During this assessment phase of the Impaired Waters Program, MassDOT has focused on directly contributing areas and identified opportunities for BMPs that could be constructed entirely on MassDOT property without resulting in substantial wetland impacts or resulting in an adverse impact on historical or archeological resources. Projects meeting those requirements can be implemented under the Impaired Waters Program Retrofit Initiative.

MassDOT has identified that additional control measures are needed to reduce its phosphorus loading within the directly contributing watershed and, after an initial review of the area, feels that appropriate locations are potentially available for control measures, such as curb cuts directing stormwater to an infiltration swale along I-495 or Route 28. MassDOT will now work with its design consultants to identify locations suitable for construction of additional BMPs to treat stormwater runoff from directly contributing MassDOT property as part of MassDOT's Impaired Waters Retrofit Initiative. The project designer will gather additional information in this phase, such as soil data, wetland delineations, and site survey, to further refine the proposed BMPs. The design consultants will develop construction plans for BMPs that will aim to provide pollutant load reduction to the maximum extent practical.

Once the design of the proposed BMPs is finalized, MassDOT will provide an update in the NPDES permit annual report with BMP information and summarize the final phosphorus reduction.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the groundwatershed of Parker Mills Pond, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design either through retrofit or programmed projects, plans for construction of BMPs, reduction achieved by finalized BMP designs and progress made towards achieving phosphorus load reductions.

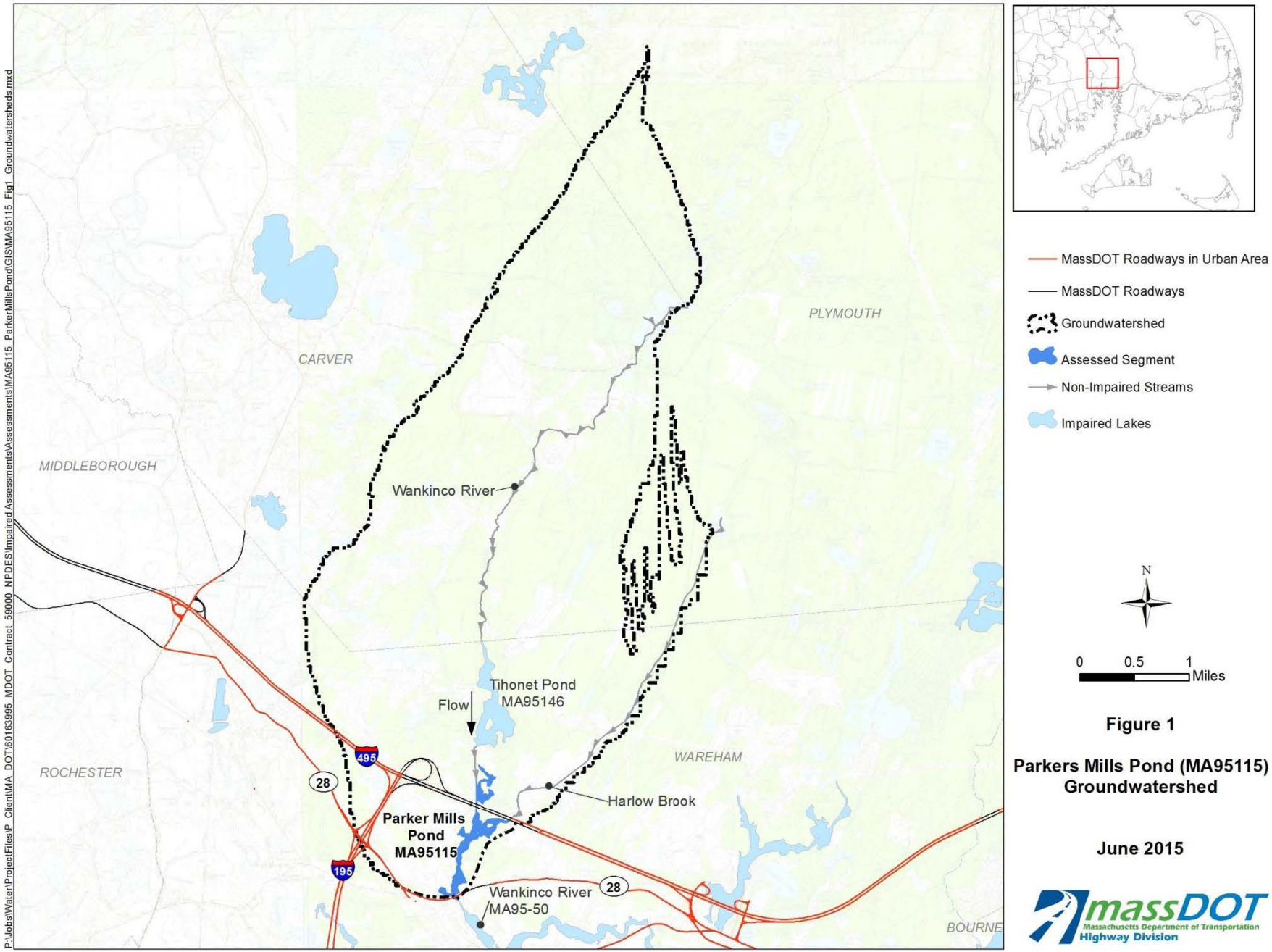
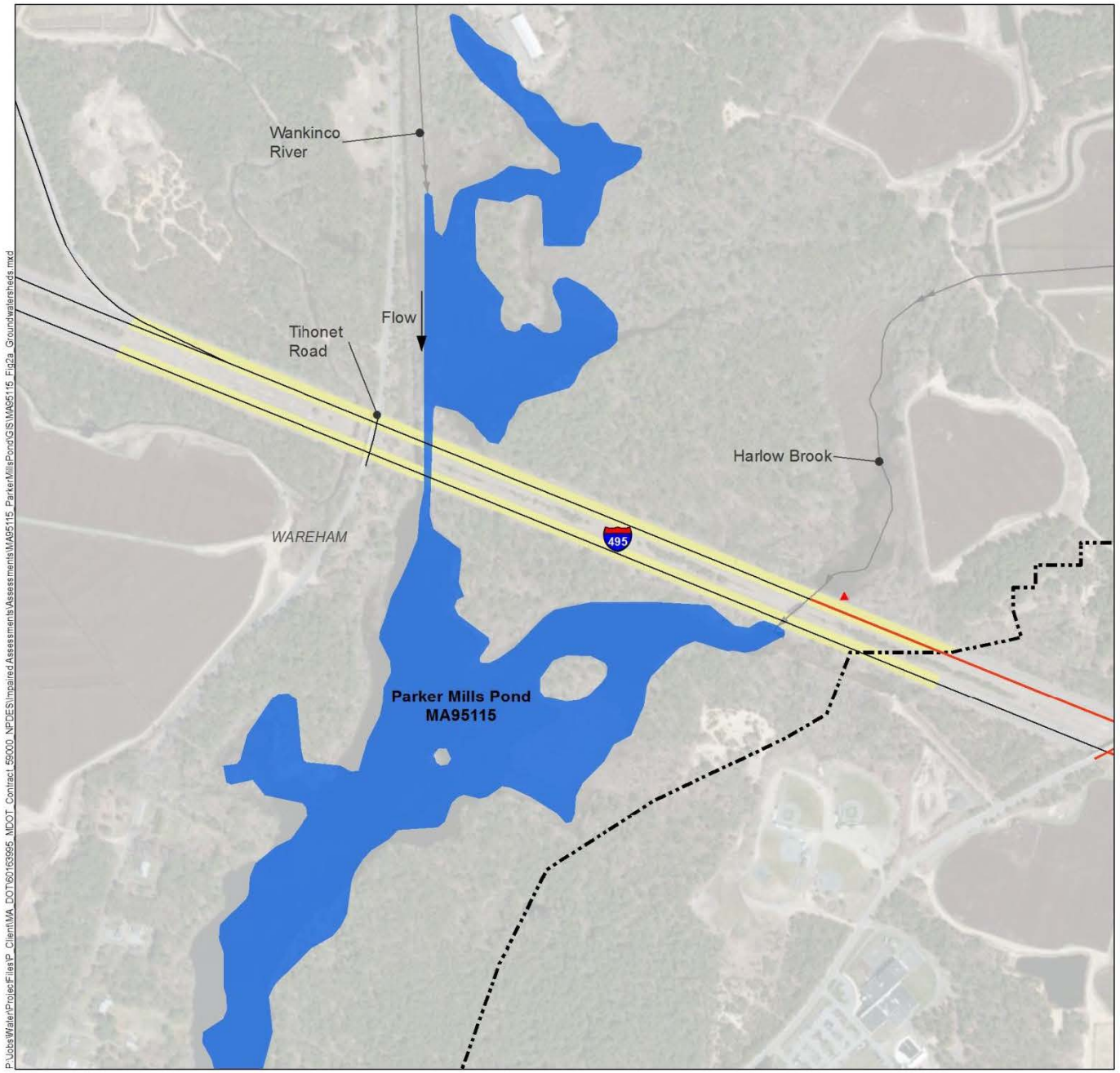
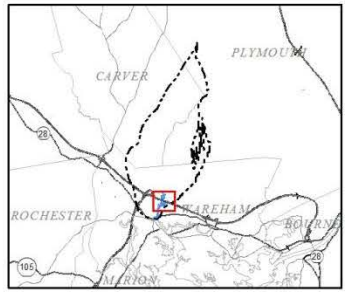


Figure 1

Parkers Mills Pond (MA95115) Groundwatershed

June 2015





- MassDOT Outfalls
- MassDOT Roadways in Urban Area
- MassDOT Roadways
- Groundwatershed
- Assessed Segment
- Non-Impaired Streams
- MassDOT Directly Discharging Area

N

0 500 1,000 Feet

Figure 2a

**Parkers Mills Pond (MA95115)
Directly Contributing
MassDOT Watershed**

June 2015

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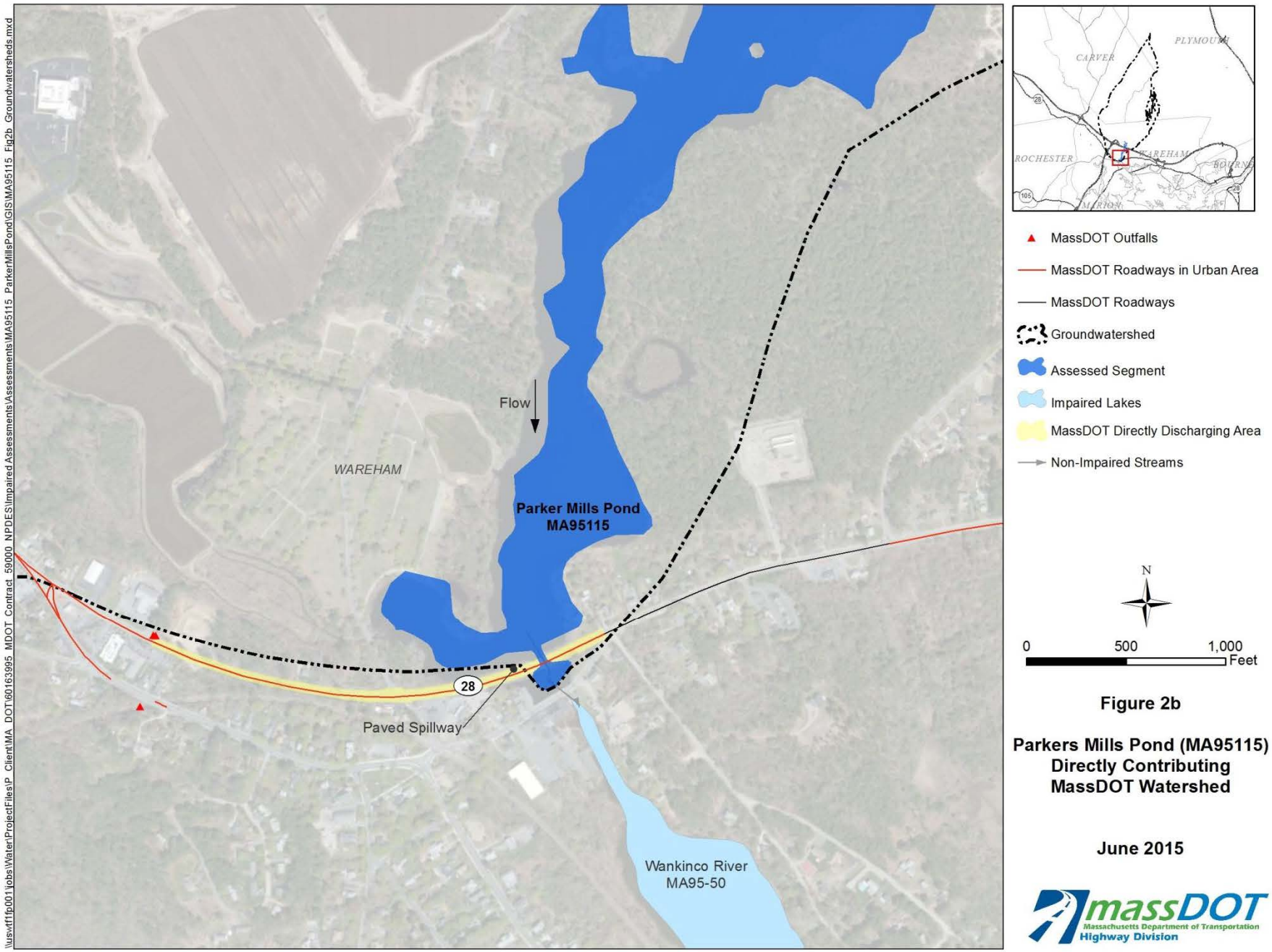

Figure 2b

**Parkers Mills Pond (MA95115)
Directly Contributing
MassDOT Watershed**

June 2015

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Highway Division

06/08/2015

Impaired Waters Assessment for Crystal Lake (MA96050)

Summary

Impaired Water[1]	Stormwater Impairments:	*Dissolved Oxygen*
	Category:	*5 (Waters requiring a TMDL)*
	Final TMDLs:	*None*
	WQ Assessment:	*Cape Cod Coastal Drainage Areas 2004-2008 Surface Water Quality Assessment Report*[2]
Location	Towns:	*Orleans*
	MassDOT Roads:	*Route 6, Route 28*
Assessment Method(s)	7R (TMDL Method) ☐	7U (Non-TMDL Method) ☒
BMPs	Existing:	*None*

Site Description

Crystal Lake (MA96050) is a 33-acre waterbody located east of Route 28 in Orleans, Massachusetts. Crystal Lake is not connected hydraulically with other surface waterbodies. The groundwatershed for this segment is based on technical reports[3] developed by the Massachusetts Estuaries Project (MEP). The MEP team includes technical staff from USGS and the Cape Cod Commission and works collaboratively with MassDEP and the University of Massachusetts Dartmouth School of Marine Science and Technology (SMAST) to refine USGS groundwatershed boundaries for receiving waters in Cape Cod. Figure 1 illustrates the groundwatershed for Crystal Lake.

MassDEP's *Cape Cod Coastal Drainage Areas 2004-2008 Water Quality Assessment Report*[2] identifies the Aquatic Life Use with an "impaired" status based on the severe oxygen depletion that occurred below 16 feet representing approximately half of the lake's total volume. Areas of oxygen depletion corresponded to greater depths, which coincided with the highest phosphorous readings. In addition, MassDEP's *Cape Cod Coastal Drainage Areas 2004-2008 Water Quality Assessment Report* notes that phosphorous is contributing to the impairment for the water body. Higher total

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

[2] MassDEP, May 2011. Cape Cod Coastal Drainage Areas 2004-2008 Surface Water Quality Assessment Report. Available at: http://www.mass.gov/eea/docs/dep/water/resources/71wqar09/96wqar12.pdf

[3] University of Massachusetts Dartmouth and MassDEP, 2006. Massachusetts Estuaries Project Linked Watershed-Embayment Model to Determine Critical Nitrogen Loading Thresholds for the Pleasant Bay System, Orleans, Chatham, Brewster and Harwich, Massachusetts. Available at: http://www.oceanscience.net/estuaries/Pleasant_Bay.htm

phosphorus values in samples taken near the bottom of the water column indicate a release from sediments and an internal source of nutrients to the lake. Secondary Contact Recreation Use and Aesthetics Use are both listed with a "support" status. All other uses were not assessed. The water quality report also lists the Town of Orleans NPDES Phase II stormwater permit in the discussion of Crystal Lake (Permit # MAR041146). The permit requires the Town of Eastham to develop, implement, and enforce a stormwater management program and reduce the discharge of pollutants from their system.

MassDOT property within the groundwatershed of Crystal Lake includes Route 6 and Route 28 (Figure 1). After review of aerials and field observations, it was determined that Route 6 does not directly discharge to Crystal Lake. Route 6 traverses the groundwatershed in a north-south direction, approximatively 0.85 miles west of Crystal Lake. Although stormwater from Route 6 discharges within the groundwatershed of this water body, stormwater from this roadway does not directly discharge to the water body and is therefore not considered to contribute to the waterbody impairment. Crystal Lake is an inland lake impaired for dissolved oxygen, which is typically related to eutrophication processes caused by excess phosphorous.[4] Phosphorus is removed from surface runoff through infiltration, filtration and sorption processes through the natural soil before reaching groundwater.[5] Therefore, MassDOT has only considered direct surface runoff to Crystal Lake as a contributing cause of the impairment.

Route 28 is a MassDOT-owned two-lane roadway traversing the groundwatershed in the north-south direction. Based on field observations, runoff from a portion of Route 28 is collected in a drainage system that discharges directly to Crystal Lake via a 36 inch reinforced concrete pipe. The MassDOT directly discharging property, as shown on Figure 2, extends approximately 1,830 feet. The area of impervious cover directly discharging to Crystal Lake is approximately 2.5 acres. A portion of this impervious cover is located outside of the groundwatershed boundary. Starting approximately 200 feet north of the intersection of Route 28 with Finlay Road and Pond Road and extending to the groundwatershed boundary, stormwater runoff is collected in a closed drainage system that discharges directly to Crystal Lake.

Crystal Lake and bordering land areas are mapped as an Outstanding Resource Water and part of the Pleasant Bay Area of Environmental Concern (ACEC; Figure 2). Wetlands with certified vernal pools are located west of Route 28 on the opposite side of the road from Crystal Lake. Although there are no wetlands mapped on the eastern border of Route 28, the existing outfall discharging MassDOT runoff to Crystal Lake is mapped as being within the ACEC and very close to mapped wetlands.

Existing BMPs

MassDOT did not identify any existing BMPs in place to treat roadway runoff from the directly discharging area before reaching the impaired water segment.

Assessment

In cases where a TMDL has been approved, MassDOT assesses the waterbody for the impairments covered by the TMDL under the BMP 7R methodology.[6] MassDOT separately assesses the

[4] CWP, 2003. Impacts of Impervious Cover on Aquatic Systems. Watershed Protection Research Monograph No. 1. Ellicot, Md.

[5] NCHRP, 2006. Report 565: Evaluation of Best Management Practices for Highway Runoff Control. Transportation Research Board of the National Academies.

[6] MassDOT, July 2010. BMP 7R: TMDL Watershed Review. Available at:
http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7R_TMDL_WatershedReview.pdf

waterbody for any stormwater-related impairments that are not covered by the TMDL under the BMP 7U methodology.[7] MassDOT assessed Crystal Lake (MA96050) using the methodologies described below.

This assessment has been completed based on the *Massachusetts Year 2012 Integrated List of Waters – Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act*.[1] MassDEP has released a proposed *Massachusetts Year 2014 Integrated List of Waters,* which has been reviewed for any proposed changes to the condition of the water bodies.[8] The condition of Crystal Lake is not proposed to change.

BMP 7U for Highway Related Impairments

A final TMDL is not in place to address Crystal Lake's (MA96050) following impairments: dissolved oxygen. Therefore, MassDOT assessed the stormwater-related impairments not addressed by a TMDL using the approach outlined in BMP 7U.[7] The impairment identified for the assessed segment is typically related to eutrophication processes, which for inland lakes and ponds are primarily due to elevated levels of phosphorous.[4] In addition, MassDEP's *Cape Cod Coastal Drainage Areas 2004-2008 Water Quality Assessment Report* notes that phosphorous is contributing to the impairment for the water body.[2]

MassDOT is not aware of any published literature definitively establishing a phosphorous loading goal for this waterbody. Because this assessed water body is located within a USGS delineated groundwatershed rather than surface watershed, MassDOT's IC Methodology is not applicable for establishing a target. In the absence of a credible and supportable goal for phosphorous loading for the water body, MassDOT is unable to establish a MassDOT phosphorous contribution target. Therefore, MassDOT will conservatively implement BMPs to treat its stormwater runoff to the assessed segment to the maximum extent practical.

This assessment has identified locations for potential stormwater BMPs. The Proposed Mitigation Plan describes the next steps for the potential BMPs to treat MassDOT roadway runoff to the maximum extent practical before it discharges to the assessed water body.

Proposed Mitigation Plan

During this assessment phase of the Impaired Waters Program, MassDOT has focused on directly contributing areas and identified opportunities for BMPs that could be constructed entirely on MassDOT property without resulting in substantial wetland impacts or resulting in an adverse impact on historical or archeological resources. Projects meeting those requirements can be implemented under the Impaired Waters Program Retrofit Initiative.

MassDOT has identified that additional control measures are needed to reduce its phosphorus loading within the directly contributing watershed and, after an initial review of the area, feel that appropriate locations are potentially available for control measures such as curb cuts directing stormwater to an infiltration swale along Route 28. MassDOT will now work with its design consultants to identify locations suitable for construction of additional BMPs to treat stormwater runoff from directly contributing MassDOT property as part of MassDOT's Impaired Waters Retrofit Initiative.

[7] MassDOT, April 2010. BMP 7U: Water Quality Impaired Waters Assessment and Mitigation Plan. Available at: http://www.massdot.state.ma.us/Portals/8/docs/environmental/npdes/BMP_7U_ImpairedWaterbodiesAssessment.pdf

[8] MassDEP, June 2014. Massachusetts Year 2014 Integrated List of Waters – Proposed Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. Massachusetts. Available at: http://www.mass.gov/eea/docs/dep/water/resources/07v5/14iwlistp.pdf

The project designer will gather additional information in this phase, such as soil data, wetland delineations, and site survey, to further refine the proposed BMPs. The design consultants will develop construction plans for BMPs that will aim to provide pollutant load reduction to the maximum extent practical.

Once the design of the proposed BMPs is finalized, MassDOT will provide an update in the NPDES permit annual report with BMP information and summarize the final phosphorus reduction.

MassDOT will continue to ensure proper non-structural BMPs are being implemented within the groundwatershed of Crystal Lake, including regular roadway and drainage system maintenance, erosion and sedimentation control, and outreach and education. Further work by MassDOT on programmed projects, which often include broader scale road layout changes, may provide additional opportunities for construction of new treatment BMPs. This is consistent with an iterative adaptive management approach to address impairments. MassDOT will include an update in NPDES permit annual reports to EPA regarding proposed BMP design either through retrofit or programmed projects, plans for construction of BMPs, reduction achieved by finalized BMP designs and progress made towards achieving phosphorus load reductions.

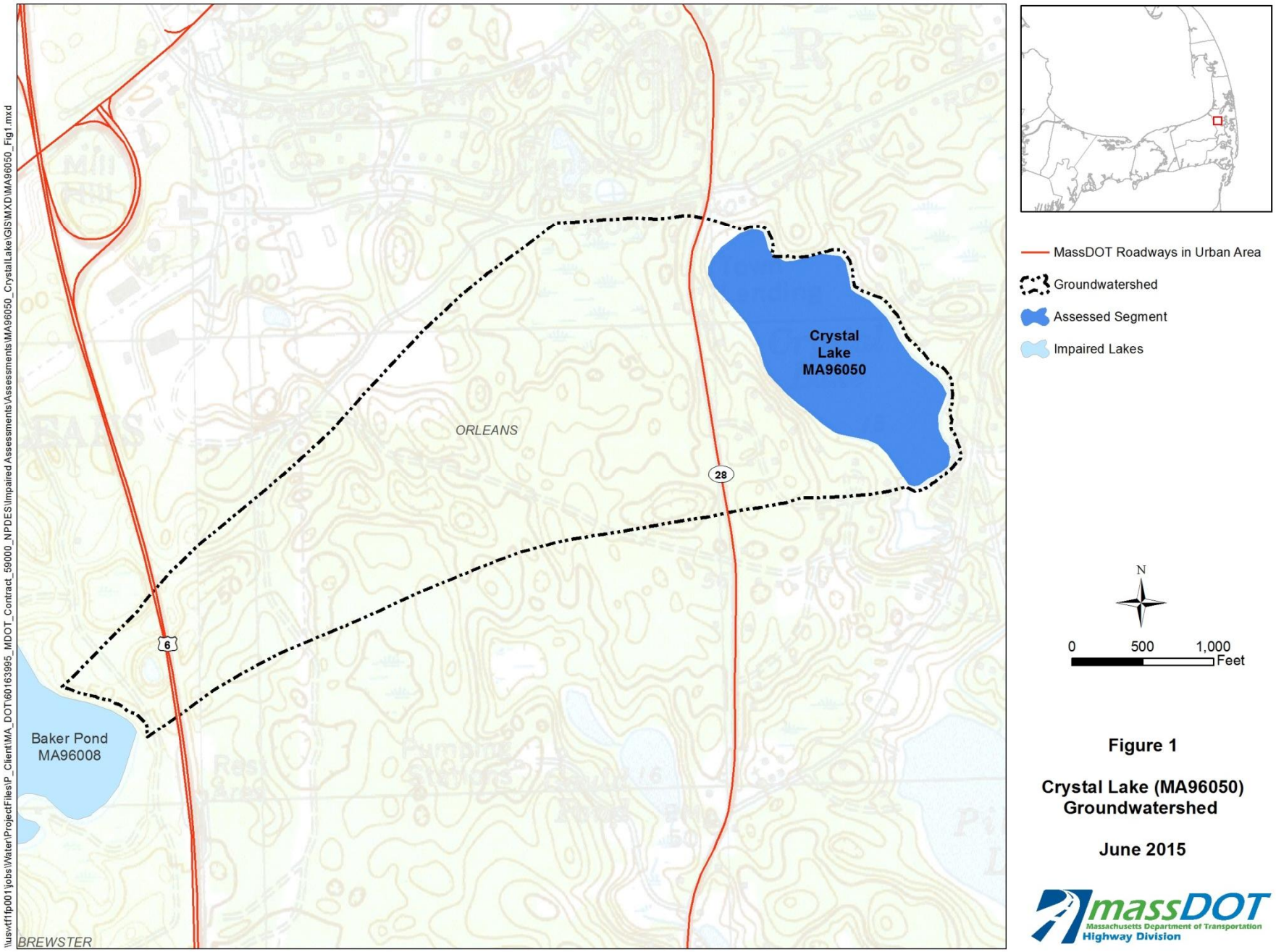

Figure 1

Crystal Lake (MA96050) Groundwatershed

June 2015

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Highway Division

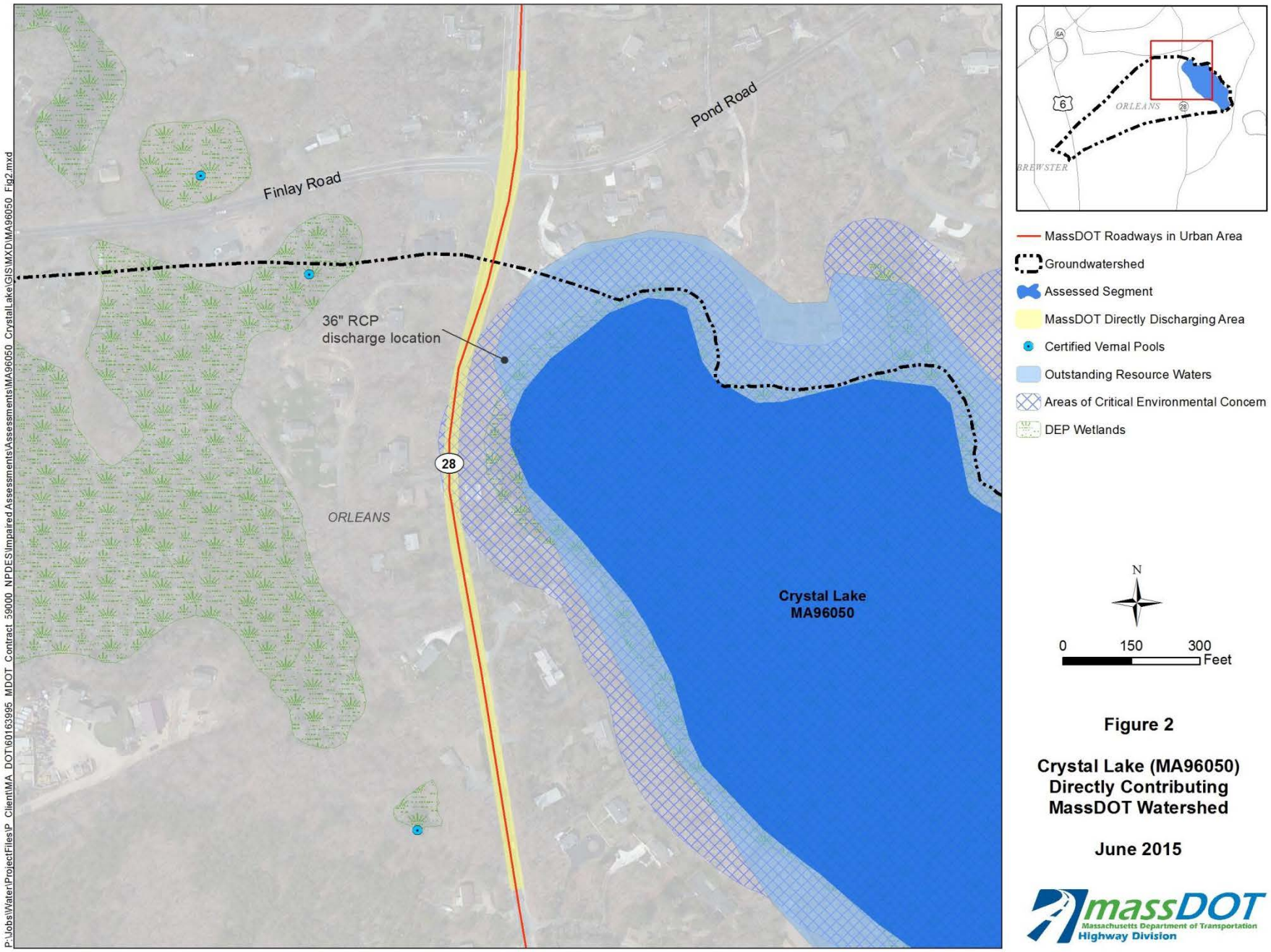

Figure 2

Crystal Lake (MA96050)
Directly Contributing
MassDOT Watershed

June 2015

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