Evaluation of TN Endpoint for the Protection of Eelgrass

Prepared by
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In November 2018, EPA Region I identified a paper published by Dr. James Latimer (Latimer and Rego, 2010)[1] as appropriate for setting nitrogen load restriction in Great Bay estuary for the protection of eelgrass. In subsequent meetings, NHDES requested that the Great Bay Municipal Coalition identify an alternative approach, based on literature and other relevant scientific information, that could be considered protective of eelgrass resources and used to set nutrient limitations while site-specific studies are being conducted in the Estuary. This memorandum provides a Summary Table of various TN endpoints identified as being protective of eelgrass resources in nearby New England estuarine systems. The table primarily reflects a subset of TN endpoints from approved TMDLs developed to protect eelgrass habitat, prepared by MassDEP as part of the Massachusetts Estuaries Project (MEP). The MEP program relied on verified exposure data and resulting system response (i.e., the values are based on conditions documented to be protective, not theoretical model loading analyses). The subset was limited to about 20 approved endpoints (instead of pulling all of the TMDL endpoints) because the TN targets all clustered within a small range and our purpose was to select an interim value supported by a preponderance of accepted values.

Each of the MassDEP TMDL endpoints was developed for a relatively small embayment, using the "sentinel" station approach to develop the target endpoint. The target TN endpoint was selected from a station near the mouth of the embayment system with higher quality waters that supported eelgrass habitat. Each of the embayments was primarily under the influence of TN loading from groundwater sources associated with septic systems and land usage. As such, the TN load was primarily in the form of dissolved inorganic nitrogen (DIN). Each of the reported endpoints in the Summary Table is a growing season average concentration. Therefore, if an interim endpoint value is selected from the Summary Table for application to the Great Bay Estuary, it should also be applied as a growing season average. For added conservativism, the criteria would be applied as total nitrogen.

As part of this literature review the Coalition also examined the *Long Island Sound Comprehensive Conservation and Management Plan 2015* and the *Long Island Sound Nitrogen Reduction Strategy* (December 2015) which, among other things, establish goals for restoring eelgrass and limiting hypoxia in Long Island Sound. This Plan was developed and approved by multiple parties, including EPA Region 1, to protect eelgrass resources. An overview of the nitrogen reduction strategy was presented by EPA via public webinar on November 8, 2017. One conclusion of the strategy was to differentiate between coastal embayments with small watersheds influenced primarily by groundwater loadings and those which received loadings from larger riverine systems (such as that present in Great Bay). The USEPA Fact Sheet with the Nitrogen Reduction Strategy specifically noted that the empirical relationships between nitrogen

[1] Latimer, J.S., and Rego, S.A.. 2010. Empirical relationship between eelgrass extent and predicted watershed-derived nitrogen loading for shallow New England estuaries. Estuarine, Coastal and Shelf Science 90 (2010) 231 – 240.

loads and eelgrass health, such as that developed by Latimer and Rego (2010), may not be valid for larger riverine systems and, consequently, was not employed as the basis for developing nutrient loading targets. (*Nitrogen Reduction Strategy, Fact Sheet #2* at 1). As noted in the LIS documents, the direct loading approach suggested by Latimer and Rego (2010) does not addresses (1) actual site-specific system responses, (2) relevant forms of nitrogen, (3) systems where the major loading are from riverine sources or (4) the unique hydrodynamics of an estuary impacting plant growth responses to nitrogen inputs. Consequently, as with the LIS Strategy, the use of this approach is not scientifically defensible for assessing TN impacts in the Great Bay Estuary system.

EPA (through Tetra Tech) also prepared a literature review memo summarizing its technical approach for establishing nitrogen thresholds in Long Island Sound[2]. The literature review memo is organized by watershed groupings including separate evaluations for smaller embayments and those affected by large riverine systems. For each of these groupings, EPA is developing nitrogen thresholds to translate the narrative water quality standard into a numeric target concentration (as done in the MEP TMDLs summarized in the table) and identifying where nitrogen watershed loading results in exceedances of the identified threshold. Based on the literature review of median growing season TN concentration necessary to protect eelgrass, page F-3 of the Report stated the following:

> *For embayments, Tetra Tech selected a median value of 0.40 mg/L TN to protect the seagrasses in embayments. This value is the rounded value of the median TN protective of seagrasses (0.39 mg/L; range: 0.30 to 0.49 mg/L). Values above the literature review maximum TN concentration of 0.49 mg/L were not considered protective of eelgrass (see Table F-1).*

Once a TN endpoint was identified, the load necessary to meet the endpoint was calculated considering the system hydrodynamics. (See, *Establishing Nitrogen Endpoints for Three Long Island Sound Watershed Groupings. Subtasks F and G. Summary of Empirical Modeling and Nitrogen Endpoints*. April 13, 2018) From the LIS studies and peer review (discussed below), it is clear EPA Region 1 is not using the Latimer and Rego (2010) loading approach to establish reduction requirements for eelgrass protection in Long Island Sound, even in the smaller embayments. Rather, first a TN concentration necessary to protect eelgrass resources is identified. Then, the load necessary to ensure that the TN endpoint is not exceeded is determined. This is the same approach used in the MEP TMDLs that are summarized in the Endpoint Summary Table and is consistent with the approach the Coalition has undertaken here.

Finally, an independent peer review of the proposed LIS approach was completed in January 29, 2019 by EPA Region 1. The independent peer review Technical Review Team, funded by EPA, included Dr. Victor J. Bierman. Dr. Bierman was also on the peer review team that evaluated the 2009 Draft Nutrient Criteria for Great Bay. In that analysis, Dr. Bierman stated the following:

[2] Literature Review Memo. March 27, 2018. Long Island Sound (LIS): Application of Technical Approach for Establishing Nitrogen Thresholds and Allowable Loads for Three LIS Watershed Groupings: Embayments, Large Riverine Systems and Western LIS Point Source Discharges to Open Waters.

> [E]elgrass and aquatic life are the assessment endpoints. If appropriate analyses are conducted with all of the relevant site-specific data, then TN concentration targets can be developed that will protect the assessment endpoints. In turn, an appropriate site-specific, load-response model can then be used to determine TN loads from the watershed that can meet the in-water TN concentration targets. This is the approach currently being used with the linked watershed-embayment model in the 89 MEP embayments (Howes et al., 2006).

This is the approach that the Great Bay Municipal Coalition is currently pursuing. Therefore, consistent with EPA's own findings and approaches in LIS, it is appropriate to employ the literature review approach presented in this memorandum, to identify a range of growing season average TN endpoints (0.35-0.45 mg/l) for use as an interim target, pending completion of the site-specific studied for the Great Bay system. The interim TN target can be used to evaluate interim TN load limitations using the hydrodynamic model as we are currently doing.

TN Endpoint Summary Table

No.	Receiving Water/Source	Author	Protected Use	TN Source	Avg. Period	TN Endpoint	Page Citation
1	Wild Harbor Estuarine System TMDL for TN	MassDEP November 2017	Eelgrass Cover	Ground water (septic)	Summer Seasonal Avg.	0.35 mg/L	iii
2	Parkers River Embayment System TMDL for TN	MassDEP May 2017	Eelgrass Habitat	Ground water (septic)	Summer Seasonal Avg.	0.42 mg/L	iii
3	Fiddlers Cove and Rands Harbor Embayment Systems TMDL for TN	MassDEP November 2017	Benthic Community Structure	Ground water (septic)	Summer Seasonal Avg.	0.50 mg/L	iv
4	Quissett Harbor Embayment System TMDL for TN	MassDEP November 2017	Eelgrass Habitat	Ground water (septic)	Summer Seasonal Avg.	0.34 mg/L	iv
5	Bass River Estuarine System TMDL for TN	MassDEP May 2017	Eelgrass, Benthic Habitat	Ground water (septic)	Summer Seasonal Avg.	0.42 mg/L	V
6	Tampa Bay	Barriers and Bridges in abating Coastal Eutrophication March 2019	Eelgrass	Point Sources	Annual	~0.32 mg/L	See Figure 2 at 9
7	Lagoon Pond TMDL for TN	MassDEP July 2015	Eelgrass Habitat	Ground water (septic)	Summer Seasonal Avg.	0.35 mg/L	V
8	Nantucket Harbor TMDL for TN	MassDEP January 28, 2009	Eelgrass Habitat	Ground water (septic)	Summer Seasonal Avg.	0.35 – 0.36 mg/L (no macroalgae present)	Iii

TN Endpoint Summary Table (continued)

No.	Receiving Water/Source	Author	Protected Use	TN Source	Avg. Period	TN Endpoint	Page Citation
9	Green Pond TMDL for TN	MassDEP April, 2006	Eelgrass Habitat	Ground water (septic)	Summer Seasonal Avg.	0.42 mg/L	13
10	Great Pond TMDL for TN	MassDEP April, 2006	Eelgrass Habitat	Ground water (septic)	Summer Seasonal Avg.	0.40 mg/L	13
11	Bournes Pond TMDL for TN	MassDEP April, 2006	Eelgrass Habitat	Ground water (septic)	Summer Seasonal Avg.	0.45 mg/L (shallow)	13
12	Tisbury Great Pond Black Point Pond Estuarine System TMDL for TN	MassDEP December 2017	Eelgrass Habitat	Ground water (septic)	Summer Seasonal Avg.	0.46 mg/L (limited habitat; bathymetry)	Iv
13	Three Bays System TMDL for TN	MassDEP September 2007	Eelgrass Habitat	Ground water (septic)	Summer Seasonal Avg.	0.38 – 0.50 mg/L	Iii
14	Swan Pond River Estuarine System TMDL for TN	MassDEP May 2017	Eelgrass Habitat	Ground water (septic)	Summer Seasonal Avg.	0.40 mg/L	V
15	West Falmouth Harbor Embayment System TMDL for TN	MassDEP November 2007	Eelgrass Habitat	Ground water (WWTP, septic)	Summer Seasonal Avg.	0.35 mg/L	Iii
16	Pleasant Bay System TMDL for TN	MassDEP May 2007	Eelgrass Habitat	Ground water (septic)	Summer Seasonal Avg.	0.16 – 0.20 mg/L bioactive N conc. (DIN + DON) 0.52 mg/L TN	Iii
17	Waquoit Bay System TMDL for TN – Jehu Pond/Great River	MassDEP January 2006	Eelgrass Habitat	Ground water (septic)	Summer Seasonal Avg.	0.446 mg/L	12

TN Endpoint Summary Table (continued)

No.	Receiving Water/Source	Author	Protected Use	TN Source	Avg. Period	TN Endpoint	Page Citation
18	Waquoit Bay System TMDL for TN – Hamblin Pond/Little River	MassDEP January 2006	Eelgrass Habitat	Ground water (septic)	Summer Seasonal Avg.	0.38 mg/L	12
19	Waquoit Bay System TMDL for TN – Quashnet River	MassDEP January 2006	Benthic Habitat	Ground water (septic)	Summer Seasonal Avg.	0.50 mg/L	12
20	MEP Linked Watershed-Embayment Approach – Waquoit Bay	MassDEP May 2012	Eelgrass Habitat	Ground water (septic)	Summer Seasonal Avg.	0.327 mg/L	197