

Work Plan

Exploring Development of Numeric Nutrient Criteria in Casco Bay, Maine under Nutrient Scientific Technical Exchange Partnership and Support (N-STEPS)

Prepared for:

U.S. Environmental Protection Agency
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Health and Ecological Criteria Division
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1 GOALS:

The work for this project will help the Maine Department of Environmental Protection (MDEP) lay the foundation for development of numeric nutrient criteria (NNC) for the Portland vicinity of Casco Bay. This will be accomplished through:

1. Development of conceptual models relating nutrient enrichment effects to biological responses in Portland vicinity waters,
2. Identification, extraction, and compilation of relevant data,
3. Analysis of data to help identify nitrogen values that support aquatic life use in Portland vicinity waters,
4. Recommendations on how to proceed.

2 CONTACT INFORMATION

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3 BACKGROUND:

In response to recent recommendations from the Casco Bay Nutrient Council, MDEP is working to develop numeric nutrient criteria for nitrogen for the Portland vicinity of Casco Bay. Waters for which criteria are being developed include waters of Casco Bay in the vicinity of the Portland East End discharge, within the area designated as an SC waterbody classification (Figure 1). Though these waters are not currently subject to numeric nutrient criteria, TN thresholds do apply to the ambient waters in the vicinity of the outfall for the purposes of Reasonable Potential (RP) analyses for wastewater discharge licensing. To date, RP assessments have utilized two Total Nitrogen (TN) threshold values to address aquatic life use of Maine's marine waters:

- 1) 0.32 mg/L for protection of eelgrass, when historically mapped as present within close proximity to the discharge in question; and
- 2) 0.45 mg/L for protection of dissolved oxygen, when eelgrass has not been historically mapped within close proximity to the discharge in question.

Maine DEP's definition of "close proximity" has been eelgrass located approximately 0.5 km from the wastewater outfall, or as informed by Best Professional Judgement (BPJ) based on known eelgrass resources. The TN threshold value currently used in Maine's marine wastewater permits for protection of eelgrass was a concentration used regionally by EPA licensing staff (David Webster, personal communication). The EPA decision to use 0.32 mg/L was due to its numerical midpoint between 0.34 mg/L, a concentration deemed protective of eelgrass by the Massachusetts Estuary Project, and 0.30 mg/L, an average concentration from the lower Piscataqua River where Maine DEP observed epiphytic growth on eelgrass that resulted in a 2012 impaired waters listing due to eelgrass loss. The TN threshold value used for dissolved oxygen originates from a New Hampshire Department of Environmental Services (NH DES) guidance document for the Great Bay estuary (NH DES 2009) and was utilized in an EPA-issued wastewater discharge license in the Taunton River estuary in Massachusetts (EPA 2015).

Since 2017, MDEP has been monitoring a range of water quality parameters across nine sites in Casco Bay¹. Additional monitoring efforts carried out by MDEP include aerial surveys of the Portland vicinity to enable eelgrass delineation and establishment and monitoring of eelgrass health metrics at three beds at varying distances from the East End outfall. Additional ambient data are available through historic and ongoing water quality monitoring by Friends of Casco Bay (FOCB), a University of Maine buoy with comprehensive sensor suite adjacent to the discharge (August-October 2019), and high resolution nitrate and ammonium analyzer data managed by the Casco Bay Estuary Partnership (CBEP) (summer 2019).

¹ Ambient monitoring efforts include discrete measurement of temperature, salinity, dissolved oxygen, pH, chlorophyll, turbidity, transparency, and Photosynthetically Active Radiation (PAR), and surface characterization of nitrogen and phosphorus species, chlorophyll a and Total Suspended Solids (TSS) on ebb and flood tides approximately every three weeks from May-October. Unattended sonde deployments measuring temperature, salinity, dissolved oxygen, and pH occur at select locations. Acquisition of aerial photography and eelgrass ground truthing for areal extent and percent cover assist with identification of sensitive aquatic life in proximity to nitrogen sources.

This N-STEPS effort will leverage the information gained through the above-mentioned monitoring efforts to develop nitrogen and environmental indicator targets which will ultimately be incorporated into numeric nutrient criteria for the Portland vicinity of Casco Bay.

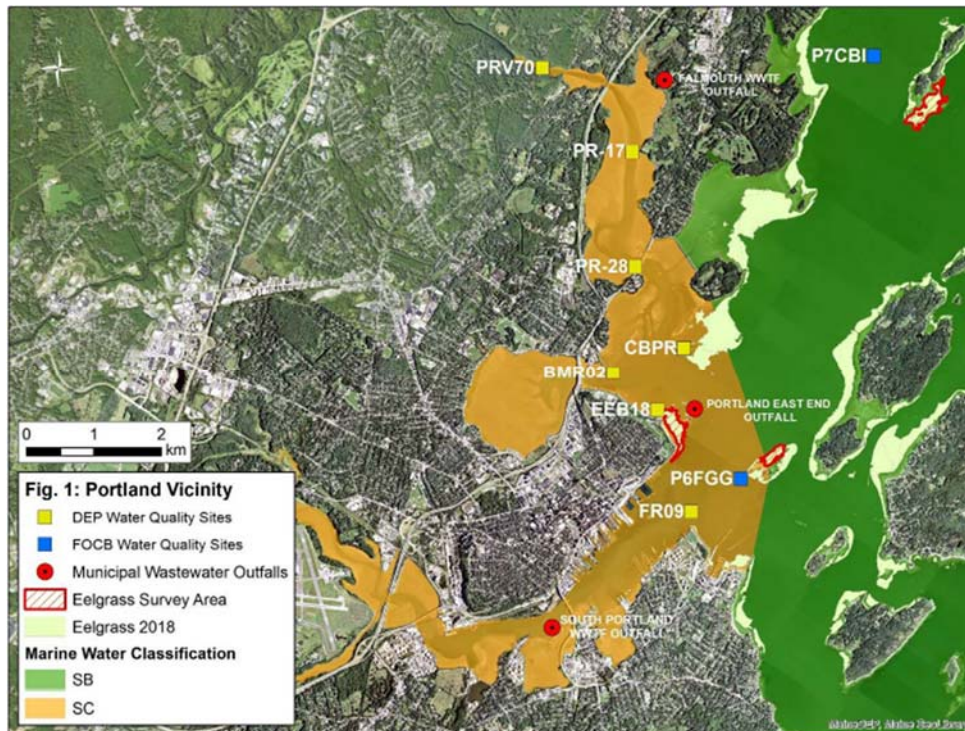


Figure 1: Map of Portland East End outfall and eelgrass survey areas

4 PROPOSED PROJECT TIMEFRAME

Schedule: Following workplan approval, from November 2020 until approximately July 2021.

5 TASKS:

Task 1: Administration and communication

Tetra Tech (Tt) will provide regular reports on progress to MDEP and EPA. In addition, Tt will participate in regular conference calls and webinars with MDEP and EPA to communicate progress and solicit and incorporate feedback from participants.

Deliverables: Calls and progress reporting

Schedule: Ongoing

Task 2: Kick-off call

Discuss goals, roles, tasks, and activities of the joint project.

Principal Staff: MDEP, EPA (HQ, R1), Tt



Activities:

1. Discuss MDEP's goals for this project.
2. Discuss Maine's designated uses and TN threshold values.
3. Identify any other interested parties (e.g., CBEP, FOCB) and discuss their role in this project.
4. Compile existing materials related to nutrient criteria development in estuarine waters, including, but not limited to:
 - a. Studies done by MDEP.
 - b. Studies done by CBEP.
 - c. Relevant peer-reviewed literature (e.g., nutrient dynamics in estuaries, preferably for systems in the Northeastern United States)
5. Discuss division of labor and finalize project schedule.
6. Discuss existing data relevant to this project and facilitate data exchange between MDEP and Tt.
7. Gain mutual agreement to begin tasks and schedule the next conference call.

Anticipated outcome/deliverable:

- A. List of interested parties.
- B. List of pertinent existing materials.
- C. Agreed upon division of labor.
- D. Initial list of available data.
- E. Agreement between parties about tasks to be performed and anticipated outcomes and deliverables.

Schedule: November 2020

Task 3: Identify Spatial Frame

Principal Staff: Tt, EPA, MDEP, Nitrogen Criteria Working Group

Activities:

1. Identify spatial boundaries of waters within Casco Bay that are being considered for this project.
2. Discuss near field and far field issues associated with criteria development.

Anticipated outcome/deliverable:

- A. Identification of project's geographic scope.

Schedule: 1 month after Task 2

Task 4: Summary of state narrative nutrient criteria and consolidated listing and assessment methods

Principal Staff: Tt, EPA, MDEP, Nitrogen Criteria Working Group

Activities:

1. Summarize Maine's existing narrative nutrient criteria and methods of interpretation for assessment/listing, permitting and TMDLs in estuarine and coastal waters. Summary will include, but not be limited to: approaches to deriving thresholds, durations, and frequencies; relevant water quality parameters and associated quantitative thresholds, durations, and frequencies; the locations, durations, and frequencies of sampling; and sampling and analytical methods.
2. Review and discuss examples of narrative criteria interpretations for estuaries and coastal waters in the context of conceptual model(s) to determine potential approaches available to Maine.
3. Frame the management goals and assessment endpoints to inform conceptual modeling.



Anticipated outcome/deliverable:

- A. Call focused specifically on discussing these issues.
- B. Memo summarizing existing state's narrative nutrient criteria interpretations and relevant numeric thresholds.

Schedule: 1 month following Task 2

Task 5: Develop conceptual models relating nutrient enrichment effects to biological responses. Consider if spatial classification is needed.

This is an opportunity to learn about estuarine and coastal systems in Maine, dig into some literature and other resources to identify how nutrient pollution impacts this system, and identify the linkages from nutrient sources, through biological responses and other candidate assessment endpoints, to management goals.

This conceptual modeling effort may also require spatial classification of sub-waterbodies in the system. Classification may be based on segmentation according to state regulations for the area or a finding that segmentation is necessary for purposes of deriving criteria (i.e., to identify areas of the project frame that respond differently to nutrients).

Principal Staff: Tt, EPA

Activities:

1. Conduct brief review of relevant literature to explore existing work on estuarine and coastal systems in Maine, their ecology, and effects of nutrients. Engage in conversations with key players to get pertinent background and technical information.
2. Discuss whether classification of the Casco Bay waters might be necessary, based on physical habitat, expected dominant biological communities, geographic location, and/or other suitable metrics.
3. Develop conceptual models for different designated uses linking excessive nutrients with biological and water quality endpoints in Casco Bay.
4. Characterize major pathways through which nutrients influence endpoints in Casco Bay and factors that affect those pathways, including but not limited to, residence time, morphometry, stratification, turbidity, tidal action, waves and wind, and land use/land cover.
5. Use conceptual model(s) to inform subsequent tasks on assessment endpoint and target selection, data acquisition and sharing, and data analysis.

Anticipated outcome/deliverable:

- A. Conceptual model diagram(s) in PowerPoint along with supporting description(s).
- B. Potential classification of the Casco Bay waters, if needed.

Schedule: 1 month after Task 2

Task 6: Data Sharing and Compilation

Principal Staff: Tt, EPA, MDEP, Nitrogen Criteria Working Group

Activities:

1. Identify and discuss MDEP datasets that may be used in the analysis and how these data may be accessed.
2. Using MDEP's data quality standards, including methodologies and quality assurance and quality control, as a guide, identify data type and data quality benchmarks that can be used to determine whether other



easily accessible datasets may be included in the analysis (e.g., NCCA, NCA, other estuarine datasets from MDEP). Discuss availability and appropriateness of LULC and discharger data.

3. Initiate data exchanges with MDEP by establishing a centralized location (e.g., FTP, OneDrive or SharePoint) for sharing data and documents with participants (MDEP, EPA R1 and HQ, and Tetra Tech staff). Data shared by MDEP with EPA and N-STEPS is to be used for the expressed purpose(s) identified in this work plan. Use of data by EPA and N-STEPS for purposes outside the work plan must be approved by MDEP.
4. Develop a brief summary and meta-analysis describing the data sources, data compiled to date, and a plan for data sharing final dataset.
5. Identify any additional compilation/reconciliation recommendations and modify the deliverables of this task pursuant to feedback from EPA or MDEP.
6. According to the compilation plan, organize data that may be used for analysis.
7. Share and review data to ensure its quality for analysis.

Anticipated outcome/deliverable:

- A. Brief summary of available data and data sharing and compilation plan.
- B. Database for analysis.

Schedule: 3 months after Task 5

Task 7: Data Analysis Planning

Principal Staff: Tt, EPA, MDEP, Nitrogen Criteria Working Group

Activities:

1. As part of regularly planned calls, discuss and refine desired outcomes of the empirical analyses to be conducted by N-STEPS, including those in support of any spatial classification and stressor-response analyses.
2. Discuss how data will be used in analyses, including, but not limited to: parameters to be used in the analyses; treatment of non-detects and minimum reporting limits; minimum sample size required for calculation of seasonal concentrations; aggregation of data from multiple locations; aggregation of data from multiple site locations within close proximity; use of vertical profile data; missing data, confounding variables, etc.
3. Using conceptual model(s), existing criteria, other state regulatory information, and literature, among other sources, discuss and document MDEP selection of potential assessment endpoints and target values to be used in analyses. Targets may also be derived through analysis in Task 8.
4. During planning, identify gaps in available data that may constrain analyses. Attempt to remedy or leave for future monitoring.
5. Document decisions in a data analysis plan memo that will be reviewed by EPA and MDEP and revised accordingly before proceeding with the bulk of data analysis.

Anticipated outcome/deliverable:

- A. Short memo describing the agreed upon analysis approach.

Schedule: 1 month after Task 6

Task 8: Analysis

The goal of this task is to conduct exploratory and stressor-response analyses to explore relationships between nutrients (e.g., TN, TP, TIN, etc.) and identified response variables (e.g., pH, DO, clarity/light levels, algal biomass (chlorophyll-a), phytoplankton assemblage data, cyanobacteria cell counts, cyanotoxin concentration) at various temporal and spatial scales, as allowed by the data. Analyses used may include visual plots of interest, linear and



nonlinear curve fits and interpolation, and thresholds determined using visual estimates with nonlinear and/or nonparametric models.

Principal Staff: Tt, EPA, MDEP

Activities:

1. Use S-R analyses to:
 - a. Evaluate the potential influence of confounding factors. Important confounding factors for consideration include, but are not limited to, the N:P ratio, non-algal turbidity, residence time, and salinity.
 - b. Evaluate whether spatial classes are appropriate and should potentially be refined, and update stressor and response analysis if additional spatial classes are refined.
 - c. Identify and provide rationale for potential quantitative nutrient and response variable thresholds. Outputs will help inform MDEP's selection of thresholds for use in Maine.
 - d. Identify frequency and duration elements for determining attainment or exceedance of narrative criteria.
 - e. Identify data gaps where data and information are insufficient to derive stressor and response thresholds to inform future sampling.
2. As identified above, incorporate spatial classes as well as confounding factor analysis into stressor-response models to the extent allowed by the data. Analyses used may include model based recursive partitioning, multiple regression models, hierarchical models and Bayesian network models, among others.
3. Examine the effect of period (none, seasonal, annual, etc.) on summary statistics and resulting relationships.
4. Review preliminary results of the stressor response analysis and revise the analysis based on feedback prior to finalizing the analyses and summarizing the results.

Anticipated outcome/deliverable:

- A. A summary document providing:
 - a. Results of the data analyses; and
 - b. Discussion of available data, data gaps, and recommendations to effectively fill data gaps.

Schedule: 3 months after Task 7