WORK PLAN

ON

Development of an Integrated Ecosystem Framework for the Southeast New England Program (SNEP) Region

Prepared for:

U.S. Environmental Protection Agency, Region 1 (EPA R1)

Submitted By: Great Lakes Environmental Center, Inc.

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1 INTRODUCTION

The EPA Region 1 Southeast New England Program (SNEP) has spent the last year building on its strong foundation of stakeholder collaboration to develop a user-focused communications strategy, to characterize the existing scope and value of monitoring activities in the region, to expand its understanding of ecosystem services research and potential applications, and to plan and host a SNEP Symposium. These activities have set the stage for the program's next steps that include developing a cohesive monitoring strategy for the SNEP region based on an Integrated Ecosystem Services Framework (IESF).

Complex coastal and transitional ecosystems, like the SNEP region, are faced with numerous pressures including climate change, coastal erosion, overfishing, land use/land cover changes, and pollution. To build public support for the investment in restoration, or other interventions and management actions meant to address these pressures, it is important to communicate the tradeoffs associated with all options. An IESF will help SNEP quantify and communicate the numerous benefits that the ecosystem provides to communities. An IESF that links ecological conditions and/or functions to ecosystem services in the form of benefit-relevant indicators will provide insight into the potential impacts (positive AND negative) associated with changes to the ecological conditions/functions (Olander et al. 2018). Since the IESF will highlight focal ecological conditions and functions, it can also be used to prioritize monitoring efforts for those focal conditions/functions.

Great Lakes Environmental Center, Inc. (GLEC), in partnership with E&C Enviroscape, LLC (E&C) and Eastern Research Group, Inc. (ERG), brings the strong subject matter expertise and facilitation proficiency needed to fully support this effort.

Throughout this project, the Team will work closely with EPA to establish an Integrated Ecosystem Services Framework (IESF) that:

- Identifies the most appropriate metrics and indicators for tracking and assessing environmental condition
- Creates linkages between and among environmental conditions, ecosystem functions, ecosystem services, and human activities
- Will inform the format and content of periodic "State of the SNEP Region" reports

2 WORK PLAN

Technical Approach

Task 1: Project Management and Administration

Our management approach prioritizes frequent and proactive communication, adaptability and responsiveness to challenges, strict quality control procedures, and timely budget and schedule tracking. Our management system will consist of the following elements:

Program Management. Dr. Mick DeGraeve (GLEC) will manage the GLEC Team at the contract level and assure that EPA's needs and expectations are met for this procurement. He is the founder of GLEC and for the past 45 years has interacted regularly with professionals in a wide range of disciplines and with representatives of industry, government and academia. Mick's technical aquatic biology/toxicology professional experience has included managing EPA Office of Water level of effort contracts for GLEC for 20+ years. Over that period, he has been responsible for the technical and financial oversight of 11 EPA Office of Water contracts; five for the Health and Ecological Criteria Division (HECD), three for the Standards and Health Protection Division (SHPD), one for the Permits Division of the Office of Wastewater Management (OWM), and two for the Office of Ground Water and Drinking Water's (OGWDW) Technical Support Center.

Expert Project Manager and Enthusiastic Facilitator (Project Lead). Dr. Emily Shumchenia (E&C Enviroscape) will lead the GLEC Team. She will regularly coordinate with and take direction from EPA, oversee all project staff, and ensure that all tasks are completed on time and on budget. Emily will also serve as lead facilitator for SNEP Committee and Subcommittee meetings in this scope and offer strategic advice to EPA staff to ensure fruitful engagement of committee members. Emily brings over 10 years of experience in project management, research, and science communication to the project team. She has designed and led numerous workshops and meetings at the interface of science and management for the Northeast Regional Ocean Council, the Long Island Sound Blue Plan Development Team, the Mid-Atlantic Regional Council on the Ocean, the MassBays Estuary Program, and SNEP. In addition, Emily has expertise in designing monitoring programs, evaluating marine environmental and biological indicators and metrics, and developing effective visualizations of monitoring results. Emily has a PhD in oceanography and has been studying the benthic habitats of the SNEP region since 2004.

Core staff. We propose a small but highly qualified "Core staff" for this project. Emily Shumchenia (E&C) will be the Project Lead and Charles Goodhue (ERG) will serve as an ecosystem services and economic valuation expert. Charles and Emily will be present for all meetings associated with this project to maintain continuity with Subcommittee work that they led throughout 2019 and strengthen ties across SNEP entities for this body of work. E&C and ERG will also each provide an additional team member to the Core staff. Dr. Clifford "Chip" Heil (E&C) will support data analysis, synthesis, and communication throughout the project, and bring expertise in characterizing ecosystem responses to climate change in coastal, terrestrial, and lake ecosystems. Alexandra Phillips (ERG) brings expertise in outreach/engagement and project planning and will conduct the majority of the background research and also provide

meeting logistics support. Aside from the Core staff, Chris Lamie (ERG), will serve as a senior advisor and reviewer to the Core staff and work with the GLEC team and SNEP staff on project strategy and approach for Task 2—the team will leverage his extensive experience and lessons learned from leading EPA's Report on the Environment and Climate Change Indicators in the U.S. Dr. Julianne Heinlein (GLEC) will serve as a senior advisor and reviewer to the Core staff and SNEP on strategy and approach for Task 4 – the team will leverage her extensive experience in metrics development (specifically algal data/metrics) and integrating ecosystem services into state and federal monitoring frameworks.

Robust program support. GLEC and ERG have each supported EPA programs for decades. Their familiarity with EPA policies and procedures regarding information sharing, communication, and dissemination strengthens our Technical Approach. Specifically, ERG will provide secure access to a project SharePoint site for information sharing among EPA and team members, as well as the capability to generate web-based content that meets EPA requirements.

Frequent communication. The team will hold routine conference calls to discuss project progress and next steps. The Project Lead will be responsive and available via email and phone as needed between scheduled calls.

Understanding the relationships among Tasks

Tasks 2 and 3 are presented separately in the RFQ for logistical and budgetary purposes. However, our team recognizes that work on these tasks will likely be conducted in a coordinated fashion. For example, meetings with the Subcommittees, Committees, and staff (Task 3) will be used to obtain vital feedback on preliminary and draft products related to Task 2 that will help shape the final deliverables and overall conceptual Integrated Ecosystem Services Framework (IESF). In addition, elements of Task 4 will likely inform the IESF. Figure 1 shows relationships among Tasks and assigns specific subtasks to "Data Gathering", "Synthesis", and "Outputs" categories for further organization.

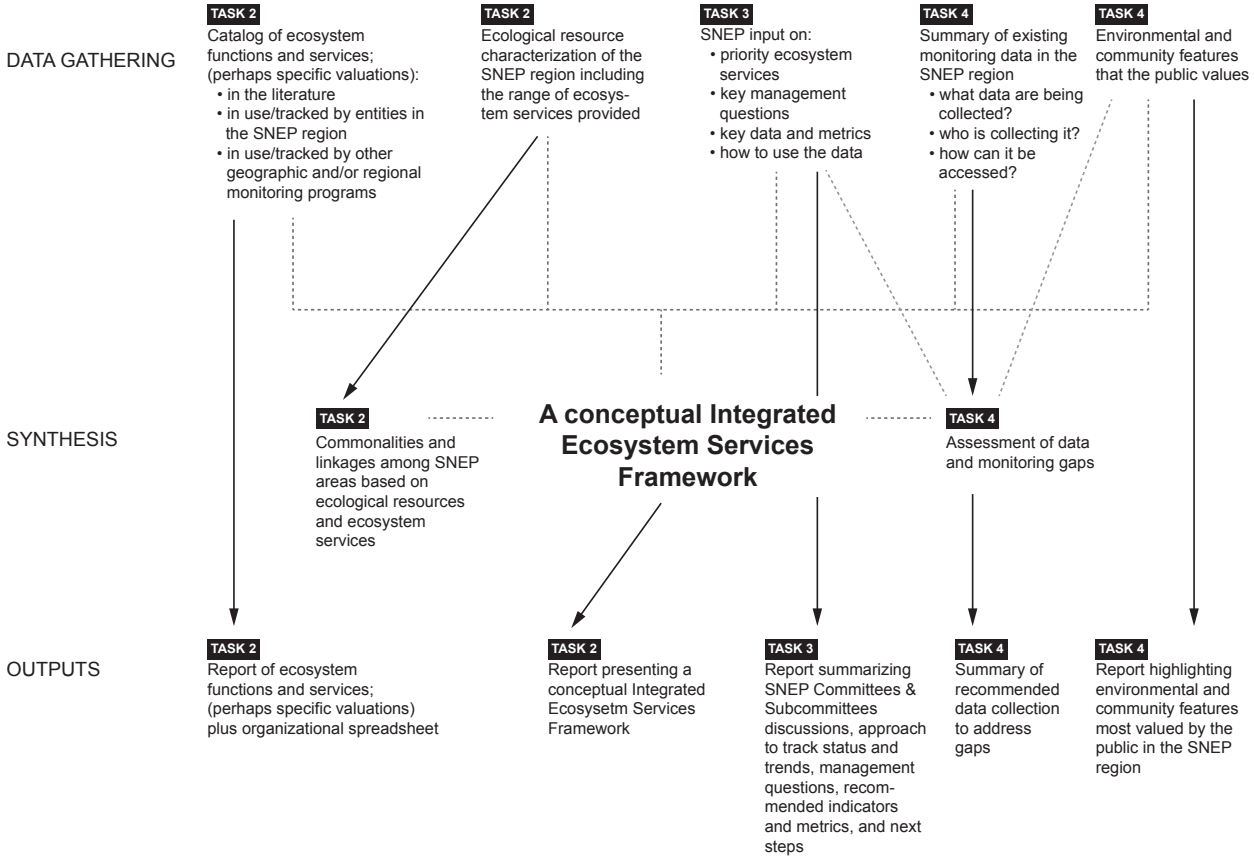

Figure 1. A workflow diagram showing the relationships between and among elements of Tasks in this scope. Arrows roughly indicate the flow of information. Solid lines represent a direct relationship between elements. Dashed lines indicate more indirect relationships where elements inform each other.

Task 2: Development of a Conceptual Model of Ecosystem Function and Service – An Integrated Ecosystem Services Framework (IESF)

E. Shumchenia will coordinate the GLEC Team's work on Task 2. C. Lamie will provide overall Task guidance and leverage his existing knowledge of various indicator/monitoring programs and connections to those program developers/managers/staff. Work on Task 2 will directly follow and be informed by the work our team completed under the 2018 Solicitation. This project's Task 2 involves data gathering, synthesis, and generating outputs toward a conceptual IESF. Below we suggest further partitioning of this Task into Subtasks beyond what is outlined in the RFQ.

Subtask 2.A. Report documenting the pertinent findings of the literature review, review of analogous organizations, review of geographic programs, and logical/relational organization of the data in an Excel spreadsheet

ERG staff will lead the literature and program reviews. The purpose of the reviews in this Subtask is to compile existing information on the types of ecosystem services provided in complex coastal regions, and how these have been measured and tracked by other entities. Our team will leverage the existing work compiled by SNEP on this topic, provided in Appendix A and Appendix B in the RFQ, as well as the body of information compiled by both the Monitoring and Ecosystem Services Subcommittees under the 2018 Solicitation. We will implement the following major steps to perform this literature and program review.

1) **Perform an initial literature review**. We will dedicate some portion of our literature review resources to assemble Ecosystem Functions (EF) and Ecosystem Services (ES) info and data that could be used to develop an IESF for SNEP. We will parse information into a sortable and filterable database, and we will develop a two-page summary to present our initial findings and our plan for outreach to related organizations and geographic and regional monitoring programs (steps 3 and 4 below).
2) **Present our initial summary to both subcommittees.** We will present our findings from the initial literature review and our outreach plan on a subcommittee meeting call. One option for this step is to hold a joint subcommittee call or meeting. The goal is to determine if there are other organizations to connect with and identify key questions needing to be answered based on the initial findings. Additionally, many of the organizations we connect with will be part of one or both SNEP subcommittees, so this will provide background information to facilitate discussion.
3) **Perform an assessment of related organizations.** We will hold phone calls with related organizations, including EPA Office of Research and Development, U.S. Fish and Wildlife Service, The Nature Conservancy, the Cape Cod and Martha's Vineyard Commissions, Chambers of Commerce, NOAA, NERRS Science Collaborative, and Municipal Town Offices in addition to other key organizations recommended during step 2 or identified during step 1. As part of this outreach, we will also mine data from each organization's website.

4) **Perform an assessment of other geographic and regional monitoring programs**. We will reach out to monitoring programs within and outside the SNEP region. This will provide perspective about activities in the region as well as help us characterize outside programs so we can consider their metrics and approaches for the SNEP region. We will develop an Excel sheet that pulls these various performance metrics and approaches for measuring progress.
5) **Perform a supplemental literature review to address any gaps**. We will save some resources to target any gaps identified from steps 2, 3, and 4 with a supplementary literature review. We will then develop a short report documenting key findings of the literature review (steps 2 and 5), related organizations (step 3), and geographic programs (step 4) (Deliverable 2A-1). We will additionally submit a sortable, filterable Excel database with information parsed into columns (e.g., ecosystem type, ecosystem service type, geography, literature type, date of publication, size of ecosystem, beneficiaries, data/metrics to measure ecosystem service) (Deliverable 2A-2).
6) **Extract spatial information from entities within the SNEP region**. Using the information gathered in the literature review and from subcommittees, we will develop draft maps that show gaps and/or overlaps in indicators/metrics being measured in the region.

Subtask 2.B. Report presenting a conceptual IESF including a functional schematic

E&C will lead the development of a conceptual IESF. We have recent experience developing and communicating ecosystem services frameworks to support coastal assessment and communication. Team member E. Shumchenia is currently working with the EPA Office of Water, Office of Research and Development staff at the Atlantic Ecology Division and Gulf Ecology Division, and the MassBays Estuary Program to develop an Ecosystem Services Gradient tied to a Biological Condition Gradient (Figure 2). This work is described as a case study in a book chapter, "The Ecosystem Services Gradient: A Descriptive Model for Identifying Thresholds of Meaningful Change" by Susan Yee, and others, including Margherita Pryor from Region 1 and GLEC team member E. Shumchenia. While this chapter applies EPA-terminologies such as "FEGS" (Final Ecosystem Goods and Services) that may be too jargon-y for this work, there are several conceptual models and processes similar to those of Grizzetti et al. 2016 and Olander et al. 2018 (see Figure 3 below, which corresponds to Figure 2 in Yee et al. in review) which suggest that many of the chapter's recommendations can be helpful in structuring a SNEP IESF.

For their 2017 State of Narragansett Bay and Its Watershed report, team member E. Shumchenia developed a series of functional schematics showing the relationships between stressor indicators and resource/condition indicators. A summary schematic developed for the report introduction shows the relationships among all indicators discussed in the report and the ecosystem services affected (Figure 4). While this diagram is somewhat simpler than the framework being developed for MassBays, they represent concepts already in use in the SNEP region and can therefore inform the work under this Subtask.

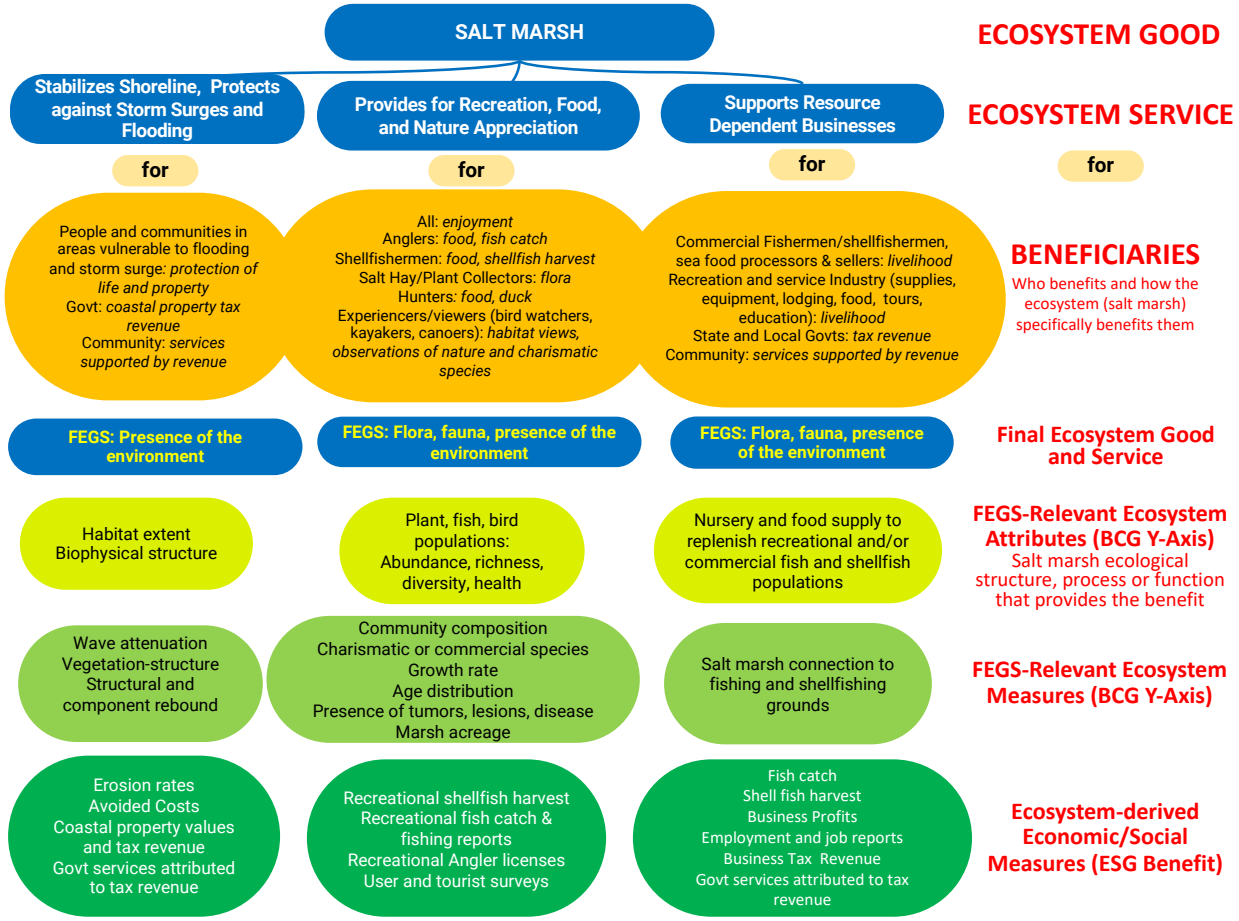

Figure 2. An example IESF for MassBays salt marsh habitats that compiles some of the ecosystem services and beneficiaries of salt marsh habitats and suggests potential ecological indicators (FEGS-Relevant Ecosystem Attributes) and ecosystem services indicators (Ecosystem-derived Economic/Social Measures [ESG Benefit]).

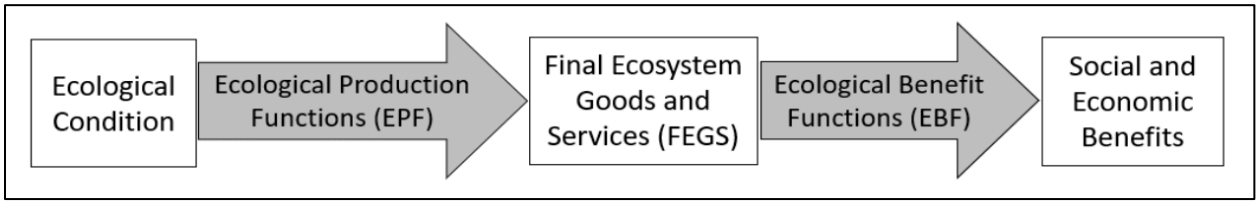

Figure 3. A conceptual model for one type of IESF under development by partners at ORD Gulf Ecology Division and Atlantic Ecology Division, and Region 1 staff. This model mirrors the "Benefit-Relevant Indicators" discussed in Olander et al. 2018.

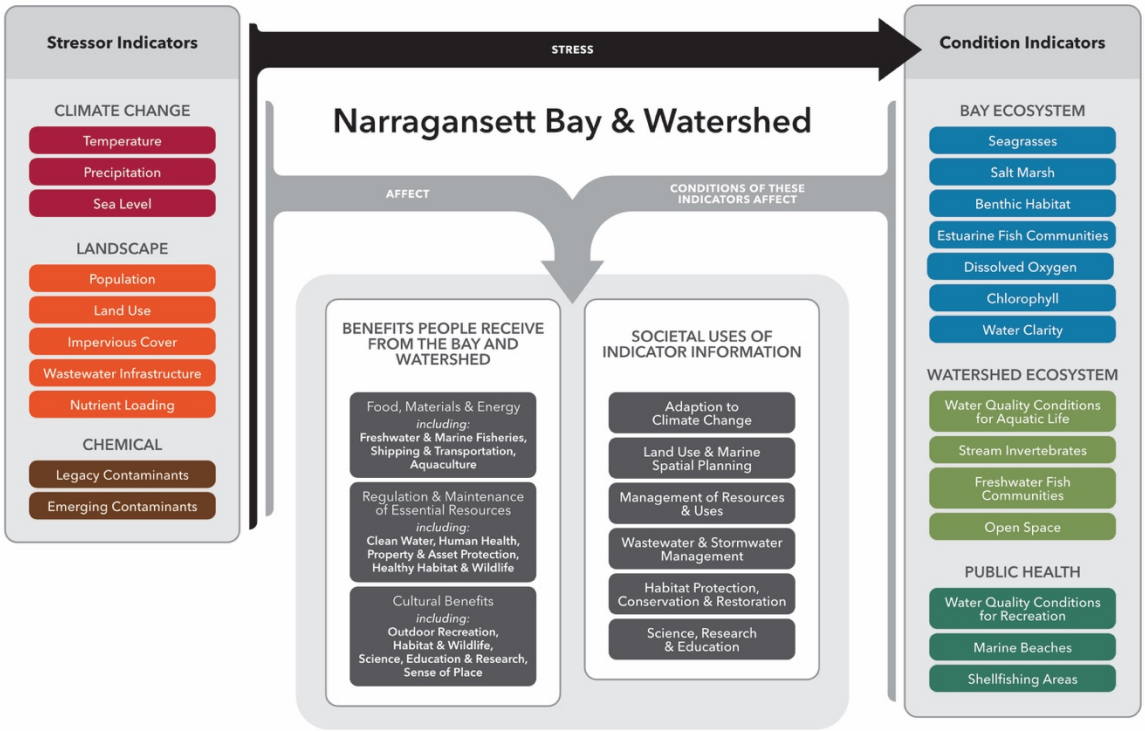

Figure 4. A simple IESF developed for the Narragansett Bay Estuary Program State of Narragansett Bay and Its Watershed report, clearly linking stressor indicators to condition indicators, and the relationships that both have with ecosystem services and societal uses.

EPA input: Prior to beginning this subtask, a draft report and spreadsheet assembled for Subtask 2.A will be shared with the Monitoring and Ecosystem Services Subcommittees for feedback (via Task 3). The Subcommittees' feedback will help frame the conceptual IESF, including a process/flow diagram, and determine the focal ecological functions and services that should be included for the SNEP region. If desired, revised drafts will then be offered to the SNEP Committees (via Task 3) and feedback will be incorporated into the IESF. A final IESF functional schematic and report will be produced (Deliverable 2B).

Scale: We will work with EPA staff and the Committees/Subcommittees to determine the appropriate focal scale of the IESF. Considerations include the focal scale of the Ecological Resource Characterization (Subtask 2.C), as well as the key management questions, priority ecosystem services, and key data/metrics identified by the SNEP Committees and Subcommittees (Task 3).

Nomenclature: We will also work with EPA staff and Committees/Subcommittees to choose a consistent and accepted nomenclature for use in the IESF, building off of the Ecosystem Services Valuation literature database compiled by ERG, MassAudubon, and others under Task 4 in the 2018 Solicitation, as well as the information gathered for this scope under Subtask 2.A.

Subtask 2.C. Characterization of SNEP ecological resources and the range of ecosystem services provided, including the region's commonalities and linkages

To fully populate the IESF, and to understand the range of ecosystem services provided, ecological resources of the SNEP region must first be characterized. E. Shumchenia and C. Heil (E&C) will lead this effort. E. Shumchenia has topic-area and spatial data expertise, and C. Heil brings experience gathering, manipulating, analyzing, and communicating large datasets.

This Subtask could be viewed as a first step toward the creation of ecosystem services maps throughout the SNEP region. As such, while we will work with EPA staff, SNEP Committees and Subcommittees to develop/select the preferred nomenclature and hierarchy, we also recommend considering the nomenclature and hierarchy of existing spatial datasets to ensure consistency between prior, current, and future ecosystem services maps. For example, National Land Cover Data (NLCD), state Land Use/Land Cover data, and National Wetlands Inventory (NWI) data each present spatial resource characterizations and terminologies that could be leveraged for this Subtask. The Narragansett Bay Estuary Program (NBEP) used these datasets in their 2017 State of Narragansett Bay and Its Watershed Report which not only offers methodological insights into data aggregation/hierarchies and trend interpretations that would be of value to this project but further developed these characterizations and nomenclature with respect to RI and MA environments (NBEP 2017).

Once the resources are cataloged and characterized, we will summarize similarities and differences in resource expression across the SNEP region. This element will require extensive data mining and manipulation to summarize resource information and generate summary statistics and visualizations (e.g., total acres of urban land can be calculated and compared among Narragansett Bay, Buzzards Bay, and Cape Cod areas). Zones for summarization will be determined in collaboration with EPA and SNEP Committees/Subcommittees (especially with regard to key management questions and other reporting considerations) and could build upon USGS Hydrologic Unit Code (HUC) watersheds, for example. This information will then be represented spatially in the form of draft maps. Because the database will be large and multivariate, we suggest developing a draft web-based and interactive map that can be visualized and queried in different ways depending on the topic of interest. For example, the map user could select the "whole SNEP region" scale and visualize summaries of ecological resources and ecosystem services profiles for the whole region. Alternatively, a user could select "large estuaries" or "large rivers" and see summaries of ecological resources and services at those scales.

Potential inputs to Deliverable 2C-2

- Omernik Ecoregions of New England
- Finer-scale state Land Cover/Land Use data, with insights from NBEP 2017 bistate crosswalk
    - New, nationally-consistent Beta Derived Moderate Resolution C-CAP Data (10m land cover)
    - MA high-resolution (1-meter) C-CAP program data (2016); 25 classes (Figure 5)

  - RI 0.5-acre Land Cover/Land Use data (2011); 37 classes which could be collapsed/cross-walked to match the MA C-CAP data (or other common set of classes) using methods similar to NBEP 2017

- Conservation Assessment and Prioritization System (CAPS) data for additional detail on natural lands, as in NBEP 2017
- NWI data for additional detail on wetland types
- Shellfish habitat and eelgrass data from www.northeastoceandata.org
- Aquaculture data from www.northeastoceandata.org

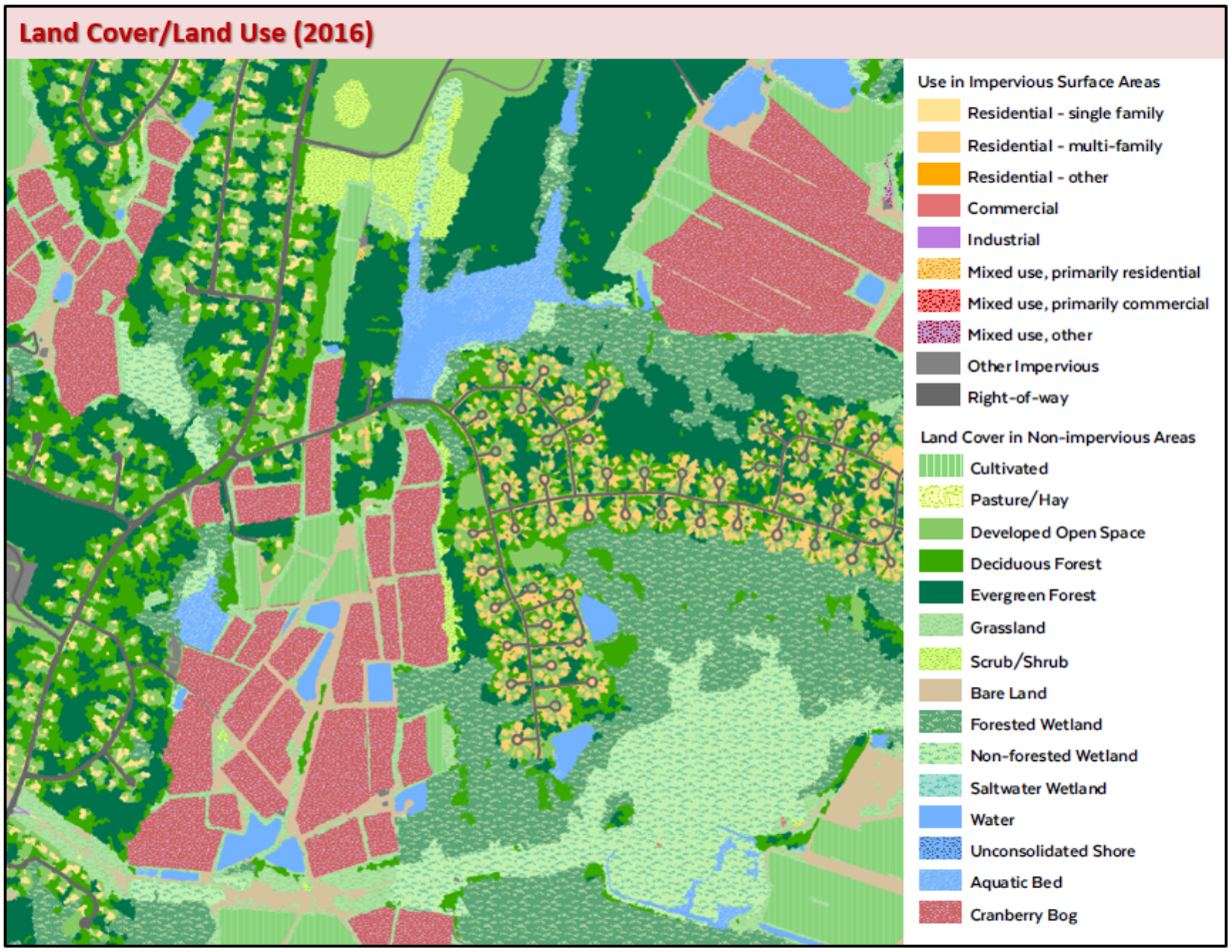

Figure 5. Example map and legend showing the 25 classes for the 2016 high-resolution Massachusetts C-CAP land cover dataset (credit: MassGIS https://docs.digital.mass.gov/dataset/massgis-data-2016-land-coverland-use).

Table 1. Task 2 Deliverables

Deliverable	Timeline
2A-1 Report documenting findings of the reviews (literature, SNEP programs, other geographic programs)	Within eight (8) weeks of Kickoff Meeting
2A-2 Spreadsheet organizing the data and information from the reviews	TBD based on kickoff meeting schedules/ workplans
2B IESF Report and functional schematic	Within four (4) months of kickoff meeting
2C-2 Ecological resource characterization of the SNEP region (data summaries) Draft maps of ecological resources and services in the SNEP region	Within six (6) months of kickoff meeting Within eight (8) months of kickoff meeting

Task 3: Development of Indicators and Metrics of Ecosystem Function and Health

E. Shumchenia will coordinate the GLEC Team's work on Task 3. While the majority of effort for Task 3 is concentrated on organizing, facilitating, and attending meetings with SNEP staff, Committees, and Subcommittees, our team will be focused and dedicated to this Task's key objective: to develop a common monitoring approach for southeast New England coastal ecosystems. This will require our team to iteratively gather and synthesize information in Task 2, communicate the findings to SNEP staff, Committees, and Subcommittees (a component of this Task 3), and then incorporate the information gathered from experts and stakeholders into the Task 2 synthesis. The final report will bring all of these elements together.

Subtask 3.A. Meetings with SNEP staff, Monitoring Subcommittee, Ecosystem Services Subcommittee, Policy Committee, and Steering Committee

Meetings will serve as important checkpoints to allow SNEP entities to learn of our team's progress and provide feedback. Our team's experience meeting with the Subcommittees and staff over the past year positions us to take immediate action on this Task and offer a seamless transition from the previous work to this new scope. Resuming ongoing work with the Subcommittees, we will continue developing:

- Key management questions that reflect the basic human needs or ecosystem services that the SNEP community values and that SNEP should focus on long-term and over the next 5-10 years
- Metrics needed to answer those key management questions
- An understanding of the data being currently being collected in the region that can feed into those metrics (see Task 4)
- A characterization of other supporting data that should be continually collected for its legacy value (e.g., temperature data)

- Approaches to communicating status and trends (i.e., monitoring results presented in a "State of the SNEP region" report)
- Next steps to implementing a SNEP monitoring framework

The GLEC Team has budgeted for four in-person full-day Subcommittee meetings (Deliverable 3A-1), one in-person full-day Policy Committee meeting (Deliverable 3A-3), and one in-person full-day Steering Committee Meeting (Deliverable 3A-5). We assumed that we will retain no-cost venues within the SNEP region for each meeting, in accordance with EPA preferences. The GLEC Team will schedule the meetings and handle venue logistics including registration. Based on previous experience, we assumed that EPA will provide all meeting consumables (e.g., nametags, handouts, flipcharts, easels, markers, etc.). Our team will work with EPA to design the agendas to be engaging, interactive, and productive and to identify appropriate read-ahead and supporting materials that are pertinent to the meeting agenda items. E. Shumchenia will serve as lead facilitator for all meetings, with assistance from C. Goodhue. All four Core staff will attend each in-person meeting, with a team member designated to take notes. Notes will inform meeting summaries, which will be sent to EPA for review, input, and distribution to Subcommittee members.

We have also budgeted for six Subcommittee conference calls/webinars (Deliverable 3A-2), one Policy Committee call/webinar (Deliverable 3A-4), and one Steering Committee call/webinar (Deliverable 3A-6). The GLEC Team will schedule all calls and handle webinar (GoToMeeting) logistics. We will work with EPA to design the agendas and identify appropriate read-ahead and supporting materials that are pertinent to the call/webinar agenda items. E. Shumchenia will serve as lead facilitator for all calls, assisted by C. Goodhue. Another team member from either E&C or ERG will join these calls to take notes for the meeting summaries.

Finally, we have budgeted for two in-person meetings with EPA staff at Region 1 offices (Deliverable 3A-7). We have assumed that these meetings will be approximately a half-day each. One of these meetings may align with a SNEP Technical Assistance Network Steering Committee meeting to ensure continuity and communication among our projects. E. Shumchenia and C. Goodhue will work with EPA staff to identify meeting objectives and desired outcomes prior to each meeting.

Joint Subcommittee meetings may be held to foster cross-pollination and coordinate among groups/topics, and to create efficiencies in project communication.

Subtask 3.B. Report summarizing discussions, approach to track status and trends, management questions, recommended indicators and metrics, and next steps

This Task culminates in a final report that summarizes all of the discussions held with and recommendations from SNEP entities on the SNEP monitoring framework elements. E&C will lead this Subtask. The report will be provided to EPA staff in draft form and revised with their input. If desired, we will also offer members of the Subcommittees and Committees opportunities to provide input before finalization (Deliverable 3B).

Table 2. Task 3 Deliverables.

Deliverable	Timeline
3A-1 Four in-person Subcommittee meetings	TBD based on discussion at Kickoff Meeting
3A-2 Six Subcommittee conference calls/webinars	TBD based on discussion at Kickoff Meeting
3A-3 One in-person Policy Committee meeting	TBD based on discussion at Kickoff Meeting
3A-4 One Policy Committee conference call/webinar	TBD based on discussion at Kickoff Meeting
3A-5 One in-person Steering Committee meeting	TBD based on discussion at Kickoff Meeting
3A-6 One Steering Committee conference call/webinar	TBD based on discussion at Kickoff Meeting
3A-7 Two in-person meetings with EPA staff	First meeting within six (6) to eight (8) weeks of Kickoff Meeting; second meeting within four (4) months of Kickoff Meeting
3B Report summarizing discussion, approach, recommendations	No later than September 1, 2020

Task 4: Assessment of Data and Gaps

E. Shumchenia will coordinate the GLEC Team's work on Task 4. J. Heinlein will provide overall Task guidance, and leverage her knowledge of bioassessment, monitoring, and metrics development. We anticipate that the discussions, data gathering, and synthesis that occur throughout Tasks 2 and 3 will logically highlight 1) data that have been and continue to be collected in the SNEP region and are readily available and 2) gaps in data collection. We will start by expanding upon the existing data collection and known gaps cataloged by the Monitoring Subcommittee and Ecosystem Services Subcommittee in their 2019 workshops. Further research and discussion as part of the current scope is expected to reveal additional details on existing data and data gaps and will be collated into separate reports in Subtasks 4.A and 4.B, respectively. These individual reports will be synthesized with input from SNEP Committees, Subcommittees, and staff into a single report of recommendations to address data gaps in the SNEP region (Subtask 4.C).

A final component of data gathering for this scope involves characterizing the ecological attributes, community features, and ecosystem services that the public values. Full ecosystem services valuation exercises are complex and using stated-preference and willingness-to-pay techniques can introduce social and economic biases (Waigner et al. 2018). Therefore, to understand what ecosystem attributes and services the SNEP community values, we propose a novel crowd-sourced approach, described below.

Subtask 4.A. Summary of existing monitoring data in the SNEP region

Using information collected during the Task 2 literature review and Task 3 meetings and webinars, ERG staff will compile the information on existing monitoring data. Then, with EPA input, GLEC staff will then dig deeper into a number of representative SNEP-funded projects that required monitoring over a period of time to compile:

- The parameters monitored by the projects and the kinds of information those parameters were proposed/intended to convey;
- How long the project was monitored and how well it captured the proposed/intended information;
- Whether the project achieved its aims and continues to meets its aims, and whether monitoring is continuing after the project period is over

Obtaining the above information will involve coordination with EPA and SNEP grant partners. As necessary and in consultation with EPA, GLEC will contact SNEP project leads and grantees to glean further detail about SNEP project monitoring and to evaluate projects.

We will develop a summary of existing monitoring data in the SNEP region including who is collecting the data and how the data can be found/accessed (Deliverable 4A).

Data gathering completed for this task will then be used to inform discussions at meetings with SNEP Subcommittees and Committees (Task 3) and to inform the IESF (Task 2).

Subtask 4.B. Summary of data gaps

ERG staff will compile the information on monitoring data gaps. We will use information from the Task 2 literature review and feedback from the Task 3 meetings to develop a summary of data gaps as part of the same document in Subtask 4.A (Deliverable 4B). As such, the timing of completion for this deliverable may depend on the timing of the Task 3 meetings (see Table 6 below). We will connect these gaps to related performance metrics from other geographic regions as we transition to Subtask 4.C. below to inform recommended data collection.

Subtask 4.C. Summary of recommended data collection to address data gaps

E&C will synthesize the information from Subtasks 4.A and 4.B as well as information provided by EPA staff, Subcommittees, and Committees to develop recommendations for addressing data gaps along with an assessment of the usefulness and applicability of existing data and monitoring programs to answer management questions of interest (Deliverable 4C). In addition, this summary will be informed by the metrics and indicators collected throughout the SNEP region and other geographic programs (Task 2) as well as the priority ecosystem services valued by the community and identified via Subtask 4.D.

Subtask 4.D. Report highlighting environmental and community features most valued by the public in the SNEP region

E&C will lead this Subtask. The challenge presented by this Subtask is to obtain information outside the environmental protection sector and SNEP stakeholders and to characterize preferences and values of a broader segment of the population living, working, and vacationing within the SNEP region without using traditional survey methods. Although we expect to obtain helpful and useful information on this topic from SNEP Committees and Subcommittees, many of whom conduct robust public outreach campaigns and/or can contribute results of their own public surveys, we propose a novel crowd-sourcing approach to supplement SNEP programmatic knowledge.

Social media data represents a vast quantity of information that could reveal the interests, preferences, and values of its users. Although this area of social research is relatively new, tools to gather and analyze social media resources are readily available (Waigner et al. 2018). Social media content has been used to quantify nonuse ecosystem values (Waigner et al. 2018), links between cultural ecosystem services and landscape features in Europe (Oteros-Rozas et al. 2018), and to map nature-based recreation patterns and value recreational ecosystem services related to wetlands in India (Sinclair et al. 2018).

We plan to access publicly available content from Twitter, one of the most widely used social media platforms, to examine the prevalence of words in users' posts that would reflect interests and values within the geography of the SNEP region. Public Twitter data will be accessed in accordance with the Twitter Developers' Policy and User Agreement, then the data will be gathered, aggregated, and anonymized using the TwitteR R package. In consultation with EPA, we will select focal words or phrases to include in searches (see Table 5 for examples). Word prevalence can be easily summarized and visualized using bar charts and word clouds which represent the relative importance of these topics in the community (Figures 6 and 7, respectively). C. Heil will lead the application development and data analyses necessary to summarize the interests, preferences, and values of social media users in the SNEP region. E&C will interpret the data and write the report (Deliverable 4D).

Table 3. Some potential search terms for characterizing what the public values

Example words and phrases that could represent interest in SNEP ecosystem services to include in social media searches
• River • Beach • Fishing • Marsh • Wetlands • Ocean • Farmland • Habitat • Open space • Shellfish

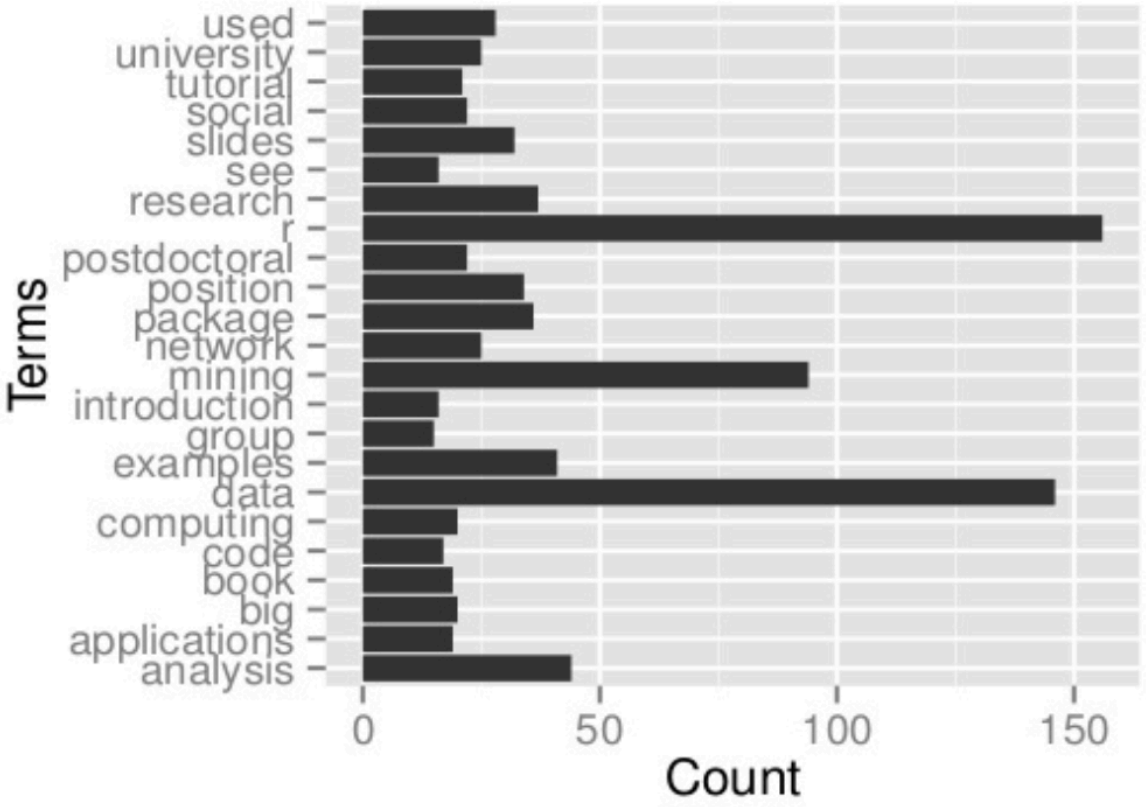

Figure 6. A bar chart showing the frequency of terms used in a university twitter account
Credit: *https://www.slideshare.net/rdatamining/text-mining-with-r-an-analysis-of-twitter-data*

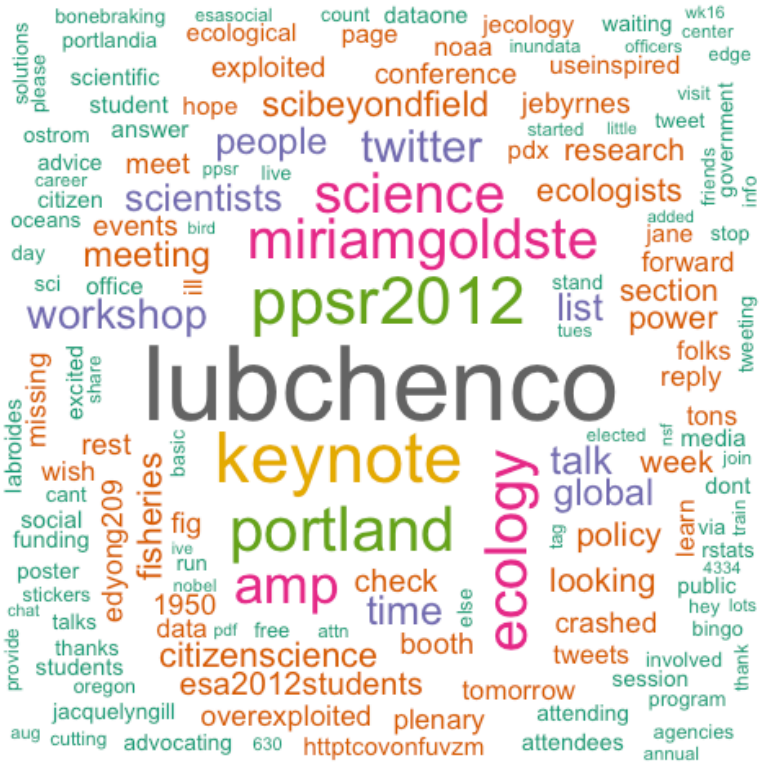

Figure 7. A word cloud made from analyzing tweets from the 2012 Ecological Society of America (ESA) meeting held in Portland, OR. Credit: ESA Blog, https://www.esa.org/esablog/ecology-in-the-news/esa-and-twitter-sunday/

Subtask 4.E. Support for four webinars

The GLEC team assumes that these webinars will last approximately 90 minutes each and supporting effort could include:

- Invitation/promotion *(need to identify maximum number of participants)*
- Agenda and presentation preparation (*assuming each webinar is unique*)
- Hosting and facilitating the webinar
- Summary notes

Table 4. Task 4 Deliverables

Deliverable	Timeline
4A Summary of existing monitoring data in the SNEP region	Within six (6) to eight (8) months of Kickoff Meeting
4B Summary of data gaps	TBD, based on timing of Task 3 meetings, but likely within six (6) to eight (8) months of Kickoff Meeting

Deliverable	Timeline
4C Summary of recommended data collection to address gaps	Within eight (8) months of Kickoff Meeting
4D Report highlighting environmental and community features most valued by the public in the SNEP region	Within ten (10) months of Kickoff Meeting
4E Support for four (4) webinars	TBD

Task 5: Ecosystem Service Valuation of SNEP Ecosystem Resources/Functions – A First Step

E. Shumchenia will manage the GLEC Team's work on Task 5, in close coordination with Mick DeGraeve (GLEC), and ecosystem valuation experts at the EPA Office of Research and Development Atlantic Coastal Environmental Science Division (ORD-ACESD) in Narragansett, RI, Nate Merrill and Marisa Mazzotta. Merrill and Mazzotta will serve as technical experts and advisors on this task.

This task will initiate a preliminary ecosystem services (ES) valuation of targeted and appropriately-bounded SNEP ecosystem resources/functions (EF/R). This task is directly dependent on the Integrated Ecosystems Services Framework (IESF) to be developed for Task 2 of the original Performance Work Statement (PWS). Consequently, it is expected that the level of effort (LOE) for this task will be greatest in the latter half of the project performance period. The draft report and spreadsheet (Subtask 2.A), and IESF functional schematic (Subtask 2B), on which this work depends, are projected to be developed by late February or early March. These products will define the focal EF/R in the SNEP region that could be targeted for valuation studies, and may describe existing valuation exercises in the region that could be used for a benefit transfer approach.

This task will represent the initial foray into ES valuation in the SNEP region. To define reasonable and appropriate bounds, we will limit this ES valuation to one (1) estuary-related ecosystem service that may be affected by a, or a set of, coastal water quality improving actions within the SNEP region. The Oyster Pond (Chatham, MA) case study described in this Amendment is a likely candidate for the ES valuation, but we will take guidance from advisors Merrill and Mazzotta, and also solicit input from both the SNEP Ecosystem Service Subcommittee and the SNEP Monitoring Subcommittee to identify other potential ES valuation opportunities in the SNEP region before making a final selection.

The ES valuation will employ the benefit transfer method by which economic values for ES are estimated by transferring available information from existing ES valuations of other locations with common ES. In order to attempt this benefit transfer it is necessary to 1) identify the available and quantifiable, water quality sensitive ecosystem services that lend themselves to benefit transfer types of valuation, 2) develop the appropriate benefit transfer functions or process for select ES, and 3) conduct a valuation of the flow of and changes in services due to water quality improvements. Because it is difficult to fully assess the LOE necessary to conduct an extensive ES valuation with the information currently available, it is anticipated that, at a

minimum, we will develop an ES valuation framework that will provide the rationale and assumptions to initiate and/or complete the valuation of whichever ES is ultimately chosen in the event that the LOE for Task 5 is inadequate.

We propose the following steps for Task 5.

- Identify existing data and potential resources for economic values of EF/R that can be applied to the SNEP region using the benefit transfer method, and select an appropriate focal estuary for testing the method.
- Using the IESF report and functional schematic, identify the SNEP region EF/R commonalities with existing valuation reports to define, to the extent allowable from EF/R commonalities, a valuation table relevant to the SNEP ES selected for evaluation (and generally relevant to the SNEP region).
- Determine if or how existing ES valuations require economic modifications specific to the SNEP region and/or its ES.
- Generate a tailored report on the ES valuation of the EF/R target determined by SNEP Staff and the SNEP subcommittees.

E&C has budgeted for four (4) half day (~4 hours) meetings for E. Shumchenia and C. Heil to meet with Merrill and Mazzotta at ORD in Narragansett, RI for this task. We suggest that one meeting occur as soon as the amendment is approved to more fully scope the task with respect to the bullets above, understand potential limitations of the assumptions in this response, and preliminarily identify a focal estuarine system and focal ecosystem function/resource to include in this exercise. Two of these meetings will occur in spring and summer 2020 to track progress on the task and hear feedback from the advisors. The final meeting will be scheduled near completion of the draft tailored report (estimated in early September 2020) to hear feedback from the advisors and finalize the report (estimated in late September 2020).

E&C will leverage existing meetings that have been budgeted as part of the original PWS to obtain input and feedback on this task from the SNEP Subcommittees.

GLEC has also included project management time for team member E. Shumchenia for this additional element to ensure continuity and integration of these deliverables into the overall project.

Task 5 Deliverables

- Four (4) half day meetings with EPA ORD-ACESD staff
- Draft and Final ESV Reports on EF/R target per the schedule below

Table 5: Task 5 Deliverables

Deliverable	Timeline
Four (4) meetings with EPA ORD-ACESD advisors	January 2020; April 2020; July 2020; September 2020
DRAFT ESV Report on EF/R target	No later than September 15, 2020
FINAL ESV Report on EF/R target	No later than September 30, 2020

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