ATTACHMENT 1

EPA Region 1 Blanket Purchase Agreement, BPA-68HE0118A0001-0003

RFQ _____

PERFORMANCE WORK STATEMENT
Holistic Watershed Management for Existing and Future Land Use Development Activities: Opportunities for Action for Local Decision Makers: Phase 1 – Modeling and Development of Flow Duration Curves (FDC 1 Project)
PERIOD OF PERFORMANCE 10/1/20 – 9/30/21

TASK ORDER CONTRACTOR OFFICER REPRESENTATIVE (TOCOR):
Ray Cody
US Environmental Protection Agency, Region 1
5 Post Office Square, Suite 100
Mail Code OEP06-1
Boston, MA 02109-3912
Telephone No.: 617-918-1366

ALTERNATE TOCOR (Alt. TOCOR):
Steven Winnett
US Environmental Protection Agency, Region 1
5 Post Office Square, Suite 100
Mail Code OEP06-1
Boston, MA 02109-3912
Telephone No.: 617-918-1687

I. PURPOSE

In brief, this project ("Phase 1") is a 'proof of concept' demonstration: development and use of flow duration curves (**FDC**) for low-order and/or headwater stream segments as an important next-generation watershed optimization management tool for qualifying and quantifying the impacts and benefits of changes in land cover from new development and/or redevelopment (**nD/rD**), including impacts from changes to water quality, flooding frequency and duration, channel stability, ecohydrological function, and hydrogeomorphology. FDCs will also be used to assess impacts and inform on potential management actions needed related to development activities under existing and future climate change, such as flooding risks, stream-channel stability, increased pollutant export and reduced base flows.

Outcomes of this project will lead to Phase 2 that will directly inform development of next-generation municipal ordinance and bylaws that incorporate next-generation nD/rD practices,

referred to here as "Conservation Development" (CD) practices, that include among other things, de-emphasis on use and application of impervious cover (**IC**), an increasing role of landscape architecture to achieve enhanced evapotranspiration (ET) and better geospatial distribution of nD/rD site runoff, preservation of natural vegetated areas and incorporation of architecture for increased sustainability and resilience and which preserves the pre-development hydrological condition. In addition, project outputs will include specific tasks to disseminate the technical transfer of the project, including the development of technical support documents (TSD) and webinars and trainings. In particular, it is contemplated that the project outputs would include a workshop for the SNEP Technical Assistance Network (STAN) to facilitate transfer of the project outputs.

The purpose of this project is consistent with the Vision, Purpose, Mission and Long-Term Goals of the Southern New England Program (**SNEP**),[1] the purpose of this project is to (a) build capacity of municipalities and of SNEP partners to support restoration activities (Goals 4 and 5), (b) expand the use of nature-based approaches to treat pollution at the source and offer associated benefits for habitat, wildlife, and outdoor recreation (Goals 1, 2 and 4) and (c) identify opportunities to restore water quality and physical processes that support critical habitat and ecosystem function (Goals 1, 2 and 4).

III. PROJECT BACKGROUND

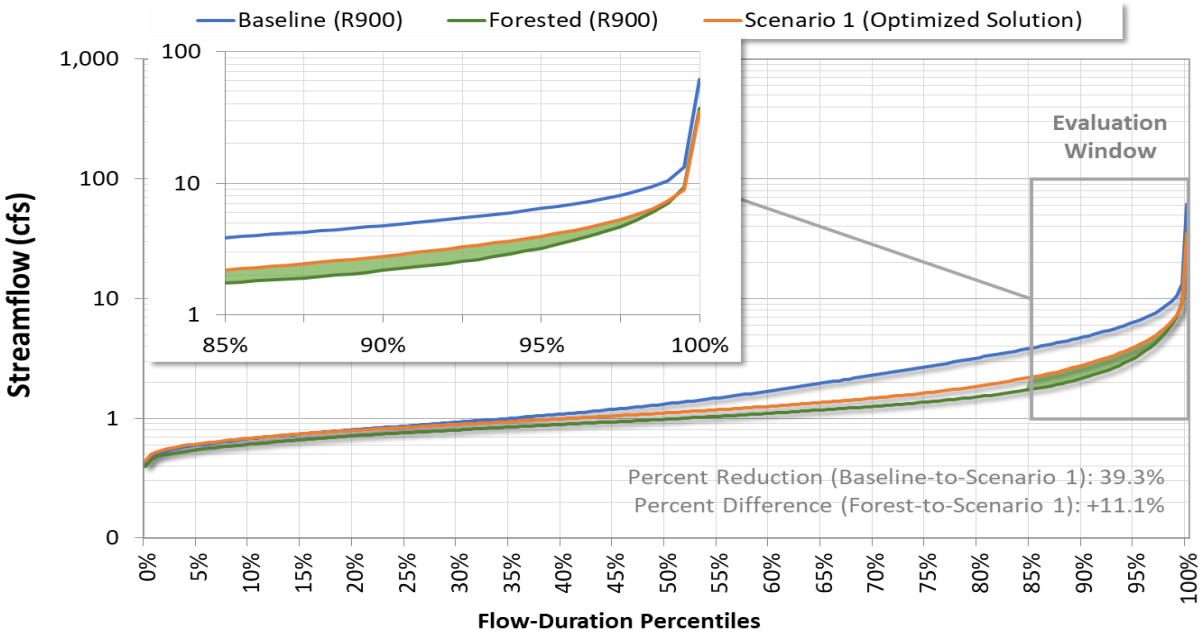
Conventional development approaches and existing stormwater management standards (where applicable) do not adequately address the full range of hydrologic, water quality and aquatic life impacts associated with human development and impervious cover ("IC"). The weight of evidence is clear that human development and urbanization have had a profound impact on water resources in multiple ways. The paving of vegetated land disrupts the natural hydrologic cycle at a site scale that has ramifications for the larger watershed. Recent research assessing the health and integrity of watersheds indicates that efforts to restore the hydrological and ecological function of our watersheds are not likely to offset the combined impacts of 1) past and future development that expands watershed impervious cover (IC), and 2) changing climate conditions. For instance, "billions of dollars continue to be invested in the physical restoration of urban channels. [However,] post-construction studies generally show . . . [these streams are in fact biologically] unrestored [except where stormwater control measures have been extensively implemented]." (Hawley; 2015). Watershed management needs to consider the magnitude, frequency, and timing of various flow events – and incorporate new insight on the role of lesser permeability soils (e.g., tills) which indicate such soils provide a primary mechanism for maintaining hydrological balance (Boutt; 2017). As human populations continue to grow, and population centers shift in response to changing natural hazards associated with climate change impacts, appropriate guidance on resource protection is a fundamental need for humans and ecological communities. The Flow Duration Curve encapsulates the full spectrum of hydrologic and hydrogeologic balance needed for assessing and preserving the future health of watersheds.

[1] Refer to https://www.epa.gov/snecwrp/vision-and-purpose-southeast-new-england-coastal-watershed-restoration-program

In brief, the FDC describes the frequency and duration of stream flow rates for a given location that occur over a long period. The FDC is a powerful diagnostic tool for evaluating impacts of watershed development and potential benefits of future management alternatives across the full spectrum of in-stream flow regimes:

- **FDCs Quantify <u>Impacts</u>.** FDCs can be used to quantify the impacts (change in frequency and duration) to critical flow regimes (e.g., bank-full flow (i.e., flooding), scouring flows (i.e., channel destabilization), base flow (i.e., aquatic life), high pollutant export flows, etc.) for varying levels of development and IC.

- **FDCs Quantify <u>Benefits</u>.** FDCs can be used to quantify anticipated benefits of alternative development practices and watershed stormwater management alternatives including:
    - relevance of existing stormwater standards;
    - enhanced Low Impact Development approaches;
    - optimized stormwater management solutions emphasizing green infrastructure (stormwater control measures (GI SCM) for both existing and future development conditions; and
    - identifying high-value hydrologic/ecological resource areas in which development should be avoided to maintain natural watershed functions essential for future watershed and water resource resiliency.



The above figure is an example flow duration curve for predevelopment and existing watershed development conditions, as well as an alternative conservation development management solution. The figure provides an example optimized solution for a given subwatershed after incorporating specific development and management practices in order to normalize the FDC

towards the natural hydrologic condition of the forested state. Except for the smaller percentage of larger storm events, the optimized solution demonstrates that the watershed can be hydrologically restored, a condition that translates overall into less geomorphic distortions, reduction in flooding events, and improved water quality. Hydrologic normalization is a precursor for ecological health and restoration.

V. SCOPE OF WORK

This following scope of work is predicated on developing flow duration curves for the headwaters and/or other low-order stream systems of the Taunton River watershed. By conducting this work in the Taunton River Watershed, the Project will capitalize on prior work, including an existing USGS-calibrated Hydrologic Simulation Program – Fortran (HSPF) model; the watershed data analyses conducted as part of applying the EPA Watershed Management Optimization Support Tool (WMOST) in a portion of the Taunton; and EPA Region 1's calibrated Opti-Tool and SUSTAIN models. Building on this previous work will allow the project to address outstanding resource management needs at considerable cost savings - and thereby a best value for SNEP.

A major component of this project will be to employ existing calibrated continuous simulation hydrologic and watershed management models for a portion of the Taunton River watershed. The models will be applied and refined as needed to develop flow duration curves (FDC) of stream flows that are representative of pre-development and existing development conditions to demonstrate impacts and develop optimized stormwater retrofit management strategies for improving conditions and to provide the groundwork for Phase 2 of this project for developing future land use managment strategies designed to protect water resources from future watershed development activities. To this end, the project shall evaluate a wide range of potential management measures including GI SCMs, removal of existing IC and potential future CD practices that can be reasonably simulated in the hydrologic modelling.

The project will focus FDC modelling analyses on three sub-watershed areas draining to low-order stream segments (e.g., headwaters, 2nd and/or 3rd order) by applying existing calibrated continuous simulation hydrologic models (e.g., USGS developed HSPF model of the Taunton) that simulate stream flow with flow contributions from runoff and ground water (GW). To best meet project objectives, it may be necessary to make use of an existing hydrologic model for a larger watershed area draining to a long-term streamflow gage record to refine model calibrations and inform model applications to the lower-order streams draining the study's sub-watersheds targeted for FDC analysis. Additionally, and as a quality control check for this study, a long-term flow record may be used to test the model for distinctly different levels of watershed development corresponding to historic flow record (e.g., 1960s compared to present). Water quality will not be simulated in the FDC hydrologic modelling analyses but pollutant export loads from various land use-based watershed source areas shall be estimated using EPA R1's calibrated SWMM HRU models associated with Opti-Tool.

Task 0: Work Plan, Budget and Schedule

The Contractor shall prepare a detailed work plan and budget response to the following work scope describing its proposed approach to completing all of the tasks in this PWS. Its response shall include a description of all assumptions and contingencies made by the Contractor, a proposed scheduled including a list of deliverables with due dates and schedule for deliverables, an estimated budget, and special reporting requirements (if any). The Contractor's response will include a description of proposed staff and the number of hours and labor classifications proposed for each task.

Task 0 Deliverables

The Work Plan, Budget and Schedule is due within three (3) weeks of Task Order (**TO**) award.

Task 1: Prepare Quality Assurance Project Plan (QAPP)

EPA policy requires that an approved Quality Assurance Project Plan be developed in advance for work that involves the collection, generation, evaluation, analysis or use of secondary environmental data for environmental decision making. The QAPP defines and documents how specific data generation and collection activities shall be planned, implemented, and assessed. To accomplish some of the work assignment objectives, it will be necessary for the Contractor to use existing environmental information/data and to develop modelled stormwater runoff flow and pollutant load estimates for various land source areas within the Town of Tisbury using EPA Region 1's Opti-Tool. Additionally, Opti-Tool shall be applied to help inform the development of SCM retrofit management strategies. Therefore, the Contractor shall develop a QAPP for all activities that involve assembling, reviewing and using existing environmental information and data, as well as for applying Opti-Tool.

As a template, the Contractor may use an existing QAPP for a related EPA project, entitled "Quality Assurance Project Plan for Phase 2 Mystic River Watershed Eutrophication Analysis" dated September 7, 2017, prepared for EPA by Eastern Research Group under Contract EP-C-16-033, Work Assignment No. 1-35. This QAPP is provided as a separate attachment to this PWS (**Appendix A**).

Task 1 Deliverables

The Contractor shall provide a draft QAPP to the TOCOR in electronic format **at the time of submitting the Work Plan.** The Contractor shall submit a final QAPP within 5 business days after receiving comments on the draft QAPP from the EPA TOCORs.

Task 2: Project Management and Administration

This task includes subtasks related to administration, management and coordination of the project.

Mark Voorhees (Stormwater Permitting) and **Ray Cody** (Surface Water Branch, NPS Unit) will serve as the core Project Team (**Project Team**) and/or Project Technical Leads (**PTL**) for this

project (**hereinafter, "the Project"**). **Ray Cody** will serve as the Task Order (TO) Contracting Officer Representative (**TOCOR**) and **Steven Winnett** will serve as the Alternate TOCOR (**Alt. TOCOR**). Except as provided (e.g., invoicing, contract-related correspondence), the Contractor shall direct all draft and final deliverables to the Project Team and copy (i.e., cc) the TOCOR and Alt. TOCOR.

Invoicing, generally

Provisions for invoicing are also generally set forth in the GSA Contract and/or the BPA. To the extent the following is not inconsistent with either, then to ensure timely administration, invoices shall be submitted promptly within the first week of each calendar month. Invoices shall be directed to the TOCOR. The TOCOR will distribute as appropriate to the Project Team Leader and/or the Project Team for review and consideration, as appropriate. Invoices shall, among other things, summarize the Contractor's work for the billing month, project anticipated work for the next billing period(s), identify and anticipate any problems that may impact the project or its schedule, and specify and identify the billable hours and other direct costs on a Task and Subtask basis. In its response to this PWS, the Contractor may add one or more specific Subtasks or line items under this Task for its general administration of the project.

In addition, to ensure timely processing of invoices, the Contractor shall copy the TOCOR on invoice submittals (by email as *.pdf) and any and all correspondence to the EPA Servicing Center (presumably, Research Triangle Park (RTP) Financing Center at RTPReceiving@epa.gov) and the subject line or body of such email submittals shall include the following pertinent information:

- Project Name (in this case, "SNEP Technical Assistance Project")
- Contract No.
- Order No.
- Billing/Invoice No.
- Billing Period
- Total Amount Billed for the Billing Period

Deliverables, generally

Provisions for Deliverables are generally set forth in the GSA Contract and/or the BPA. To the extent the following is not inconsistent with either, EPA intends to provide any and all formal reports produced under this contract for public dissemination, in whole or in derivative documents, as appropriate. The Contractor shall always provide draft versions of any spreadsheets, calculations or reports. EPA and its stakeholders may review and comment on draft deliverables / submittals. If so, then the Contractor shall incorporate any such comments into a final version(s). For communiques and reports, the Contractor shall use standard computer software (e.g., Adobe Acrobat, MS Word, MS Excel, MS PowerPoint). All other software (e.g., computer models) must utilize publicly available non-proprietary code. In addition, software application files, if delivered to the Government, must conform with Section 508 of the

Rehabilitation Act of 1973, as amended (29 U.S.C. § 794(d)).[2] Refer to http://www.section508.gov/.

Subtask 2A. Kickoff Meeting

The Contractor shall initiate a project kick-off meeting with the project team at EPA's Region 1 Boston office located at 5 Post Office Square, Suite 100, Boston, MA 02109-3912. Due to Covid-19, it may be appropriate to convene this meeting using a videoconference application such as Skype, Zoom or GoToMeeting.

For its cost response to this PWS, the Contractor shall provide a separate line item for in-person meeting(s) and assume travel, lodging (if applicable), logistics and coordination for managerial and technical personnel. Under an assumption in-person meeting funds are not expended, the budget line item may be re-allocated by the TOCOR using Technical Direction. For the Kickoff Meeting, EPA will make available any additional technical references not already provided herein, or other supplemental data or information that may assist the Contractor.

A week following this meeting, the Contractor shall summarize its understanding of the project kick-off meeting (e.g., action items; scheduling adjustments) and transmit these by email to the COR.

Subtask 2A Deliverables

- Kickoff meeting within one (1) month of Task Order Award.
- Kickoff meeting summary (incl. action items, scheduling adjustments, etc.) within one (1) week of kickoff meeting.

Subtask 2B. Conference Calls, Meetings and Project Team Support

Following the Kickoff Meeting, the Contractor shall provide for monthly conference calls (as needed) to keep the project team updated as to the status of the project. These calls may utilize EPA's teleconferencing facilities and EPA can provide teleconferencing details in advance of each call. The Contractor shall briefly summarize its understanding of each conference call (e.g., action items; scheduling adjustments) and/or meeting and transmit these by email to the TOCOR.

It is possible that drafts of any given deliverable may require time and level of effort (**LOE**) for EPA review and/or same for facilitating such review of the drafts by others. The Contractor shall include reasonable provisions for incorporating such review into the development of final deliverables.

[2] In 1998, Congress amended the Rehabilitation Act of 1973 to require Federal agencies to make their electronic and information technology (EIT) accessible to people with disabilities. The law applies to all Federal agencies when they develop, procure, maintain, or use electronic and information technology. Under Section 508, agencies must give disabled employees and members of the public access to information that is comparable to access available to others.

Subtask 2B Deliverables

- Monthly Conference Calls
- Monthly Conference Call Summaries
- Reasonable provisions for incorporating EPA and/or stakeholder review and input, if any.

Task 3: Technical Steering Committee (TSC) Meetings

The Contractor shall assist EPA R1 in the formation and management of a Technical Steering Committee (TSC) that will be comprised of members with expertise related to watershed and hydrologic stream flow modelling; geology and hydrogeology; stream ecology; fluvial geomorphology; green infrastructure and stormwater management; land use planning; and landscape architecture. The purpose of the TSC shall be to provide guidance and feedback to the core project team throughout the project, which shall be largely accomplished through their preparation for and participation in up to five (5) TSC meetings. EPA R1 shall be responsible for convening the TSC and will coordinate with the contractor as needed. In consideration of the Technical Steering Committee, an option would be to convene the project kickoff meeting at the University of Massachusetts, Amherst, MA (UMass Amherst). EPA R1 anticipates convening the TSC meetings at the following project milestones to facilitate receiving timely TSC input prior to key project decision points:

- TSC Meeting 1: Completion of Subtask 4A - Draft Technical Scope Outline
- TSC Meeting 2: Completion of draft Task 5 technical memorandum
- TSC Meeting 3: Completion of draft Task 6 technical memorandum
- TSC Meeting 4: Completion of draft Task 7 technical memorandum

The following individuals have either agreed to or shall be asked to participate on the TSC (listed alphabetically):

- Tom Ballestero, Director, University of New Hampshire Stormwater Center (Water Resource Engineering);
- Jeff Barbaro, U.S. Geological Survey (HSPF Model);
- David Boutt, Associate Professor, Department of Geosciences, UMass Amherst (Geology / Hydrogeology);
- Sara Burns, The Nature Conservancy (Water Resource Policy and Science);
- Naomi Detenbeck – EPA Office of Research and Development (ORD), Atlantic and Ecology Division, Narragansett, RI (Water Resource Management/Ecology; WMOST model);
- Jamie Houle, UNHSC (GI/SW Management);
- Kim Groff, The Southern New England Program (SNEP) Technical Assistance Network (Water Resource Engineering);
- Scott Jackson, Dept of Environmental Conservation, UMass Amherst (Integrated Research);

- Michael Kline, Fluvial Matters Consulting, University of Vermont, (Fluvial Geomorphology);
- Bill Napolitano, Southeastern Regional Planning and Economic Development District, Lead Environmental Planner;
- Gretchen Rabinkin, Boston Society of Landscape Architects, Chapter President;
- Allison Roy, Research Assistant Professor**,** US Geological Survey's (USGS) Massachusetts Cooperative Fish and Wildlife Research Unit, UMass Amherst (Stream Ecology); and
- Viki Zoltay, Massachsetts Department of Conservation and Recreation (WMOST, hydrology)

  In addition, select representatives from EPA R1 and/or MassDEP will be asked to participate.

Task 4: Coordinate with TSC to Finalize Phase 1 Project Approach

The objective of this task is to vet and refine the technical scope of the project with input from the TSC. The Contractor shall complete the following subtasks to develop a final project approach designed to meet the Phase 1 project objectives and provide the supporting technical foundation for future work to be conducted under Phase 2.

Subtask 4A: Draft Technical Scope Outline

The Contractor shall develop a project scope outline that provides brief descriptions of proposed technical tasks to be performed during Phase 1 that, at a minimum, covers the project elements described in this PWS. Also, the outline shall describe how the Phase 1 work will be suitable for accomplishing Phase 2 work and achieving the overall project objectives of both Phases 1 and 2. The Phase 1 project scope outline shall introduce the use of Flow Duration Curves (FDC) and their value for understanding and illustrating a wide-range of conditions and impacts related to hydrologic (flooding and baseflow), water quality, physical stream channel, and habitat conditions/impacts associated with watershed land surface alterations such as the conversion of vegetated permeable areas to impervious cover (IC conversion). For example, the following concepts should be specifically addressed:

- Quantification of the frequency-duration of all measured and or modelled stream flow values that occur over long periods of time (e.g., 20 years).

- Identify critical flow values and/or flow zones that reflect the occurrence of flooding (overtopping stream bank $Q_{Bankfull}$) and larger flood flows associated with specific return periods as well as key ecological conditions (e.g., scouring flows[3]), zone of increased pollutant export, baseflow and low flow conditions reliant on groundwater (GW) recharge, sensitive temperature flow regimes dependent upon GW sources, etc.

[3] Hawley, Robert & Vietz, Geoff. (2015). Addressing the urban stream disturbance regime. Freshwater Science. 000-000. 10.1086/684647

- Demonstrate how FDC can be used to evaluate changes in stream flow dynamics resulting from watershed development and IC conversion for various development conditions and climatic periods of interest.

Subtask 4B: Finalize Technical Scope

The Subtask 4A Draft Technical Scope Outline shall be shared with the TSC for their review and comment and discussed during a virtual (remote meeting). Based on discussions and comments received from the TSC, the Contractor shall finalize the technical scope of work/project approach.

Task 4 Deliverables

- Subtask 4A Draft Technical Scope Outline
- Subtask 4B Finalized Technical Scope

Task 5: Compile Available Data/Information for Taunton River Watershed Modelling Analyses

The objective of this task is for the Contractor to assemble, review and develop information to define the specific scope of modelling work to be conducted and quantify the magnitude of change to watershed functions associated with landscape conversion to impervious cover. The contractor shall accomplish the following subtasks for compiling available data and information for the Taunton River Watershed Modeling Analysis:

Subtask 5A - Data/Information Assessment

The Contractor shall collect, review and assess all readily available data and information including previous hydrologic modelling analyses related to the Taunton River Watershed, as well as related scientific/technical information that is pertinent to achieving the project's objectives. The Contractor shall coordinate with EPA, EPA ORD and USGS experts to ascertain availability and extent of data / information and gather such data. The Contractor may use one or more conference or videoconference calls to assist with such coordination. This will likely include:

- Identify Candidate Subwatershed Drainage Areas. Identify and assess candidate subwatershed areas draining to low-order stream reaches (e.g., headwaters, 2nd and or 3rd) within the Taunton River watershed with varying levels of development ranging from very rural to more highly developed with distinctly different amounts of IC (e.g., very rural (<10% IC); rural/suburban (15%-25% IC); and suburban to urban (greater than 30%)) that would be suitable for further assessment and modelling analysis under Phase 1. The Contractor shall consider and assess the suitability of previous hydrologic model calibration efforts for informing application of the hydrologic models to develop FDCs and evaluate hydrologic management solutions in the sub-watershed areas.

- Land Cover. Investigate the availability of historic land cover datasets / information in the Taunton River watershed to inform past development progression patterns and watershed condition for model simulations.

- Subwatershed Prioritization. Prioritize the candidate sub-watersheds based on assessment of key watershed/stream hydrologic characteristics and recommend three (3) sub-watersheds for further study and modelling analysis under Phase 1. The Contractor shall coordinate with EPA R1 to include within the prioritization process a qualitative assessment of the level of potential engagement of local municipalities to consider project findings in their future water resource-related planning and implementation activities. EPA R1 shall take the lead on coordinating with watershed partners and the TSC to assess the potential level of municipality engagement.
- Identify Useful Streamflow Gauging Station Data**.** Identify other previously modelled watershed areas within the Taunton River watershed that drain to streamflow gauging stations with long-term flow records that may be useful for informing model development/refinement/testing for applying the models in the pilot sub-watersheds to best achieve project goals.

- Related Data (Qualification / Refinement). Identify potential short-term data and informational needs (e.g., geomorphic assessments, literature reviews of aquatic health response to urbanization) that would potentially enhance project outcomes.

- Literature Reviews. Conduct literature reviews to assist in informing the identification of critical flow regimes/flow metrics necessary to characterize conditions in low-order stream systems related stream channel stability, aquatic life and habitat health and flooding. A primary objective of the literature reviews will be to recommend critical flow regimes / metrics to be displayed on flow duration curves (FDC) developed for the pilot sub-watersheds to indicate changing conditions / impacts associated with watershed development and to guide development of management solutions.

- Monitoring. Investigate current, ongoing work in the watershed that includes monitoring of chemical, physical, and/or biologic communities.

Subtask 5B – Past, Current and Future Climatic Data Analysis

The Contractor shall compile local climatic data of hourly precipitation and daily temperature (maximum and minimum) for a period of approximately 40 years (e.g., 1980 to 2019). The Contractor shall analyze climatic data to evaluate changing conditions for this period and identify trends in precipitation patterns and daily air temperatures. The analysis shall include interdecadal comparisons of the frequency of occurrence of precipitation event depths, hourly precipitation intensities and daily maximum temperatures. The Contractor shall also assess existing estimates of future climatic conditions and propose daily temperature and hourly precipitation timeseries suitable for conducting hydrologic model simulations for future climatic conditions in the study area. The Contractor shall recommend the existing and future climatic datasets to be used in the modeling analyses for this project.

Subtask 5C – Baseline Unit-Area Modelling Analysis

The Contractor shall conduct baseline unit-area (e.g., hydrologic response unit (HRU)) continuous simulation modelling analyses to estimate long-term (e.g., 20-year period) cumulative changes and impacts to watershed functions (e.g., hydrologic, pollutant export, heat exchange and carbon sequestration associated with changes in land use cover especially related to the conversion of permeable vegetated areas to IC (IC conversion).

The Contractor shall apply the calibrated water-quality SWMM HRU models associated with EPA R1's Opti-Tool (or equivalent) for developing quantified estimates in changes in average annual volumes of runoff, recharge and evapotranspiration and average annual runoff-pollutant export using local climatic data compiled in subtask 5B for the most recent 20 year period. The contractor shall also investigate methods to quantify unit-area changes in heat exchange and carbon sequestration associated with IC conversion and develop best estimates of average annual changes given available information.

The Contractor shall prepare Fact Sheets with figures and tables as needed to convey the unit-area estimates of long-term cumulative alterations and impacts to watershed functions and discuss how the results can be scaled to better understand the potential magnitude of cumulative watershed-wide impacts associated with land use changes and associated IC conversion

Subtask 5D – Develop Hydrologic / Streamflow and Water Management Modelling Approach for Taunton River Sub-watershed Analyses

The Contractor shall propose a modelling approach to be applied to the sub-watershed areas to simulate hydrologic and stream flow conditions with and without stormwater (SW) management actions. **The hydrologic modelling shall account for the full water balance associated with precipitation, runoff, evapotranspiration, runoff, groundwater interflow and deep groundwater recharge.** The modelling approach should also include a description of proposed refinements to existing models (e.g., USGS HSPF models or their equivalent (e.g., LSPC)) previously applied in the Taunton River watershed and R1's Opti-Tool to simulate management options that are needed to accomplish project goals. The Contractor shall provide supporting technical documentation for the proposed method(s) to be incorporated into the Opti-Tool to achieve the project objectives.

Task 5 Deliverables

The Contractor shall prepare a **Technical Memorandum (TM)** detailing the proposed approaches, recommendations and results of work performed under subtasks 5A, 5B, 5C and 5D. The Contractor shall submit a draft TM to the TOCOR. The Contractor shall finalize the TM and provide a summary or otherwise incorporate responses to all comments within 10 business days from the date of receiving comments from the TOCOR. The TOCOR will be responsible for obtaining input from the TSC. In addition, The Contractor shall submit a draft **Fact Sheet** as described for Task 5C (e.g., up to 2 pages) to the TOCOR and shall finalize the Fact Sheet within 10 business days of receiving comments from the TOCOR.

Task 6: Phase 1 Hydrologic Streamflow Modelling Analyses

The objective is this task for the Contractor to develop continuous simulation hydrologic modelling tools suitable for creating FDCs to quantify stream flows for the pilot sub watersheds associated with baseline and future climatic conditions for varying levels of land cover development (e.g., predevelopment, historic development, (if available) and existing land cover development conditions). Additionally, the Contractor shall also propose methods and necessary model refinements needed to evaluate a variety of watershed management actions on FDCs in the pilot study areas. To this end, the Contractor shall carryout the modeling approach described in the Task 5 final TM. Work under this task will likely include the following work elements as described under the following subtasks:

Subtask 6A: Adapt Models for Flow Duration Curve Analyses for Pilot Sub-watersheds

The Contractor shall conduct the following to develop and apply the pilot sub-watershed hydrologic models:

- GIS-based Watershed Characterization. Perform watershed characterization including necessary GIS spatial data analyses for the selected three sub-watershed areas and any additional areas identified to be needed to inform development/refinement/testing of the hydrologic models for stream FDC development. The characterization of key watershed and stream information shall include the features identified below for existing, historic (e.g., circa 1960s) and pre-development conditions (i.e., fully natural vegetative conditions):

    - Watershed: Size, slopes, soils, aspect, natural vegetative cover (wetlands, forest, scrub shrub, barren), land use, area in conservation, surficial geology, total impervious cover, etc.
    - Stream: length, channel substrate, slope, conditions (geomorphic assessment). Evaluate historic information to assess changes in conditions over time as the watershed has developed.

- Model Refinement. Refine selected hydrologic models to the study areas using best available data and information to represent hydrologic processes and streamflow routing for predevelopment, historic (if available) and existing watershed conditions for the selected baseline climatic period. Compile streamflow gaging data and conduct additional model testing, refinements and calibrations as needed. Document process and results of any additional model calibration and refinement work.

- Develop FDCs. Develop FDCs for the selected sub-watersheds for pre-development, historic development (if available) and existing development conditions for baseline and future climatic conditions to estimate changes/impacts related to stream channel stability, aquatic life and habitat health and flooding associated with watershed development and to guide development of management solutions.

- Present Results**.** Summarize the results of the FDC analyses and create accompanying tables for each of the study target sub-watersheds that depict and compare FDC results for predevelopment, historic development (if available), and existing development conditions for baseline and future climatic conditions. Provide quantified estimates of impacts associated with watershed development and IC conversion. Tabulate, and depict on FDCs where appropriate:

    - quantitative estimates of long-term cumulative impacts for the identified critical streamflow regimes / metrics (e.g., flooding, channel scouring, baseflow depletion, etc.),
    - SW runoff pollutant load export,
    - GW recharge,
    - evapotranspiration,
    - carbon sequestration and
    - heat loss exchange associated with the different development conditions.

    Additionally, provide a comparison of the results among the three pilot subwatershed areas and summarize key take away messages related to watershed development / IC conversion and the condition and health of the study's selected streams related to changes in watershed function.

Subtask 6B: Adapt EPA R1 Opti-Tool for Stormwater and FDC Management Analyses

The Contractor shall make refinements to EPA R1's Opti-Tool to include:

- Functionality to estimate the GI SCM groundwater recharge linkage to local surface waters (e.g., similar capacity to EPA R10's SUSTAIN model); and

- FDC evaluation factors for optimization simulations to identify optimal and most cost-effective management strategies to address impacts associated with the key critical flow regimes/metrics identified through this project such as minimizing the frequency and duration of occurrence of channel scouring flows, flooding, and depleted baseflow conditions.

Task 6 Deliverables

The Contractor shall prepare a **Technical Memorandum** (**TM**) detailing the work conducted under Task 6 including documentation of the modelling methodologies applied to the selected sub-watersheds and a presentation of the results including a comparative analysis of the results for the various development and climatic conditions simulated. Additionally, the Contractor shall document and provide supporting information for the enhancements made to Opti-Tool. The Contractor shall submit a draft Task 6 TM to the TOCOR. The Contractor shall finalize the Task 6 TM and provide a summary of the response to all comments within 10 business days from the

date of receiving comments from the TOCOR. The TOCOR will be responsible for obtaining input from the TSC.

Task 7: Phase 1 Stormwater/Hydrologic Management Optimization Analyses

The objective of this task is to simulate watershed management opportunities to address existing impacts documented during Phase 1 work and to set the stage for additional managment modelling analyses to evaluate mitigating impacts of future development under Phase 2. The Contractor shall carryout the SW/hydrologic management modeling approach as described in the Task 5 final TM. Work under this task will likely include the following work elements:

- GIS Analysis. Conduct GIS analyses to identify all potential stormwater management opportunities including green infrastructure stormwater control measures (GI SCM) throughout the selected sub-watersheds in preparation for performing EPA R1's Opti-Tool stormwater management optimization simulations.

- Optimize SCM Opportunities. Optimize the GI SCM opportunities in the selected pilot sub-watershed areas using EPA's R1 Opti-Tool to restore lost watershed hydrologic and pollutant attenuation functions (e.g., groundwater recharge, and evapotranspiration, etc) using FDC evaluation factors and pollutant load export for both existing and future climatic conditions. It is assumed that up to three optimization simulations shall be accomplished for each pilot sub-watershed to evaluate the most cost-effective scenarios to achieve multiple management objectives such as channel stability, low flow conditions and pollutant load export. This analysis shall involve developing prospective FDCs using the continuous hydrologic models and the EPA R1 Opti-Tool for simulating GI SCMs to assess potential long-term cumulative benefits associated with varying levels of stormwater management interventions developed through the optimization scenarios.

- Quantify Pollutant Load Export Reductions. Quantify pollutant load export reductions associated with various land-based watershed management optimization scenarios using calibrated hydrologic response unit (HRU) SWMM water quality models and the R1 Opti-Tool.

- Present Results. Summarize the results of the FDC analyses and create accompanying tables for each of the study target sub-watersheds that depict and compare FDC results for predevelopment, historic development, existing development conditions and the three optimized GI SCM scenarios for baseline and future climatic conditions. Provide quantified estimates of impacts and benefits associated with watershed development and IC conversion as well as the restoration opportunities identified in the optimization scenarios. Tabulate and depict on FDCs where appropriate quantitative estimates of long-term cumulative impacts and management benefits for the identified critical streamflow regimes/metrics, SW runoff pollutant load export, GW recharge, evapotranspiration, carbon sequestration and heat loss exchange.

- Identify Management Strategies. Identify long-term management strategies and potential mechanisms that local communities can begin pursuing (e.g., adopting more protective local ordinances for redevelopment and new development and opportunistic SW management retrofit programs) to build resiliency and make progress in restoring/protecting local and regional water resource health. Provide examples of 'real world' solutions suitable for the SNEP region.

- Final Project Report. Prepare written project report that documents all work performed during Phase 1 of this project. The final project report shall also describe how the work conducted under Phase 1 shall be applied to accomplish the objectives of Phase 2 work to develop wise water resource management strategies for future watershed development activities.

- Outreach Materials. The Contractor shall prepare outreach materials that provide brief project information summaries (not to exceed three) for efficiently conveying key messages, lessons learned, and valuable water resource management information to watershed management practitioners including local, state and federal government representatives. Outreach materials shall be developed with the goal to effectively communicate key findings including discussion of relationships between watershed function, land use development and water resource impacts in low-order stream systems and larger down-gradient waters resources (e.g., lakes, coastal waters, aquifers, etc). The information summaries should be designed with accompanying graphics and tables to clearly convey water resource impacts associated with inadequately managed IC conversion and the potential quantitative benefits of feasible watershed restoration activities/strategies identified in this study.

Task 7 Deliverables

- The Contractor shall submit a draft Phase 1 **Final Project Report** to the TOCOR. The Contractor shall finalize the Phase 1 report within 15 business days from the date of receiving comments from the TOCOR. The TOCOR will be responsible for obtaining input from the TSC.

- The Contractor shall submit draft **Outreach Materials** (not to exceed three) to the TOCOR. The Contractor shall finalize the Outreach materials within 10 business days from the date of receiving comments from the TOM. The TOM will be responsible for obtaining input on the outreach materials from the TSC.

Task 8: Phase 1 Project Webinar to SNEP Region

The Contractor shall prepare for and participate in webinar to present the Phase 1 study results and findings. The Contractor may assume webinar logistics will be provided by the SNEP.

IV. SCHEDULE

The following table provides an estimate of the project schedule. EPA understands that this schedule may change as a result of discussions with the Contractor or with the natural course of the project. In addition, the Contractor may propose modifications or an alteration of this schedule in its response to this PWS**. However, the schedule must presume completion within one year of Task Order (TO) award.**

Deliverables	**Delivery Dates**
Task 0. Workplan, Budget and Schedule	Within three (3) weeks of TO award
Task 1. Prepare QAPP • Draft • Final	 Same as Task 0: within three (3) weeks of TO award Within five (5) business days of receipt of EPA comments
Task 2. Project Management and Administration • Subtask 2A Kickoff Mtg • Subtask 2B Monthly Conference Calls and Summaries	 Within one (1) month of TO award As Needed
Task 3. Technical Steering Committee Meetings • Four (4) Meetings	 To Be Determined
Task 4: Coordinate with TSC to Finalize Phase 1 Project Approach • **Subtask 4A: Draft Technical Scope Outline**	 Within two (2) months of TO award

• **Subtask 4B: Finalize Technical Scope**	Within one (1) week of receipt of EPA comments
Task 5. Compile Available Data/Information for Taunton River Watershed Modelling Analyses **Technical Memorandum (TM) addressing:** • Subtask 5A - Data/Information Assessment • Subtask 5B – Past, Current and Future Climatic Data Analysis • Subtask 5C – Baseline Unit-Area Modelling Analysis • Subtask 5D – Develop Hydrologic / Streamflow and Water Management Modelling Approach for Taunton River Sub-watershed Analyses **Task 5C Fact Sheet**	Within six (6) months of TO award Within six (6) months of TO award
Task 6: Phase 1 Hydrologic Streamflow Modelling Analyses **Technical Memorandum (TM) addressing:** • Subtask 6A: Adapt Models for Flow Duration Curve Analyses for Pilot Sub-watersheds • Subtask 6B: Adapt EPA R1 Opti-Tool for Stormwater and FDC Management Analyses **Final Task 6 TM**	Within eight (8) months of TO award Within two (2) weeks of receipt of EPA comments

Task 7: Phase 1 Stormwater/Hydrologic Management Optimization Analyses
 	
• **Final Project Report**
  ○ Draft
  ○ Final
 	
• Task 7 Outreach Materials
  ○ Draft
  ○ Final
	
	Within eleven (11) months of TO award
	Before TO expiration
	
	Within eleven (11) months of TO award
	Before TO expiration

Task 8: Phase 1 Project Webinar to SNEP Region	Before TO expiration

V. REFERENCES

Appendix A. "Quality Assurance Project Plan for Phase 2 Mystic River Watershed Eutrophication Analysis" dated September 7, 2017, prepared for EPA by Eastern Research Group under Contract EP-C-16-033, Work Assignment No. 1-35.