AWARD/CONTRACT	1. THIS CONTRACT IS A RATED ORDER UNDER DPAS (15 CFR 700)	RATING	PAGE OF PAGES 1 | 3

2. CONTRACT (Proc. Inst. Ident.) NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQUEST/PROJECT NO.
EP-C-17-031/68HERC20F0434	See Block 20C	PR-ORD-20-01434

5. ISSUED BY CODE CAD

CAD
US Environmental Protection Agency
26 West Martin Luther King Drive
Mail Code: W136
Cincinnati OH 45268-0001

6. ADMINISTERED BY (If other than Item 5) CODE

7. NAME AND ADDRESS OF CONTRACTOR (No., street, country, State and ZIP Code)

TETRA TECH, INC.
Attn: John Hochheimer
10306 EATON PL STE 340
FAIRFAX VA 22030

CODE 198549560 FACILITY CODE

8. DELIVERY
☐ FOB ORIGIN ☒ OTHER (See below)

9. DISCOUNT FOR PROMPT PAYMENT

10. SUBMIT INVOICES (4 copies unless otherwise specified) TO THE ADDRESS SHOWN IN — ITEM

11. SHIP TO/MARK FOR CODE ORD DC

Office of Research and Development
US Environmental Protection Agency
1200 Pennsylvania Avenue, NW
MC: 8101R
Washington DC 20460

12. PAYMENT WILL BE MADE BY CODE RTP FMC

RTP Finance Center
US Environmental Protection Agency
RTP-Finance Center (AA216-01)
109 TW Alexander Drive
www2.epa.gov/financial/contracts
Durham NC 27711

13. AUTHORITY FOR USING OTHER THAN FULL AND OPEN COMPETITION:
☐ 10 U.S.C. 2304 (c) ( ) ☒ 41 U.S.C. 3304 (a) ( )

14. ACCOUNTING AND APPROPRIATION DATA
See Schedule

15A. ITEM NO	15B. SUPPLIES/SERVICES	15C. QUANTITY	15D. UNIT	15E. UNIT PRICE	15F. AMOUNT
	Continued				

15G. TOTAL AMOUNT OF CONTRACT $482,927.52

16. TABLE OF CONTENTS

(X)	SEC.	DESCRIPTION	PAGE(S)	(X)	SEC.	DESCRIPTION	PAGE(S)
		PART I - THE SCHEDULE				PART II - CONTRACT CLAUSES	
	A	SOLICITATION/CONTRACT FORM			I	CONTRACT CLAUSES	
	B	SUPPLIES OR SERVICES AND PRICES/COSTS				PART III - LIST OF DOCUMENTS, EXHIBITS AND OTHER ATTACH.	
	C	DESCRIPTION/SPECS./WORK STATEMENT			J	LIST OF ATTACHMENTS	
	D	PACKAGING AND MARKING				PART IV - REPRESENTATIONS AND INSTRUCTIONS	
	E	INSPECTION AND ACCEPTANCE			K	REPRESENTATIONS, CERTIFICATIONS AND OTHER STATEMENTS OF OFFERORS	
	F	DELIVERIES OR PERFORMANCE					
	G	CONTRACT ADMINISTRATION DATA			L	INSTRS., CONDS., AND NOTICES TO OFFERORS	
	H	SPECIAL CONTRACT REQUIREMENTS			M	EVALUATION FACTORS FOR AWARD	

CONTRACTING OFFICER WILL COMPLETE ITEM 17 (SEALED-BID OR NEGOTIATED PROCUREMENT) OR 18 (SEALED-BID PROCUREMENT) AS APPLICABLE

17. ☒ CONTRACTOR' S NEGOTIATED AGREEMENT (*Contractor is required to sign this document and return* 0 *copies to issuing office.*) Contractor agrees to furnish and deliver all items or perform all the services set forth or otherwise identified above and on any continuation sheets for the consideration stated herein. The rights and obligations of the parties to this contract shall be subject to and governed by the following documents: (a) this award/contract, (b) the solicitation, if any, and (c) such provisions, representations, certifications, and specifications, as are attached or incorporated by reference herein. (*Attachments are listed herein.*)

18. ☐ SEALED-BID AWARD (*Contractor is not required to sign this document.*) Your bid on Solicitation Number 68HERC20R0126, including the additions or changes made by you which additions or changes are set forth in full above, is hereby accepted as to the items listed above and on any continuation sheets. This award consummates the contract which consists of the following documents: (a) the Government's solicitation and your bid, and (b) this award/contract. No further contractual document is necessary. (Block 18 should be checked only when awarding a sealed-bid contract.)

19A. NAME AND TITLE OF SIGNER (*Type or print*)

20A. NAME OF CONTRACTING OFFICER
Andrea Dehne

19B. NAME OF CONTRACTOR

BY
(*Signature of person authorized to sign*)

19C. DATE SIGNED

20B. UNITED STATES OF AMERICA

BY ELECTRONIC SIGNATURE
(*Signature of the Contracting Officer*)

20C. DATE SIGNED
09/09/2020

NAME OF OFFEROR OR CONTRACTOR
TETRA TECH, INC.

ITEM NO. (A)	SUPPLIES/SERVICES (B)	QUANTITY (C)	UNIT (D)	UNIT PRICE (E)	AMOUNT (F)
	DUNS Number: 198549560 Task Order award incorporates the attached EPA blanket administrative modification signed by Raoul Scott on August 11, 2020. All other terms and conditions remain unchanged. Contractor is aware of the action consolidation. TOCOR: Kate Schofield Max Expire Date: 04/08/2022 Delivery: 04/08/2022 Period of Performance: 09/10/2020 to 04/08/2022				
0001	Task Order Issuance Line Item: Technical Support for EPA/ORD Ecological Assessment Programs Accounting Info: 20-21-C-26D2000-000FK6XR1-2532-26A5C-2026D2C015-001 BFY: 20 EFY: 21 Fund: C Budget Org: 26D2000 Program (PRC): 000FK6XR1 Budget (BOC): 2532 Cost: 26A5C DCN - Line ID: 2026D2C015-001 Funding Flag: Complete Funded: $59,888.21 Accounting Info: 19-20-C-26D2000-000FK6XR1-2532-26A5C-2026D2C015-002 BFY: 19 EFY: 20 Fund: C Budget Org: 26D2000 Program (PRC): 000FK6XR1 Budget (BOC): 2532 Cost: 26A5C DCN - Line ID: 2026D2C015-002 Funding Flag: Complete Funded: $20,065.00 Accounting Info: 19-20-C-26D2000-000FK6XR2-2532-26A5C-2026D2C015-003 BFY: 19 EFY: 20 Fund: C Budget Org: 26D2000 Program (PRC): 000FK6XR2 Budget (BOC): 2532 Cost: 26A5C DCN - Line ID: 2026D2C015-003 Funding Flag: Complete Funded: $1,887.00 Accounting Info: 19-20-C-26D2000-000FK7XR4-2532-26A5C-2026D2C015-004 BFY: 19 EFY: 20 Fund: C Budget Org: 26D2000 Program (PRC): 000FK7XR4 Budget (BOC): 2532 Cost: 26A5C DCN - Line ID: 2026D2C015-004 Funding Flag: Complete Funded: $4,741.50 Accounting Info: 19-20-C-26D2000-000FK8XPW-2532-26A5C-2026D2C015-005 BFY: 19 EFY: 20 Fund: C Budget Org: 26D2000 Program (PRC): 000FK8XPW Budget (BOC): 2532 Cost: 26A5C DCN - Line ID: 2026D2C015-005 Funding Flag: Complete Funded: $34,957.00 Accounting Info: 19-20-C-26D2000-000F84-2532-26A5C-2026D2C015-006 Continued ...				482,927.52

NAME OF OFFEROR OR CONTRACTOR
TETRA TECH, INC.

ITEM NO. (A)	SUPPLIES/SERVICES (B)	QUANTITY (C)	UNIT (D)	UNIT PRICE (E)	AMOUNT (F)
	BFY: 19 EFY: 20 Fund: C Budget Org: 26D2000 Program (PRC): 000F84 Budget (BOC): 2532 Cost: 26A5C DCN - Line ID: 2026D2C015-006 Funding Flag: Complete Funded: $138,349.50 Accounting Info: 20-21-C-26D2000-000FK8XPW-2532-26A5C-2026D2C015-007 BFY: 20 EFY: 21 Fund: C Budget Org: 26D2000 Program (PRC): 000FK8XPW Budget (BOC): 2532 Cost: 26A5C DCN - Line ID: 2026D2C015-007 Funding Flag: Complete Funded: $55,000.00 Accounting Info: 20-21-C-26D2000-000FK7XR4-2532-26A5C-2026D2C015-008 BFY: 20 EFY: 21 Fund: C Budget Org: 26D2000 Program (PRC): 000FK7XR4 Budget (BOC): 2532 Cost: 26A5C DCN - Line ID: 2026D2C015-008 Funding Flag: Complete Funded: $168,039.31 Award Type: Firm-fixed-price Delivery-Invoice Payment Schedule shall not exceed a frequency greater than once a month and 90% of the task order price. Acceptance for invoicing is based on deliverable approval by the TOCOR. For efficient processing IAW FAR clause 52.232-32, performance based payment invoicing amounts will not be submitted until the TOCOR provides deliverable approval. The TOCOR will notify Tetra Tech within 14 days of submission of a deliverable of EPAs intention to approve or disapprove. TOCOR: Kate Schofield/(202)564-2640/Schofield.kate@epa.gov ALTOCOR: Britta Bierwagen/(202)564-7676/Bierwagen.britta@epa.gov				

PERFORMANCE WORK STATEMENT

TETRA TECH, INC.
Contract #EP-C-17-031
PR-ORD-20-01434
SOL #68HERC20R0126
TO: #68HERC20F0434

I. Title: Improving the assessment of environmental impacts and their management

II. EAS Short Title: Assessing environmental impacts

III. Period of Performance: Date of TO award through 18 months following award

IV. Task Order COR:
Kate Schofield, PhD
U.S. Environmental Protection Agency Office of Research and Development
Center for Public Health and Environmental Assessment (8623R) 1200 Pennsylvania Ave NW
Washington, DC 20640
202-564-2640 (phone)
schofield.kate@epa.gov

Alternate Task Order COR:
Britta Bierwagen, PhD
U.S. Environmental Protection Agency Office of Research and Development
Center for Public Health and Environmental Assessment (8623R) 1200 Pennsylvania Ave NW
Washington, DC 20640
202-564-7676 (phone)
bierwagen.britta@epa.gov

V. Introduction:

The EPA Office of Research and Development's (ORD) Integrated Environmental Assessment Branch (IEAB) works to build the capacity of EPA program and regional offices and other decision-makers to assess and respond to potential effects on environmental quality. IEAB's research and assessment activities broadly support EPA's mission and responsibilities, through the assessment of complex environmental issues to inform and improve the next generation of environmental decisions. IEAB conducts innovative synthesis, assessment, and research to fill critical knowledge gaps by working with stakeholders and partners to identify and address both near- and long-term challenges associated with a changing environment. IEAB addresses scientific issues that focus on the impacts from local and global stressors to ecosystems and resources, water quality and drinking water, air quality, human health and well-being, and assessments of the impacts of potential response strategies.

This Task Order (TO) has multiple components, all of which contribute to IEAB's assessment of environmental impacts and their management. EPA's Office of Water (OW) and regional, state, and local water resource managers are the primary audiences for all components. Specific tasks involve evaluating how hydroclimatic changes affect stormwater best management practices (Task 2, below); furthering development of nitrogen and phosphorus inventories (Task 3, below); furthering the development of Biological Criteria Gradient and innovative methods to calculate streamflow in headwater stream (Task 4, below); developing a batch watershed delineation tool (Task 5, below); and

assisting with literature-based evidence reviews for nutrient-related linkages in aquatic systems (Task 6, below)..

VI. Specific Tasks and Deliverables:

Task 1. Establish communication with the TOCOR and develop a QAPP

1. Within one (1) week of TO award, the Contractor shall schedule a kick-off call to take place within four (4) weeks with the TOCOR and appropriate contractor staff to discuss the TO, clarify any initial questions about tasks and deliverables, and confirm the schedule, including a schedule for regular check-in calls.
2. All work conducted under this TO shall be performed pursuant to an EPA approved Quality Assurance Project Plan (QAPP) developed by the Contractor and approved by the TOCOR and QA manager. The QAPP, L-HEEAD-0032529-QP will outline the Contractor's approach and the measures the Contractor shall implement to ensure a high standard of quality in the deliverables. The QAPP shall be in conformance with EPA's *Requirements for Quality Assurance Project Plans* (EPA QA/R-5). The contractor shall not initiate tasks related to any items needing QA review until the TOCOR furnishes, in writing, a notice that the QAPP for the current period has been accepted by EPA.
3. Contractor shall maintain communication with the TOCOR throughout the duration of the TO, by providing brief, written monthly progress reports as email to the TOCOR and by participating in conference calls, as needed.

The draft QAPP shall be delivered as a .docx file and the final QAPP shall be delivered as a .docx file and PDF file.

***Deliverable 1.1*:** Kick-off phone call. Due within five (5) weeks after TO award.

***Deliverable 1.2.A*:** A draft QAPP submitted to the TOCOR and QA Manager for review. Due three (3) weeks after TO award.

***Deliverable 1.2.B*:** A final QAPP addressing TOCOR comments on the draft QAPP. Due one (1) week after receiving comments on Deliverable 1.2.A.

Deliverable 1.3.A: Monthly progress reports submitted to TOCOR via email.

Deliverable 1.3.B: Conference calls, as requested by TOCOR.

Task 2. Hydroclimatic change effects on stormwater BMPs in different U.S. regions (Contract Level PWS Task Areas 2, 4)

During the next century, a warmer climate is expected to alter the amount, seasonal timing and intensity of U.S. rainfall. These changes present a tangible, but regionally variable risk to BMP-based stormwater management plans. Urban stormwater BMPs are designed based on the expected intensity (I), duration (D), and frequency (F) of storm (rainfall) events (IDF curves). Under a previous contract (*Stream and Lake Regional Monitoring Networks Assistance and IDF Curve Development for BMPs; EP-C-17-031, TO68HERC19F00073)*, the Contractor developed a method for updating NOAA Atlas 14 IDF curves with climate data using an Equidistant Quantile Mapping approach, and conducted a pilot analysis using updated IDF curves to assess potential hydroclimatic change effects

on stormwater BMPs in 20 U.S. locations. Task 2 extends the pilot analysis to develop IDF curves and conduct a screening assessment of potential hydroclimatic change effects on stormwater and stormwater BMPs at the national scale.

Specifically, the Contractor shall:

1. Apply the method for updating NOAA Atlas 14 IDF curves described above using three (3) different climate scenarios (dry, mid, and wet) based on mid-century climate model projections at approximately 1000-2000 points (NOAA primary weather stations) located throughout the contiguous U.S. where Atlas 14 IDF curves are available. Stormwater simulations at each location shall then be conducted using a simplified rainfall-runoff model, either ORD's National Stormwater Calculator or a separate interface to SWMM contained in a dynamic link library (DLL). Simulation results will characterize the potential changes in event (stormwater) runoff in response to mid-century climate scenarios for a range of duration-frequency events, and the implied range of change in BMP (e.g., detention basins, bioretention, and green roof BMPs) sizing requirements for each location. The Contractor shall provide the TOCOR with a summary of projected future precipitation IDF and stormwater runoff simulation results in a database format approved by the TOCOR (e.g., MS Access or Excel). The Contractor shall first complete a draft database for TOCOR review. After receiving comments on the draft, the Contractor shall revise to address all comments and submit a final draft database.
2. Develop a draft manuscript based on study results describing the implied range of change in BMP sizing requirements in different regions of the U.S. The manuscript shall be written in clear, concise prose consistent with the standards of peer reviewed scientific literature (e.g., suitable for publication in technical journals such as the Journal of the American Water Resources Association). The Contractor shall first complete a draft for EPA internal review. After receiving TOCOR comments on the draft, the Contractor shall revise to address all comments and submit to the TOCOR a final draft manuscript.

Deliverable 2.1.A: Draft database with summary IDF and stormwater simulation results. Due four (4) months after TO QAPP is approved.

Deliverable 2.1.B: Final database with summary IDF and stormwater simulation results. Due two (2) months after Deliverable 2.1.A approved.

Deliverable 2.2.A: Draft manuscript for TOCOR review. Due two (2) months after Deliverable 2.1.B approved.

Deliverable 2.2.B: Final manuscript. Due two (2) months after receiving TOCOR comments on Deliverable 2.2.A.

Task 3. Assessing the Impacts of Shifting Nitrogen and Phosphorus Inventories on Water Quality in the US (Contract Level PWS Task Areas 2, 4)

Task 3 involves work related to the creation and development of nitrogen and phosphorus inventories.

Specifically, the Contractor shall:

1. Identify and process no more than 15 environmental datasets and inventory fluxes to be incorporated into the next generation of inventories, to generate a robust predictor variable

dataset for Task 3.2. In technical exchange with the TOCOR, the contractor shall identify remaining environmental, water quality, and inventory datasets to be processed and summarized, including at a minimum processing and summarizing select Daycent model outputs. Daycent outputs are not publicly available and are developed by researchers primarily at Colorado State University (Stephen Ogle Lab). In consultation with the TOCOR, the Contractor shall acquire a subset of Daycent outputs to meet the goals of this PWS; costs for acquiring the Daycent outputs will be estimated at a later date, once requirements have been finalized with the TOCOR. These datasets will be used as explanatory variables for the models to be developed in Task 3.2.

2. Develop and implement an analytical plan to explain changes in annual nitrogen and phosphorus export. Using the updated environmental and inventory datasets developed in Task 3.1, the Contractor shall develop an analytical plan for relating these fluxes to changes in water quality for all National Water-Quality Assessment (NAWQA) stations. As identified in Task 3.1, additional water quality stations may also be identified to further fill in gaps in spatial coverage across the contiguous United States. The analytical plan shall also outline how the statistical models developed will be leveraged to predict annual nitrogen and phosphorus export across the contiguous United States for the 1987-2017 period and pre-defined scenarios. The TOCOR, as well as other EPA collaborators, will work closely with the Contractor to efficiently draft the analytical plan through meetings as established in Task 1.3. The Contractor shall schedule three virtual 1-hour meetings to discuss the analytical plan. Based on discussions at these meetings, the Contractor shall draft the analytical plan for review by EPA. The Contractor shall revise the draft analytical plan based on EPA comments and then submit a final analytical plan. The Contractor shall implement this plan, construct key figures/tables for the manuscript and provide all statistical, spatial, and tabular data/information tied with the analysis plan to meet open data requirements for higher tiered journals.
3. Draft a plan for the development of a prototype web tool to visualize nitrogen and phosphorus inventories as well as modeled changes in summer low-flow concentrations (model provided by TOCOR), annual export (Task 3.2), and nitrate violations/concentrations for drinking water across the contiguous United States (model and spatial layers provided by TOCOR).

Deliverable 3.1.A: Short report outlining remaining environmental and inventory datasets that need to be processed and summarized and proceeding steps to complete processing. Due two (2) weeks after approval of Deliverable 1.2.B.

Deliverable 3.1.B: Spatial and tabular databases for all fluxes and environmental variables, including processing and summarizing select Daycent model outputs from Colorado State University. Due two (2) months after approval of Deliverable 3.1.A.

Deliverable 3.1.C: Provide associated code and written methodologies to replicate flux estimate, allocation, and interpolation procedures. Due two (2) months after approval of Deliverable 3.1.A.

Deliverable 3.2.A: Schedule and participate in three 1-hour calls with the TOCOR and other EPA staff to discuss the analytical plan. Due two (2) months after approval of Deliverable 3.1.A.

Deliverable 3.2.B: Submit a draft analytical plan, not to exceed ten (10) pages, that maps out response/predictor variables in the analysis and the statistical framework in which these

relationships will be explored and modeled across the contiguous United States. Due two (2) weeks after the approval of Deliverable 3.2.A.

Deliverable 3.2.C: Submit a final analytical plan, not to exceed ten (10) pages, that maps out response/predictor variables in the analysis and the statistical framework in which these relationships will be explored and modeled across the contiguous United States. Revisions to the analytical plan, if requested, must be submitted within two (2) weeks after receiving detailed written feedback from TOCOR on Deliverable 3.2.B.

Deliverable 3.2.D: Submit a succinct, written report clearly communicating the results of the statistical analysis and major findings (including shortcomings of the model). Due one (1) month after approval of Deliverable 3.2.C.

Deliverable 3.2.E: Construct major figures/tables that will be incorporated into the main manuscript. Due two (2) weeks after approval of Deliverable 3.2.D.

Deliverable 3.2.F: Submit all coding, statistical, spatial, and tabular data/information with sufficient metadata to ensure EPA can replicate the analysis and meet journal submission requirements. Due two (2) weeks after approval of Deliverable 3.2.E.

Deliverable 3.3.A: In coordination with TOCOR, contractor will draft a conceptual proposal, consisting of a narrative describing the capabilities of the tool as well as a handful of impactful figures/sketches, for the nitrogen and phosphorus inventory tool. Due one (1) month after completion of Deliverable 3.2.F.

Deliverable 3.3.B: The Contractor and TOCOR shall distribute the draft proposal and present their concept proposal to clients from Program and Regional Offices for further feedback either through no more than three (3) webinars or in-person meeting(s). The Contractor shall provide entry level staff to record notes and major decision points. Meeting(s) with clients and a report summarizing client feedback will be completed within one (1) month of acceptance of Deliverable 3.3.A.

Deliverable 3.3.C: After incorporating feedback from clients as described in deliverable 3.3.B, submit finalized conceptual proposal describing the content, platform, and features of the inventory tool. Due two (2) weeks after completion of Deliverable 3.3.B. Revisions to the conceptual plan, if requested, must be submitted within two (2) weeks after receiving detailed written feedback from TOCOR.

Task 4. Analytical support of and trainings for Stream and Lake Regional Monitoring Networks (RMNs) and further development of Maritime Biological Condition Gradient (BCG) community composition expectations (Contract Level PWS Task Areas 4, 6)

Previous completed work under TO-68HERC19F0007 developed a protocol document for stream and lake RMNs and R tools for partners to use. This task will refine protocol documents based on user feedback, create and enhance status update forms, add graphical features to the current R tool for lakes, add several functions to the streams RMN R Shiny app, and perform initial data analyses on data collected by partners. This task also provides remote and/or in-person meeting and workshop support for RMNs partners, as well as communication products, such as presentations and journal articles.

Finally, this task also further develops the Maritime BCG with thermal threshold modeling and future community composition expectations.

Specifically, the Contractor shall:

1. Refine stream and lake protocol documents for: vertical profile, water chemistry, ice cover, water level and general assessment form based on partner feedback.
2. Enhance the existing stream status update form used by stream RMN partners and develop a similar form for lake RMN partners.
3. Add functions to current stream and lake R and R Shiny tools and conduct initial data analyses. The existing R scripts and R Shiny application are important tools for RMN partners to manage the continuous data collected from temperature and flow sensors. Partners require support to ensure that these tools work for their sensors and IT environments. The tools also require periodic updating based on partner feedback and other needs. Task 4.3 adds functions to the existing ContDataQC R Shiny tool, adds the BioMonTools to the R Shiny app, improves BioMonTools for taxonomic harmonization, graphically adds dissolved oxygen (DO) onto a lake temperature heat map of the current lake R tool, and develops an R Shiny app to automate site summary reports for stream and lake RMN sites. Virginia has developed a variety of R Shiny applications for their TMDL and bioassessment program and will be the pilot state for site summary report automation. Task 4.3 also uses partner output from the R tools to conduct initial state and regional analyses, including putting together a database of thermal and flow metrics for available RMN sites. Finally, Task 4.3 assists partners with registering their sensors and datasets from RMN sites with OW's Interoperable Watershed Network.
4. Provide meeting support and organize webinar/conference calls with RMN leads and partners. The Contractor shall assist with meeting support and workshop planning (e.g., SWPBA, NALMS, NEAEB, AMAAB, SFS) to bring RMN partners together for training and peer-to-peer learning regarding RMN implementation, methods, data management, and data analysis. The Contractor shall assist with development of materials for Region-led workshops, such as R1, R4, R5, and R8, that bring RMN partners together for training and development sessions. Given constraints presented by the current COVID pandemic, states will be given the option of requesting customized remote meetings/workshops/conferences. The Contractor also shall support RMN partners and RMN Regional leads to ensure peer-to-peer exchanges and consistency within and across RMNs.
5. Provide thermal threshold modeling, site validations, and Maritime BCG updates. Task 4.5 builds on thermal threshold modeling for the Willamette Valley and Puget Sound Lowlands ecoregional BCG developed in collaboration with OW/OST to extend the model to species throughout the Maritime BCG region (as defined by the OW/OST partnership). These thermal thresholds shall be used to develop community composition expectations for each BCG level at decadal intervals and consistent with stream temperature expectations according to modeled climate velocities. Task 4.5 also builds on the potential restoration sites identified by BCG partners (e.g., King County) in order to perform validations of site classifications using the BCG, ICI and IWI. While many factors influence the prioritization of potential sites, partners also want additional information on current and potential future biological condition and the influence of catchment and watershed context on restoration success. This portion of the project will work with partners to validate information on the ground when possible and use aerial imagery and other remote sensing resources to further investigate proposed sites. Understanding why certain sites do not follow the expected pattern of biological condition and environmental context will give partners more information to determine restoration success. Thermal thresholds will then be

applied to the sites to determine longer term resilience to changing conditions. This project will result in site prioritization developed with county and state partners to inform their restoration and protection activities. The resulting information in Task 4.5 shall contribute to a manuscript on taxa thermal tolerance analyses and applications and a future manuscript that helps to inform on potential prioritization of sites in the context of long-term resilience.

6. Complete manuscripts for internal review or revise based on journal reviews. The Contractor shall prepare two (2) articles for internal review, revise based on EPA internal review, and submit to a journal, and revise one (1) journal article based on journal review comments and prepare for resubmittal. .

Deliverable 4.1.A: Hold up to two (2) webinars to get feedback from stream and lake RMN partners. Due four (4) weeks after QAPP approval.

Deliverable 4.1.B: Submit revised stream and lake protocol documents to TOCOR for Regional and QA Manager reviews. Due eight (8) weeks after Deliverable 4.1.A.

Deliverable 4.1.C: Submit final stream and lake protocol documents reflecting comments from Regional and QA Manager reviews for clearance and publication on the RMN website. Due four (4) weeks after Deliverable 4.1.B.

Deliverable 4.2.A: Develop draft status lake update forms and hold webinar with partners to train them on its use. Due two (2) weeks after Deliverable 4.1.B.

Deliverable 4.2.B: Address comments from TOCOR and lake RMN partners, finalize documents and distribute to lake RMN partners. Due two (2) weeks after Deliverable 4.2.A.

Deliverable 4.2.C: Work with stream partners to understand current needs with existing RMNs to enhance stream update forms and facilitate communication; deliverable is an updated stream form. Due two (2) weeks after Deliverable 4.2.A (with Deliverable 4.2.B).

Deliverable 4.3.A: Add DO visualization to lake temperature heat map in existing lake R tool and hold webinar with lake RMN partners to train them on the use of the new functions. Due within four (4) weeks after receipt of DO data from RMN partners.

Deliverable 4.3.B: Final lake R tool published on EPA's Github account and for EPA to publish on the RMN website. Due four (4) weeks after Deliverable 4.3.A.

Deliverable 4.3.C: Add in function to allow for resetting QC test thresholds with drop-down menus, add PeriodStats and other functions currently in ContData QC R tool that are not in the R Shiny application, and integrate BioMonTools (and its improvements) into the R Shiny application. Provide draft R Shiny update, final R Shiny update and hold webinar with stream RMN partners to train them on the use of the new R Shiny tool. Due six (6) weeks after Deliverable 4.3.B.

Deliverable 4.3.D: Work with partner data (continuous and discrete), including development of Regional taxa tables and taxonomic nomenclature reconciliation, and use lake and stream RMN R tools to conduct initial data analyses (examining any trends and relationships between biological and environmental data), and organize thermal and flow metrics in a database for available RMN sites. Develop initial data analysis memo, draft database, final database, and

present initial findings to lake and stream RMN partners. Due twenty (20) weeks after Deliverable 4.3.C.

Deliverable 4.3.E: Submit memo describing analyses in Deliverable 4.3.D and any revisions based on partner input. Due four (4) weeks after Deliverable 4.3.D.

Deliverable 4.3.F: Assist RMN partners with linkage of sensors and datasets to OW's Interoperable Watershed Network. EPA assumes this will involve the Contractor assisting three (3) RMN partners for no more than 24 hours total per partner. The Contractor shall submit a memo describing the assistance given for each of the RMN partners, such as mapping out the process and providing instructions to make the linkage. Due four (4) weeks after the Contractor is contacted by each RMN partner.

Deliverable 4.3.G: Develop R Shiny app to automate site summary reports using VA as a pilot. Due eight (8) weeks after Deliverable 4.3.F.

Deliverable 4.4.A: Monthly memo describing support activities and summarizing conference call or webinar discussions with RMN partners and RMN Regional leads. Due monthly.

Deliverable 4.4.B: Presentations for and participation in three remote and/or in-person meetings selected with TOCOR input and four regional remote and/or in-person meetings. The TOCOR and the Contractor shall develop a list of topics as a pool for these presentations. Presentations are due three (3) weeks before each meeting.

Deliverable 4.5.A: Use taxa list developed for Maritime BCG to perform thermal threshold modeling and update EPA's Species Traits database (to be provided by TOCOR) with species and temperature trait information. Due twelve (12) weeks after Maritime BCG taxa list is available.

Deliverable 4.5.B: Develop community composition expectations for each BCG level at decadal intervals, develop draft and final memos on the expectations, and present findings to BCG workgroup via webinar. Due twelve (12) weeks after Deliverable 4.5.A.

Deliverable 4.5.C: In partnership with King County and other BCG collaborators conduct validations (aerial photo inspections, conversations with site experts) on sites that fall outside of expected ranges in BCG, IWI, or ICI dimensions to inform the potential classification and prioritization model for restoration and protection for long-term site and watershed resilience and present findings to BCG partners. Due four (4) weeks after TOCOR consultation.

Deliverable 4.5.D: Incorporate results from Deliverables 4.5.A, 4.5.B, and 4.5.C into a manuscript on the thermal tolerance analyses. Due six (6) weeks after last of these deliverables.

Deliverable 4.5.E: Revised Deliverable 4.5.D based on TOCOR comments and ready for internal EPA review. Due four (4) weeks after receipt of TOCOR comments on Deliverable 4.5.D

Deliverable 4.5.F: Revised Deliverable 4.5.E based on internal review comments and ready for submission to ORD clearance before journal submission. Due four (4) weeks after receipt of internal review comments.

Deliverable 4.6.A: Prepare article for internal review, submit revised draft based on EPA internal review comments for TOCOR review, and final draft ready for journal submission. Internal

review draft due four (4) weeks after TOCOR consultation; revised draft due four (4) weeks after receipt from TOCOR following internal review, and final draft for journal submission due four (4) weeks after receipt from TOCOR following TOCOR revised draft review.

Deliverable 4.6.B: Prepare article for internal review, submit revised draft based on EPA internal review comments for TOCOR review, and final draft ready for journal submission. Internal review draft due four (4) weeks after TOCOR consultation; revised draft due four (4) weeks after receipt from TOCOR following internal review, and final draft for journal submission due four (4) weeks after receipt from TOCOR following TOCOR revised draft review.

Deliverable 4.6.C: Response to third journal article review comments and revised manuscript ready for resubmittal. Due within four (4) weeks after receipt from TOCOR.

Task 5. Develop a Batch Watershed Delineation Tool (Contract Level PWS Task Areas 2, 4)

Task 5 involves the development of a tool or script(s) for the batch delineation of full upstream watersheds, given a list of latitude/longitude pairs that define the approximate locations of watershed pour points for water bodies of interest. Delineation of watersheds should be accomplished by hydrologic aggregation of NHDPlus catchments to produce full upstream contributing areas. The tool or script(s) shall be capable of delineating watersheds for water bodies that are already indexed to the medium-resolution NHDPlus (i.e., that have COMIDs), as well as for water bodies that are not, such as lakes in the LAGOS-NE dataset.

Specifically, the Contractor shall:

1. Schedule an initial phone call to discuss potential approaches to Task 5; based on this discussion, produce a written memo summarizing the proposed approach.
2. Develop the delineation tool as either compiled standalone software suitable for installation on a desktop computer, or as a script or set of scripts written in R or Python, and suitable for implementation on a desktop computer.
3. Construct the tool in such a manner that each individual delineation generates and saves an associated shapefile or other GIS layer for the user.

Deliverable 5.1.A: Scoping phone call for Task 5. Due two (2) months after technical exchange with TOCOR.

Deliverable 5.1.B: Written memo summarizing the proposed approach based on the scoping phone call (see Task 5.1). Due two (2) weeks after Deliverable 5.1.A.

Deliverable 5.2: Beta version of tool/script(s) delivered to the TOCOR. Due four (4) months after Deliverable 5.1.

Deliverable 5.3: Final version of the tool/script(s) delivered to the TOCOR. Due four (4) weeks after Deliverable 5.2.

Task 6. Assist with literature-based evidence reviews for nutrient-related linkages in aquatic systems (Contract Level PWS Task Area 3)

Task 6 involves assisting with the review and synthesis of literature-based evidence for up to five (5) linkages related to nutrients in aquatic systems. The specific linkages to be evaluated, and the specific assistance provided in evaluating those linkages, will depend on research needs and be determined via technical exchange with the TOCOR. The types of assistance provided under Task 6 may include: literature database searches; compilation and curation of EndNote libraries; title/abstract and/or full text screening of citations returned in literature database searches; extraction of data from relevant citations; and/or creation of synthetic visualizations of relevant evidence bases. The Contractor shall spend time not to exceed 500 hours on this task.

Specifically, the Contractor shall:

1. Schedule an initial phone call to discuss potential approaches to Task 6, including the specific linkages to be evaluated and the specific evaluation methods to be used.
2. Based on technical exchange with the TOCOR in Task 6.1, draft a project outline summarizing the linkage(s) to be evaluated (not to exceed 5 linkages), the proposed approach(es) for each linkage, and the specific assistance to be provided by the Contractor. If needed, the Contractor shall revise this memo based on comments received from the TOCOR.
3. Complete the specific assistance detailed in the project outline (Task 6.2).

Deliverable 6.1: Scoping phone call for Task 6. Due two (2) months after technical exchange with TOCOR.

Deliverable 6.2.A: Project outline summarizing linkage(s), proposed approach(es), and specific assistance, based on the scoping phone call (see Task 6.1). Due two (2) weeks after Deliverable 6.1.

Deliverable 6.2.B: Revised project outline, based on TOCOR comments on Deliverable 6.2.A. Due one (1) week after receiving TOCOR comments on Deliverable 6.2.A.

Deliverable 6.3.A: Mid-task memo(s) summarizing progress on each literature review, as selected under Deliverable 6.2.B. Due four (4) months after Deliverable 6.2.B.

Deliverable 6.3.B: Final memo(s) summarizing process and results for each literature review, as selected under Deliverable 6.2.B. Due four (4) months after Deliverable 6.3.A.

VII. SCHEDULE OF DELIVERABLES AND MILESTONES

TASK #	DELIVERABLE	SCHEDULE
1	Deliverable 1.1. Kick-off phone call	Due within five (5) weeks after TO award
	Deliverable 1.2.A. Draft QAPP	Due three (3) weeks after TO award
	Deliverable 1.2.B. Final QAPP	Due one (1) week after comments on 1.2.A
	Deliverable 1.3.A. Monthly progress reports submitted via email	Due monthly for the duration of the TO
	Deliverable 1.3.B. Conference calls	Due as requested by TOCOR
2	Deliverable 2.1.A. Draft database with summary IDF and stormwater simulation results	Due four (4) months after TO QAPP approved
	Deliverable 2.1.B. Final database with summary IDF and stormwater simulation results	Due two (2) months after Deliverable 2.1.A approved

	Deliverable 2.2.A. Draft manuscript for TOCOR review	Due two (2) months after Deliverable 2.1.B approved
	Deliverable 2.2.B. Final manuscript	Due two (2) months after receiving TOCOR comments on Deliverable 2.2.A
3	Deliverable 3.1.A. Short report outlining remaining environmental and inventory datasets that need to be processed and summarized and proceeding steps to complete processing	Due two (2) weeks after approval of Deliverable 1.2.B
	Deliverable 3.1.B. Spatial and tabular databases for all fluxes and environmental variables, including processing and summarizing select Daycent model outputs from Colorado State University	Due two (2) months after approval of Deliverable 3.1.A
	Deliverable 3.1.C. Provide associated code and written methodologies to replicate flux estimate, allocation, and interpolation procedures	Due two (2) months after approval of Deliverable 3.1.A
	Deliverable 3.2.A. Schedule and participate in three 1-hour calls with the TOCOR and EPA staff to discuss the analytical plan	Due two (2) months after approval of Deliverable 3.1.A
	Deliverable 3.2.B. Submit a draft analytical plan, not to exceed 10 pages, that maps out response/predictor variables in the analysis and the statistical framework in which these relationships will be explored and modeled across the contiguous United States	Due two (2) weeks after approval of Deliverable 3.2.A
	Deliverable 3.2.C. Submit a final analytical plan, not to exceed 10 pages, that maps out response/predictor variables in the analysis and the statistical framework in which these relationships will be explored and modeled across the contiguous United States	Due within two (2) weeks after receiving detailed written feedback from TOCOR on Deliverable 3.2.B
	Deliverable 3.2.D. Submit a succinct, written report clearly communicating the results of the statistical analysis and major findings (including shortcomings of the model)	Due one (1) month after approval of Deliverable 3.2.C
	Deliverable 3.2.E. Construct major figures/tables that will be incorporated into the main manuscript	Due two (2) weeks after approval of Deliverable 3.2.D
	Deliverable 3.2.F. Submit all coding, statistical, spatial, and tabular data/information with sufficient metadata to ensure EPA can replicate the analysis and meet journal submission requirements	Due two (2) weeks after approval of Deliverable 3.2.E
	Deliverable 3.3.A. In coordination with TOCOR, contractor will draft a conceptual proposal, consisting of a narrative describing the capabilities of the tool as well as a handful of impactful figures/sketches, for the nitrogen and phosphorus inventory tool.	Due one (1) month after completion of Deliverable 3.2.F
	Deliverable 3.3.B. Distribute draft proposal and present to clients from Program and Regional Offices for further feedback either through no more than three (3) webinars or in-person meeting(s). Contractor shall provide entry level staff to record notes and major decision points.	Due within one (1) month of acceptance of Deliverable 3.3.A
	Deliverable 3.3.C. Submit finalized conceptual proposal describing the content, platform, and features of the inventory tool	Due two (2) weeks after completion of Deliverable 3.3.B, with revisions to the conceptual plan, if

		requested, submitted within two (2) weeks after receiving detailed written feedback from TOCOR
4	Deliverable 4.1.A. Hold webinar to get feedback from stream and lake RMN partners	Due four (4) weeks after Deliverable 1.2.B completed
	Deliverable 4.1.B. Submit revised stream and lake protocol documents to TOCOR for Regional and QA Manager reviews	Due eight (8) weeks after Deliverable 4.1.A
	Deliverable 4.1.C. Submit final stream and lake protocol documents reflecting comments from Regional and QA Manager reviews for clearance and publication on the RMN website	Due four (4) weeks after Deliverable 4.1.B
	Deliverable 4.2.A. Develop draft status update forms and hold webinar with partners to train them on its use	Due two (2) weeks after Deliverable 4.1.B
	Deliverable 4.2.B. Address comments from TOCOR and lake RMN partners, finalize documents and distribute to lake RMN partners	Due two (2) weeks after Deliverable 4.2.A
	Deliverable 4.2.C. Work with partners to understand current needs with existing RMNs to enhance stream update forms and facilitate communication due with Deliverable 4.2.B.	Due two (2) weeks after Deliverable 4.2.A (with Deliverable 4.2.B)
	Deliverable 4.3.A. Add DO visualization to lake temperature heat map in existing lake R tool and hold webinar with lake RMN partners to train them on the use of the new functions	Due within four (4) weeks after receipt of DO data from RMN partners
	Deliverable 4.3.B. Final lake R tool published on Github and RMN website	Due four (4) weeks after Deliverable 4.3.A
	Deliverable 4.3.C. Add in function to allow for resetting QC test thresholds with drop-down menus, add PeriodStats and other functions currently in ContData QC R tool that are not in the R Shiny application, and integrate BioMonTools (and its improvements) into the R Shiny application and hold webinar with stream RMN partners to train them on the use of the new R Shiny tool	Due six (6) weeks after Deliverable 4.3.B
	Deliverable 4.3.D. Work with partner data (continuous and discrete), including development of Regional taxa tables and taxonomic nomenclature reconciliation, and use lake and stream RMN R tools to conduct initial data analyses (examining any trends and relationships between biological and environmental data), organize thermal and flow metrics in a database for available RMN sites, and present initial findings to lake and stream RMN partners	Due twenty (20) weeks after Deliverable 4.3.C
	Deliverable 4.3.E. Submit memo describing analyses in Deliverable 4.3.D and any revisions based on partner input	Due four (4) weeks after Deliverable 4.3.D
	Deliverable 4.3.F. Assist RMN partners with linkage of sensors and datasets to OW's Interoperable Watershed Network	Due four (4) weeks after Deliverable 4.3.E

	Deliverable 4.3.G. Develop R Shiny app to automate site summary reports using VA as a pilot	Due eight (8) weeks after Deliverable 4.3.F
	Deliverable 4.4.A. Monthly memo describing support activities and summarizing conference call or webinar discussions with RMN partners and RMN Regional leads	Due monthly
	Deliverable 4.4.B. Meeting presentations for and participation in three meetings selected with TOCOR input and four regional meetings	Due three (3) weeks before conference/workshop
	Deliverable 4.5.A. Use taxa list developed for Maritime BCG to perform thermal threshold modeling and update EPA's Species Traits database with species and temperature trait information	Due twelve (12) weeks after Maritime BCG taxa list available
	Deliverable 4.5.B. Develop community composition expectations for each BCG level at decadal intervals and present findings to BCG workgroup via webinar	Due twelve (12) weeks after Deliverable 4.5.A
	Deliverable 4.5.C. In partnership with King County and other BCG collaborators conduct validations (aerial photo inspections, conversations with site experts) on sites that fall outside of expected ranges in BCG, IWI, or ICI dimensions to inform the potential classification and prioritization model for restoration and protection for long-term site and watershed resilience and present findings to BCG partners	Due four (4) weeks after TOCOR consultation
	Deliverable 4.5.D. Incorporate results from Deliverables 4.5.A, 4.5.B, and 4.5.C into a manuscript	Due six (6) weeks after Deliverable 4.5.C
	Deliverable 4.5.E. Revised Deliverable 4.5.D based on TOCOR comments and ready for internal EPA review	Due four (4) weeks after receipt of comments on Deliverable 4.5.D
	Deliverable 4.5.F. Revised Deliverable 4.5.E based on internal review comments and ready for submission to ORD clearance before journal submission	Due four (4) weeks after receipt of internal review comments on Deliverable 4.5.E
	Deliverable 4.6.A. Prepare article for internal review, submit revised draft based on internal review comments for TOCOR review, and final draft ready for journal submission	Internal review draft due four (4) weeks after TOCOR consultation; Revised draft due four (4) weeks after receipt from TOCOR following internal review, and final draft for journal submission due four (4) weeks after receipt from TOCOR following TOCOR revised draft review
	Deliverable 4.6.B. Prepare article for internal review, submit revised draft based on internal review comments for TOCOR review, and final draft ready for journal submission.	Internal review draft due four (4) weeks after TOCOR consultation; Revised draft due four (4) weeks after receipt from TOCOR following internal review, and final draft for journal submission due four (4) weeks after receipt from TOCOR following TOCOR revised draft review
	Deliverable 4.6.C. Response to third journal article review comments and revised manuscript ready for resubmittal	Due within four (4) weeks after receipt from journal
5	Deliverable 5.1.A. Scoping phone call	Due two (2) months after technical exchange with TOCOR
	Deliverable 5.1.B. Written memo summarizing proposed approach	Due two (2) weeks after Deliverable 5.1.A
	Deliverable 5.2. Beta version of tool/script(s)	Due four (4) months after Deliverable 5.1.B

	Deliverable 5.3. Final version of tool/script(s)	Due one (1) month after Deliverable 5.2
6	Deliverable 6.1. Scoping phone call	Due two (2) months after technical exchange with TOCOR
	Deliverable 6.2.A. Draft project outline summarizing linkages, proposed approaches, and specific assistance	Due two (2) weeks after Deliverable 6.1
	Deliverable 6.2.B. Revised Deliverable 6.2.A, based on TOCOR comments	Due one (1) week after receiving TOCOR comments on Deliverable 6.2.A
	Deliverable 6.3.A. Mid-task memo(s) summarizing progress on each literature review, as selected under Deliverable 6.2.B.	Due four (4) months after Deliverable 6.2.B
	Deliverable 6.3.B. Final memo(s) summarizing process and results for each literature review, as selected under Deliverable 6.2.B.	Due four (4) months after Deliverable 6.3.A

VIII. Acceptance Criteria:

The Contractor shall prepare high quality deliverables. Deliverables shall be edited for grammar, spelling, and logic flow. The technical information shall be reasonably complete and presented in a logical, readable manner. Figures submitted shall be of high quality, similar to those in presentations developed for national scientific meetings and should be formatted as jpeg or png files. Citation library deliverables shall be compatible with EndNote X7. Spreadsheet, report, and database deliverables shall be compatible with Microsoft Office 365 (i.e., MS Excel, MS Word, Adobe pdf, or MS Access files depending on the task and deliverable). Text files related to R code shall be compatible with R 3.5 and R Studio 1.1.