

# *Full Proposal Project Narrative: Ecosystem Services in the Roanoke River Basin*

## **Abstract**

“Ecosystem services” is becoming the conceptual and analytical framework for understanding and planning for productive interactions among people, ecosystems, and management agencies. Defined as “the benefits that flow from nature to people”, ecosystem services connect the health of nature to the wellbeing of people and the economy (Donovan, Goldfuss, & Holdren, 2015, p. 1; USDA Forest Service, 2012). They can be mapped and quantified in both biophysical and monetary terms. They are also increasingly important to federal, state, and regional land and resource planning and to environmental reviews conducted under the National Environmental Policy Act (NEPA).

In October 2015, for example, the The White House issued preliminary guidance to all federal agencies to the effect that evaluation of ecosystem services should be a part of natural resource planning for all federal agencies (Donovan, Goldfuss, & Holdren, 2015). Individual federal agencies with regulatory and management responsibilities in the Roanoke River basin (Army Corps of Engineers, US Fish and Wildlife Service) are beginning to use ecosystem services thinking in their work (Olander et al., 2015). Among the most highly valued ecosystem benefits are clean water, productive soils, and nature-based recreation. Maintaining these services is also consistent with efforts to protect rare and imperiled species.

Recent studies in the Roanoke River basin (RRB) have addressed ecosystem services at a conceptual level and conservation measures have sought to protect such services as water supply, water purification, and water-based recreation (Rashleigh B., Lagutov V., Salathe T., 2012; Roanoke River Basin Association. n.d.). The proposed work will build on this foundation by comprehensively examining a broad suite of services, including their spatial distribution and value, across the entire RRB (including the Dan River and Lower Roanoke subbasins). This broad-brush, basin-wide information will provide a foundation on which citizens, planners, and resource managers at state and federal agencies can build an understanding and prioritize actions to restore ecosystem function in the RRB.

The next step in the project is to drill down to analyze, quantify and map priority services in two focal sub-basins, the Lower Roanoke, and (together) the Upper and Lower Dan. This focus will involve participatory research techniques (National Research Council, 2008) to establish which ecosystem services are of greatest importance to these stakeholders. The tools and techniques outlined in the National Ecosystem Service Partnership (NESP) Guidebook will also provide a framework for ecosystem service analysis (National Ecosystem Services Partnership, 2016). In particular, the project will quantify and map values of services such as clean water, water-based recreation, and services connected to viable populations of rare and imperiled species, as provided by the landscapes drained by these rivers, and then explore this information with stakeholders.

Finally, and in the interest of supporting broader efforts to quantify and understand ecosystem services, the project will develop and publish code to connect spatial and tabular information on land cover/land use and ecosystem benefits and ease aggregate ecosystem service value calculations. The code will be created in Python for use in QGIS, an open-source geographic information system package. Accordingly, the code itself will be open-source and available as a free download and/or distributed as a QGIS “plugin”. This will enable less technical users to develop custom ecosystem services assessments for other subbasins, other regions entirely, and for various purposes.

## Conservation Outcome(s):

Ecosystem services provide the "scientific basis for taking human understanding from the Anthropocene to the Ecozoic.

-Anne Kinsinger, USGS, Keynote Address, ACES Conference, 2010, Albuquerque, NM

The very big picture or vision of which the proposed work is a small part is the transformation of society, and especially the economy, in ways that bring the health of ecosystems and the associated welfare of people to bear on everyday economic decisions. In the course of doing its small part, this project will:

- Advance understanding of the relationships among human and natural systems in the RRB and especially in the Dan and Lower Roanoke watersheds
- Equip key stakeholders with information to support land conservation, river restoration, and sustainable economic development actions, such as smart growth planning, green infrastructure projects, the purchase of or easements for areas important for the provision of key ecosystem services
- Apply and test tools and techniques described in the NESP guidebook, thereby providing further lessons learned and examples to follow for federal agencies and others incorporating ecosystem services thinking into land and resource management decisions.

## Activities:

In brief, the activities described below will establish an overall estimate of the ecosystem service value of land and waters in the Roanoke River Basin and, with participation from regional stakeholders, develop a detailed understanding of how that value could be affected by conservation, development, and natural resources management actions in two sub-basins (the Dan and the Lower Roanoke). Specifically, the process will involve the following:

### 1. Estimate ecosystem service value for the entire Roanoke River basin.

Using established methods, including GIS-based evaluation of land use/land cover, and the "benefit transfer method" (BTM), the first task is to establish a baseline estimate of ecosystem service value for all services and all areas within the RRB. BTM is a well-established means of estimating economic value of the ecosystem services produced at a particular place. OECD asserts that BTM is the "bedrock of practical policy analysis", especially in cases such as this when collecting primary data is not feasible within the scope of the project (OECD, 2006). BTM takes a benefit estimate already calculated for one set of circumstances ("study area") and transfers the benefit to another set of reasonably similar circumstances ("policy area"). (In this case, the policy area is the Roanoke River Basin).

Phillips and McGee (2016), and Phillips (2015) provide examples from the Chesapeake Bay watershed and western North Carolina, respectively, that can be updated and modified to match the particular conditions of the RRB. These findings will be reported in a briefing paper (~10 pages in length) that will become part of the background for detailed assessment with stakeholders in two sub-basins. The briefing paper will serve as an introduction to the general concept of ecosystem services as well as particular services that may resonate with workshop participants as key benefits for their community. This briefing paper may also be used as the first associated deliverable to key stakeholders (e.g., Roanoke River Basin Association) before workshop materials are finalized.

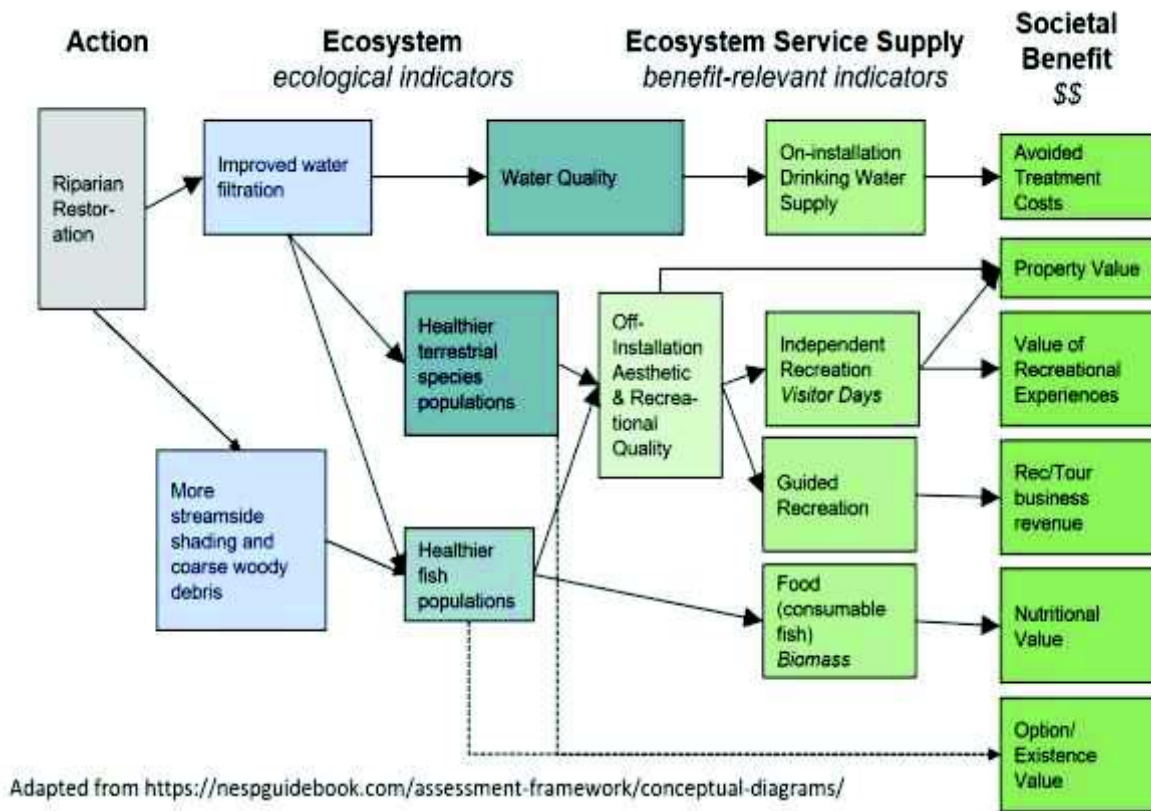
### 2. Detailed analysis for selected sub-basins (Dan and Lower Roanoke).

Working with the Roanoke River Basin Association, the Dan River Basin Association, and allied groups, the team will identify a set of issues, stakeholders, and locations around which to organize two in-

person workshops of 4-6 hours each. One workshop will focus on the Dan River watershed (mostly in Virginia); the other will focus on the Lower Roanoke in North Carolina. Specifically, the workshops aim to:

- a. Introduce and explore the ecosystem services concept/framework;
- b. Consider how various stressors (climate change, resource extraction proposals, habitat loss, etc.) relate to changes in ecosystem processes and ecosystem benefit (collectively the delivery of ecosystem services);
- c. Identify the key, or priority ecosystem services relationships (value chains) for further analysis;
- d. Assess how conservation, management, and policy actions may affect those relationships; and
- e. Lay out a research plan (with further stakeholder engagement) in order to estimate the potential effects of those actions on ecosystem service value.

**Figure 1: Sample Means-Ends Diagram**



In each workshop, interactive exercises, small group work, and facilitated large group discussion, will enable stakeholders to identify and prioritize key ecosystem services and actions. The workshops will incorporate interactive assessment tools developed by Phillips (2013) and NESP (2016) and help participants connect ecological conditions with societal benefits. Stakeholders become engaged by identifying services they care about, and can provide directly relevant input for the development of conceptual, “means-ends” diagrams through these workshops (NESP, 2016). Means-ends diagrams (see sample in the Figure 1, below) have two unique advantages of being simple and effective for lay persons, and being commonly used by federal agencies and other arms of the government in policy-making. With a collection of engaged citizens, resource managers, government planners, and scientists, the group can explore a range of ecosystem services available in the basin and work together to define issues for evaluation in terms of their impact on ecosystem service value.

**3. Use participatory research to develop thorough ES assessments and analysis.**

Guided by the in-workshop exercises and discussion, the next step is to develop estimates of ecosystem-

service flows in the two sub-basins and assess how key issues, including competing land uses could affect those flows. These analyses will be spatially explicit, enabling the team to produce maps and tables of the results. Stressors will be identified and categorized by urgency and direction of impact through a combination of the workshop input and extensive literature review. Ecosystem service benefits will be prioritized based on workshop results, and those of particular importance linked to high-level stressors may be highlighted.

**4. Perform outreach and follow-up with workshop participants.**

Reconvene stakeholders to present and discuss findings, and to solicit information on potential next-step strategies to be included in the final report. The workshops will also provide an initial opportunity to extend information about the ecosystem service value of the Dan River and Lower Roanoke River to broader audiences in their respective regions.

**5. Finalize report by incorporating “next step” strategies for the Roanoke River Basin.**

This task will entail a thorough review of cumulative input from participatory research and the ecosystem service assessments to determine explicit, specific, yet straightforward steps that the Roanoke River Basin Association, the Dan River Basin Association, and other stakeholder groups can take to utilize the results for public education, policy development, and on-the-ground restoration.

**6. Develop and publish QGIS-ready code (or plugin) for ecosystem service valuation.**

To help bring the ecosystem services concept and the science behind it to full fruition in the form of improved environmental stewardship and human well-being, accessible and robust means of supporting ecosystem-services thinking for natural resource stakeholders and decision-makers is needed. Because ecosystem services occur in an explicit spatial context, that thinking and information delivery must be based in landscape analysis. In pursuit of that end, the models and tools used to evaluate ecosystem services for the RRB and focal sub-basins will be generalized and their core functions implemented as an add-on for the QGIS spatial analysis package. At minimum, this will entail creating a Python script or scripts that connect spatial data on land cover/land use in a selected landscape to tabular data on the economic value of various ecosystem services the landscape could support. If possible within our budget, the script(s) will be packaged and published as a QGIS plugin. Either way, a tool that any agency, organization, or individual can use to advance their work or learn more about ecosystem services provided by the RRB or other landscapes will be freely distributed. For example, end users could use the tool to map areas with higher or lower ecosystem service productivity and/or the location of human populations most likely to benefit from particular ecosystem services.

## Timeline

Activity	Associated Deliverable(s)	Schedule
1. "Broad Brush" Basin-Wide Baseline	Pre-workshop Briefing Paper, including ESV estimates	Jan 2018
2. Workshop Preparation and Outreach	Stakeholder lists, Invitations, Workshop Materials	Jan-Feb 2018
2. Workshop I, Workshop II	Workshops Priority Ecosystem Service Research Plans	Mar-Apr, 2018
3. "Deep Dive" ES assessment based on Workshop Outcomes	Two reports: one for each sub-basin focused on priority ecosystem services and action steps	Apr-Aug 2018
4. Outreach / Stakeholder Follow-Up	Webinar (at minimum) and/or in-person presentation of assessment results for workshop participants and other stakeholders	Sep-Oct 2018
5. Strategy for action and further assessment.	Final report to NFWF, including "next steps" strategies for the Roanoke River Basin Association	Oct-Nov 2018
6. QGIS script/plugin development	QGIS Script/Plugin for ecosystem Services assessment	April-November 2018

## Monitoring and Maintenance

Keeping consistent lines of open communication with stakeholders and workshop participants in the Roanoke River Basin throughout all stages of the project will be essential in monitoring progress. Outside of each workshop, communication with stakeholders will come in several forms, specifically:

- Webinars after each workshop for follow-up questions, comments, or concerns from workshop participants
- Feedback surveys after each workshop to assess effectiveness of interactive tools, facilitation, and overall event
- Post-workshop progress updates on ecosystem service assessment and analysis to interested participants
- Follow-up with stakeholders after final report submission on utilization of "next step" strategies
- Bi-weekly check-in with the Roanoke River Basin Association and other major stakeholders

The timing of the workshops in March and April is designed to provide enough time between them to process feedback from the first and potentially calibrate or revise the agenda and strategy for the second workshop.

Key-Log Economics will work closely with the Roanoke River Basin Association (RRBA) throughout the project, with Dr. Paul Angermeier, a U.S. Geological Survey scientist and Virginia Tech Professor, being our key contact. Our consultation with RRBA will include review of workshop materials and the full- and sub-basin ecosystem service valuation results. Dr. Angermeier will also participate in each workshop, and our budget includes a line item to support his travel.

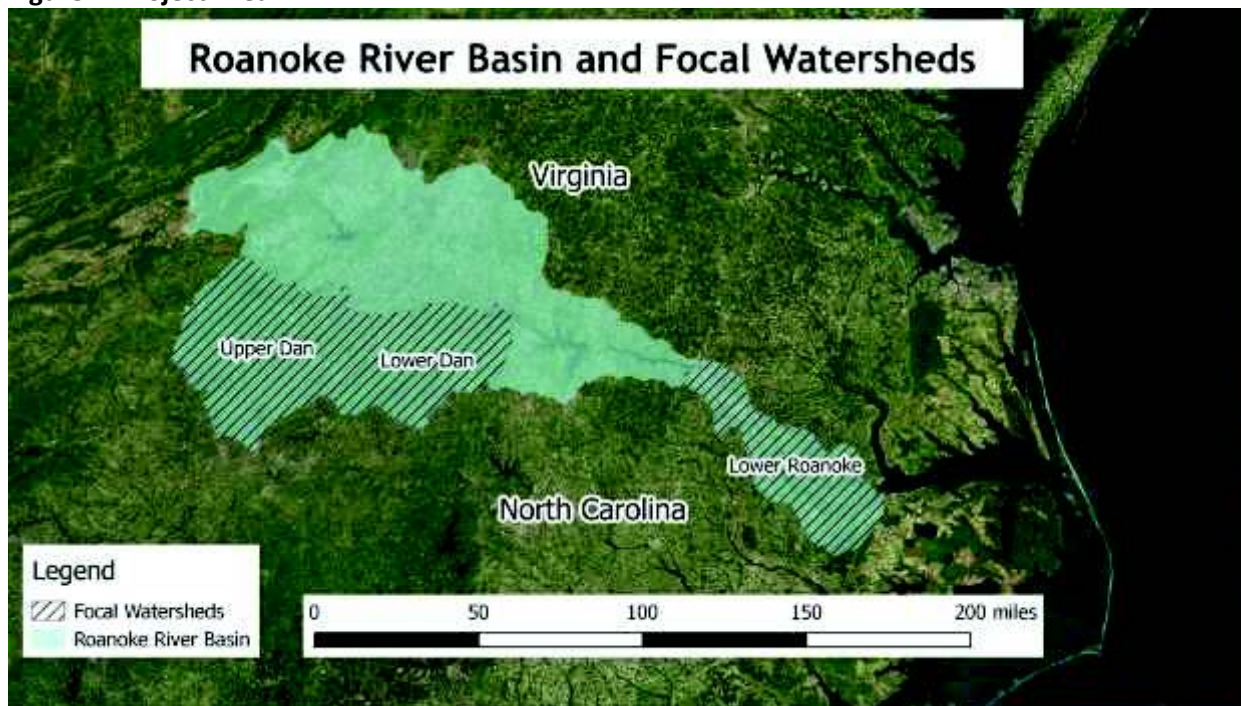
The team also anticipates providing timely (bi-monthly) updates to NFWF regarding the project and including the latest draft of project deliverables, including:

- Briefing paper with initial ESV estimates that will be presented at the workshops.
- Summary of feedback surveys from Workshop I and II
- Drafts of ecosystem-service assessment sub-basin reports (July-August 2018)

## Project Location

The proposed study region is the Roanoke River Basin, which stretches from the eastern continental divide in Montgomery County, Virginia, to the Roanoke River National Wildlife Refuge in eastern North Carolina. Our broad-brush ecosystem services assessment will cover this entire basin. The deep dive, including via participatory research workshops, ends-means analysis, and stakeholder outreach will focus on the Dan River (upper and lower) and Lower Roanoke sub-basins. These focal watersheds are indicated by the hatched areas in Figure 2.

Figure 2: Project Area



## Subcontractor

A subcontractor will be selected to assist Key-Log Economics with the Python coding/QGIS plugin development described under Activity 6. The subcontractor is not known at this time, but Key-Log Economics will provide

NFWF with a copy of the request for proposals/terms of reference when soliciting bids and will clear the selection with NFWF before executing a contract for that work.

## Works Cited

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