The Basin-Scale Opportunity Assessment Initiative: Synopsis of the Preliminary Scoping Assessment for the Connecticut River Basin

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Prepared by the Pacific Northwest and Oak Ridge National Laboratories

The goal of the U.S. Department of Energy's (DOE) Basin-Scale Opportunity Assessment (BSOA) Initiative is to develop and validate an integrative approach for the assessment of hydropower and environmental opportunities at a river basin scale. In the BSOA Initiative, *preliminary scoping assessments* are intended to provide a rapid, initial identification and screening of possible complementary[1] hydropower and environmental opportunities in a given basin for basin stakeholders to consider carrying forward as appropriate.

The purpose of this synopsis is to present the preliminary scoping assessment DOE initiated for the Connecticut River basin. The assessment is preliminary because it has not been reviewed by the BSOA national steering committee or basin stakeholders. In addition, there may be important data sets that have yet to be included. For detailed information about this scoping assessment please refer to the 2013 Annual Report.[2]

Defining Opportunities

The BSOA Initiative seeks to develop a nationally deployable approach to identify opportunities for increasing hydropower generation and improving environmental conditions at a basin scale. Thus, the BSOA process is inherently focused on *complementary* opportunities for hydropower development and environmental improvement; i.e., situations in which an existing environmental issue can be improved or mitigated, either directly or indirectly, by actions associated with hydropower development or operations. Examples of hydropower development that are considered in the BSOA process include powering non-powered dams, increasing generation at existing hydropower facilities, and new in-stream or in-canal/conduit developments. In FY13, efforts were focused on identifying environmental opportunities that are directly related to hydropower (e.g., flow management, water quality, fish passage). Methods to examine indirect environmental opportunities, such as ecosystem restoration, water management, and wetland rehabilitation will be explored in FY14.

Scoping Assessment Approach

The core of the scoping assessment process consists of five general tasks, including 1) contacting key stakeholders, 2) compiling relevant information, 3) identifying hydropower opportunities, 4) identifying environmental issues, and 5) identifying potential complementary hydropower-environmental opportunities. Information from the National Hydropower Asset Assessment Program (NHAAP,

[1] "Complementary" replaces the term "Combined" that was used in the FY13 technical report.
[2] Johnson et al. 2013. *The Integrated Basin-Scale Opportunity Assessment Initiative: Phase 1 Methodology and Preliminary Scoping Assessments for the Connecticut River and Roanoke River Basins, Annual Report 2013*. PNNL-22807. Available at http://basin.pnnl.gov.

http://nhaap.ornl.gov) database was used to identify potential hydropower development opportunities in the basin. Subsequent analyses for the Connecticut River basin focused on two main opportunity types: powering non-powered dams (NPDs) and new site developments (NSDs). Information on key environmental issues that may present challenges or potentially be improved by hydropower development was identified from publicly-available resources, such as watershed planning documents, environmental impact statements, water-quality certifications, regulatory filings for hydropower projects, and nationally available environmental data. The information was placed in geographic context within a Geographic Information System (GIS) database to allow for spatially-driven analyses of hydropower-environmental interactions. The structure of the database was based on a novel data model that describes core data elements, relationships between data elements, and rules by which interactions are explored. A central element to the model was hydrologic catchment polygons, which served as the common map unit for exploring interactions between hydropower and environmental issues that may be spatially disparate but functionally linked. Spatial representations of dam reservoirs and tailwaters were also key elements in the model for determining spatial interaction.

Interactions between hydropower opportunities and environmental issues (both positive and negative) were explored using a sequential six-step process (Figure 1). A key aspect of this process was development of criteria for structuring queries of the GIS database that would reveal complementary hydropower-environmental opportunities. Two sets of criteria were considered: the first describing attributes that may preclude hydropower opportunities, and the second describing potential environmental benefits that may be associated with hydropower. Criteria were kept fairly coarse due to the broad scale of analysis and intention of providing an initial assessment of potential opportunities.

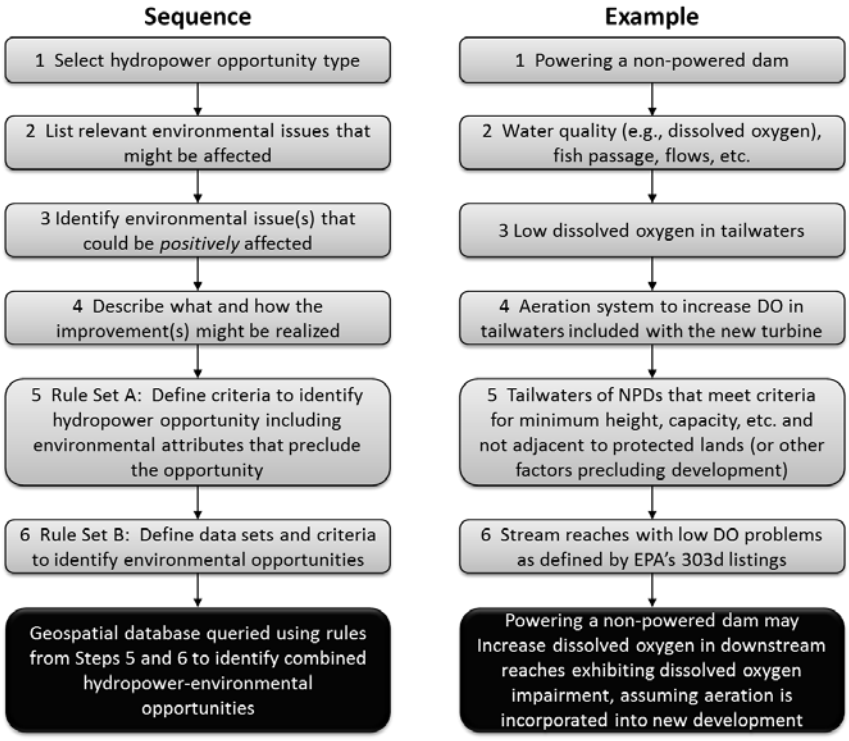

Figure 1. Sequence with example for identifying complementary hydropower-environmental opportunities.

Preliminary Results

For the preliminary assessment in the Connecticut River basin, we concentrated on hydropower opportunities for powering non-powered dams or new site development, because relevant data were readily available from the National Hydropower Asset Assessment Program database. Environmental issues were identified, including: impaired water quality (DO, temperature, sediment, turbidity); high hydrologic disturbance; impaired fish passage; and poor access to non-motorized boat recreation (whitewater and paddling). Dam removal, based on The Nature Conservancy's Northeast Aquatic Connectivity Tool, was included as an environmental opportunity if the particular dam was in catchments intersected by the reservoir or tailwater of the prospective hydropower development site. Five types of combined hydropower-environmental opportunities for the Connecticut River basin resulted in 17 NPD sites with a total potential new capacity of 20.7 MW and 20 NSD sites with a total potential new capacity of 35.2 MW (Table 1 and Figure 2).

Table 1. Summary of the number and capacity of NPD and NSD sites that have associated opportunities for environmental improvement in the Connecticut basin. This assessment of potential new hydropower capacity is conservative because it does not include other hydropower opportunity types nor does it include potential system-level benefits.

		NPD		NSD	
Environmental Criteria	Environmental Opportunity	Number	MW	Number	MW
Does not meet EPA criteria for dissolved oxygen (DO)	Aeration from new development/adding a turbine could increase DO in downstream reaches with DO impairment.	0	0	1	1.66
Does not meet EPA criteria for temperature	New development/adding a turbine could provide better flow management in downstream reaches with temperature impairment.	2	9.1	1	1.2
High level of hydrologic disturbance	New development/adding a turbine could provide better flow management in downstream reaches with high hydrologic disturbance.	7	6.4	17	30.4
Presence of American whitewater boat runs & "other" important paddling waters	Adding a turbine could provide better flow management in existing whitewater/paddling reaches below dam.	8	12.3	NA	NA
Presence of a dam that is ecologically important for anadromous fish restoration	Assume improvements to fish passage can be made as part of project development, either through facility modification or dam removal.	11	16.0	8	15.5
	Total number and MW of sites that have at least one potential environmental opportunity*	17	20.7	20	35.2

**Note: The total number of sites and megawatts is not equal to the sum of the data in the rows above because some hydropower sites have more than one environmental opportunity.

Of the 692 NPD sites evaluated, only 17 met the screening criteria for a potential hydropower opportunity that may benefit at least one environmental issue, i.e., provided a combined hydropower-environmental opportunity. Estimated capacities of these 17 combined opportunities ranged from 0.1 to

7.2 MW, representing a total capacity of 20.7 MW. Most (88%) NPD sites were not considered practical opportunities because they had an estimated capacity less than 0.1 MW. However, 284 sites (not mutually exclusive from those with capacities less than 0.1 MW) were also deemed impractical because they intersected catchments containing protected lands (GAP Status 1 or 2 or Wild and Scenic Rivers) or habitat of the dwarf wedgemussel, an ESA-listed species. Environmental opportunities associated with potentially suitable NPD sites included opportunities to diminish hydrologic disturbance and improve temperature, non-motorized boat recreation, and fish passage.

Of the 60 NSD sites evaluated, 20 met the screening criteria for a potential hydropower opportunity that may benefit at least one environmental issue. Estimated capacities of these 20 combined hydropower-environmental opportunities ranged from 1.2 to 3.8 MW, representing a total capacity of 35.2 MW. The other 33 NSD sites were deemed impractical because they intersected catchments containing protected lands (GAP Status 1 or 2 or Wild and Scenic Rivers) or dwarf wedgemussel habitat. Environmental opportunities associated with potentially suitable NSD sites included improvements in DO levels, water temperature, degree of hydrologic disturbance, and fish passage.

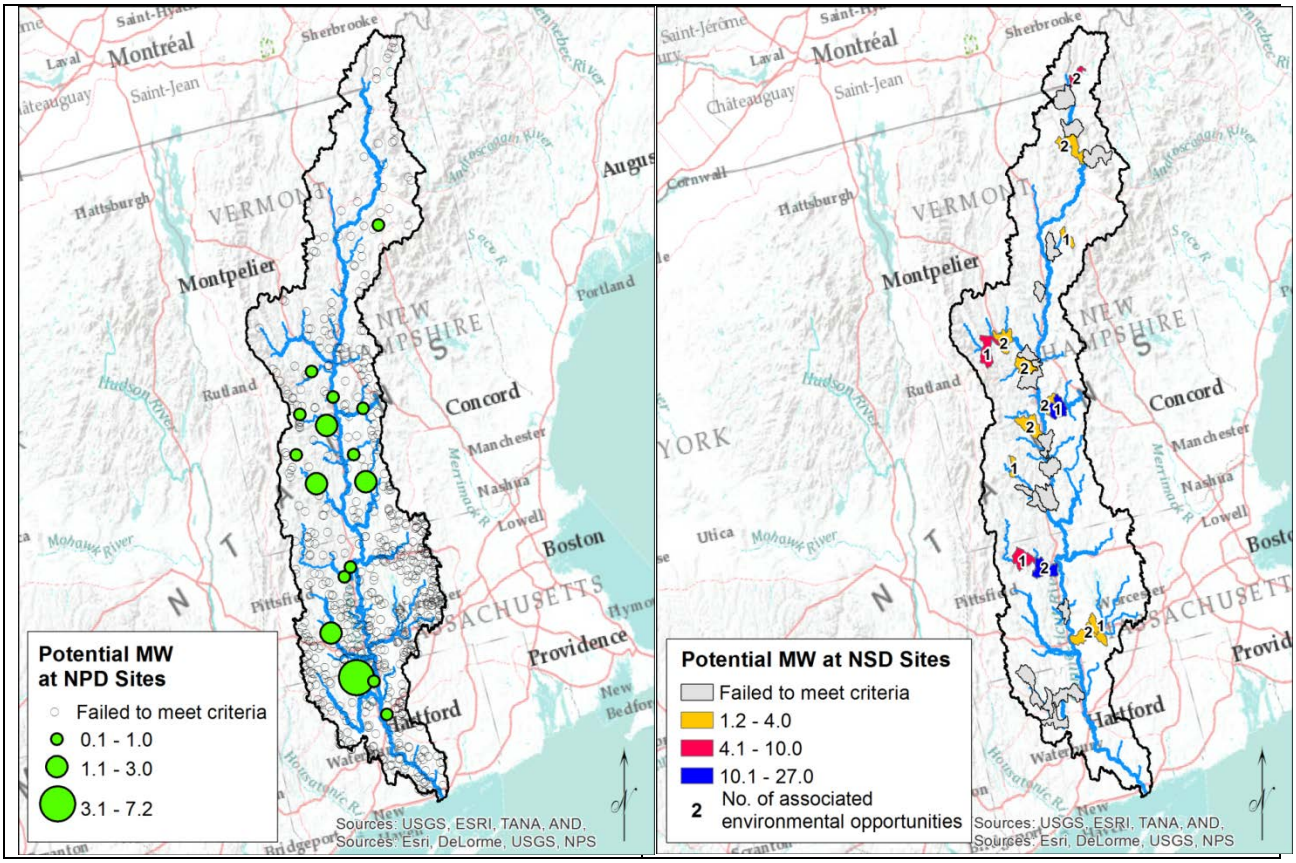

Figure 2. Non-powered dam and new stream-reach development sites in the Connecticut River basin that meet screening criteria for combined hydropower-environmental opportunities. Sites that do not meet the criteria are also shown for reference.

Conclusion

The BSOA scoping assessment approach is designed for conducting rapid initial assessments of hydropower and associated environmental opportunities at a basin scale. Key strengths of the approach

are that it is nationally deployable, relatively quick to implement (6 months or less), and useful for examining and visualizing opportunities under a variety of scenarios. The data model and GIS database allow the approach to be implemented similarly across basins, but are also flexible enough to allow for customized assessments.

An important aspect of the BSOA scoping process is the criteria that are used to identify opportunities. Criteria can be objective or subjective, depending on the objectives of the analysis and interests of the stakeholders. However, defining criteria becomes increasingly difficult as relationships among types of hydropower opportunities, environmental issues, and stakeholder interests become more complex. Defining the spatial context in which opportunities are explored also can be difficult, especially for elements that are spatially disparate but functionally linked. The use of a common analytical unit (hydrologic catchments in this assessment) helps to address this analytical challenge. However, it also creates some level of spatial ambiguity in relationships between hydropower and environmental issues that is not easily quantified.

In FY14, PNNL and ORNL seek to improve the process and methods for BSOA Phase 1 scoping Assessment based on feedback from experts and stakeholders in the Connecticut River basin. An analogous preliminary scoping assessment and outreach effort are underway for the Roanoke River basin. Example topics the project team is interested in include:

- Relevancy of the BSOA Initiative to the basin
- Usefulness of BSOA products to decision making
- Appropriateness of screening criteria and environmental issues
- Other basin-specific considerations, datasets, etc.

In conclusion, it is important to note that the results presented above are preliminary and subject to change as more information is gleaned, methodologies are refined, and stakeholder feedback is obtained. For more information, please contact Gary Johnson (gary.johnson@pnnl.gov, 503 417 7567).