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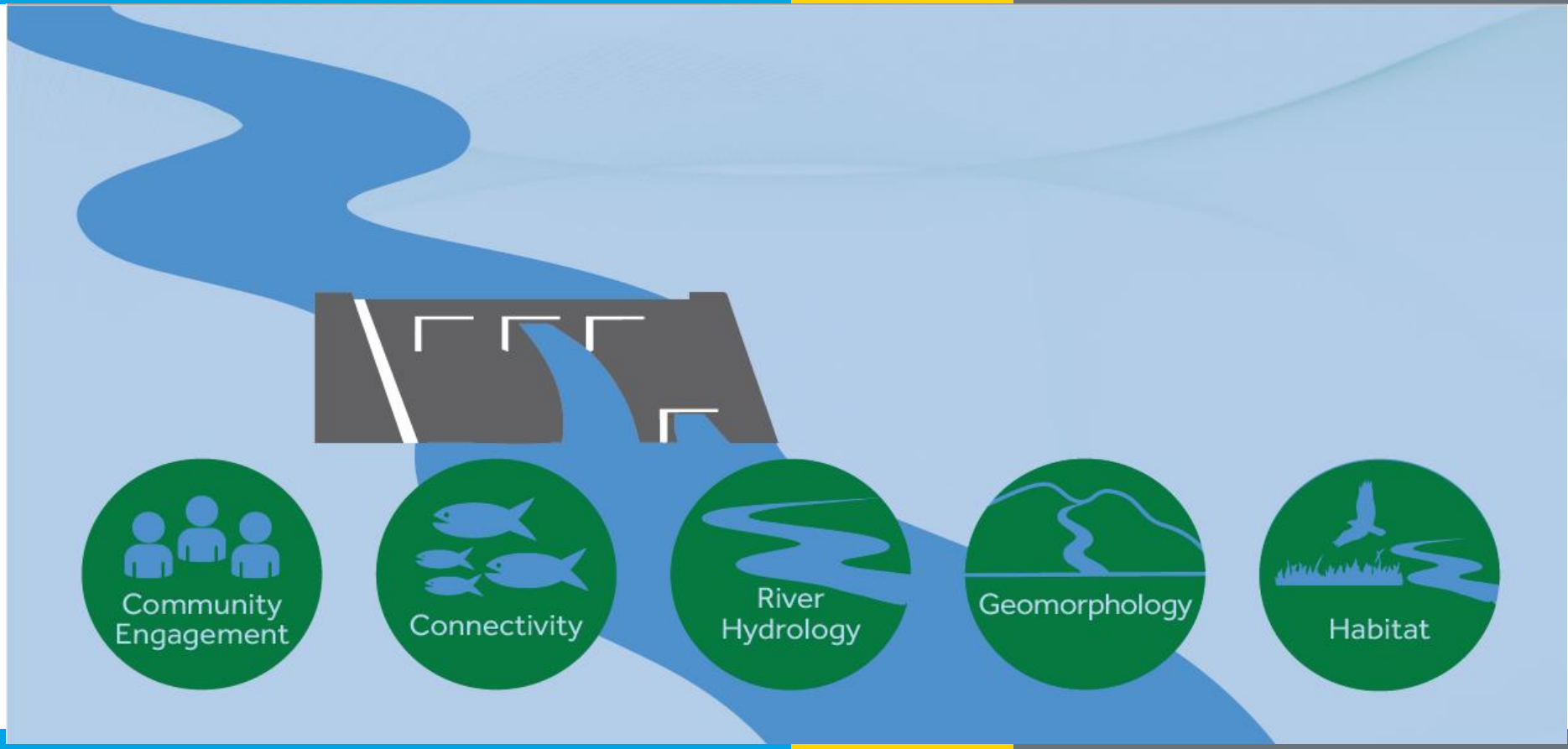

Environmental Metrics for Hydropower

Shelaine L. Curd, M.S., PMP
Oak Ridge National Laboratory
curdsl@ornl.gov 865-574-6475
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Project Overview

Environmental Metrics for Hydropower: The near-term objective of this project is to create a catalog of terminology, metrics, and metric methodology that will enable stakeholders to define, assess, and communicate their own concepts of environmental sustainability with efficacy, clarity, and transparency leading to an assessment of the adequacy of existing protocols to characterize environmental sustainability.

The Challenge: New hydropower development will not be widely accepted as a sustainable renewable energy option without an unbiased understanding of environmental effects.

Partners: Kearns & West – Collaboration and Strategic Communications; Mission and Scientific Advisory Boards

Next Generation Hydropower (HydroNEXT)

Optimization

- Optimize technical, environmental, and water-use efficiency of existing fleet
- Collect and disseminate data on new and existing assets
- Facilitate interagency collaboration to increase regulatory process efficiency
- Identify revenue streams for ancillary services

Growth

- Lower costs of hydropower components and civil works
- Increase power train efficiency for low-head, variable flow applications
- Facilitate mechanisms for testing and advancing new hydropower systems and components
- Reduce costs and deployment timelines of new PSH plants
- Prepare the incoming hydropower workforce

Sustainability

- Design new hydropower systems that minimize or avoid environmental impacts
- Support development of new fish passage technologies and approaches
- **Develop technologies, tools, and strategies to evaluate and address environmental impacts**
- Increase resilience to climate change

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The Impacts:

- A catalog of environmental metrics from literature and existing protocols
- Improved and clearer communications among diverse stakeholders about specific hydropower developments using a common set of well understood facts and information based on the best available science
- Empowered stakeholders, including agencies, to express priorities and interests about hydropower development more efficiently, concisely, and transparently
- The use of best-available scientific and quantitative analysis for informed decision making.

Technical Approach – Project Overview

Due to the need to maintain relevance to the broader hydropower community, the project takes a two-pronged approach to interweave scientific and stakeholder input.

2016

- Stakeholder Initialization
- Literature Review

Fundamental Concepts
Establish Shared Terminology

2017

- Catalog Environmental Metrics
- Reference Studies to Evaluate Environmental Metrics

2018

- Peer reviewed publication of research
- Broadly disseminate and collect feedback

Technical Approach – Scientific Framework

Terminology Paper - Defines key vocabulary and search tearms for Systematic Literature Review.

Collection of Existing Metrics

ORNL staff conduct a systematic review of peer reviewed literature, as well as a review of existing certification programs, to identify existing metrics. Sources of metrics are tracked throughout the process.

Deliverables:

- **Metrics from Systematic Literature Review**
- **Metrics from IHA, LIHI, and CEQ-FERC documents**

Database Creation

Results from literature review and review of certification documents is compiled into a database of metrics, measurements, statistics, and indicators. The database will then be summarized.

Deliverable:

- **Database of Environmental Metrics, Measurements, Statistics, and Indicators**

Catalog of Environmental Metrics

The catalog of environmental metrics will summarize the database, and contain scientifically based metrics and terminonology.

Deliverable:

- Catalog of Environmental Metrics

Compare and contrast IHA, LIHI, and CEQ-FERC

Metrics containted in the catalog will be used as a common language to identify gaps and commonalities in existing certification programs.

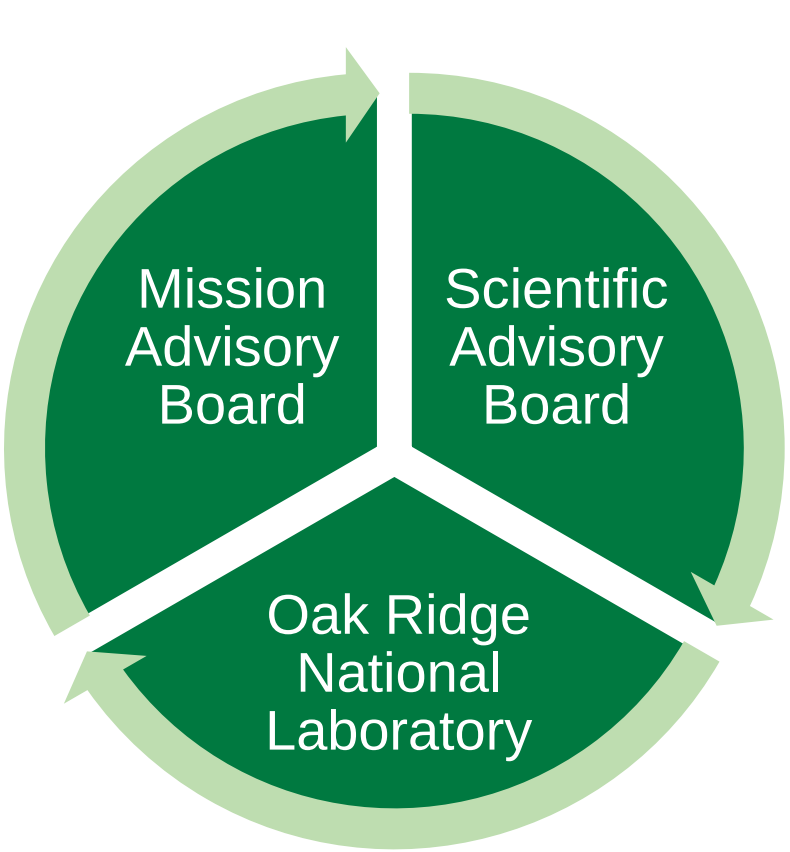
Case Study Comparison

Confirm metric gaps through case study analysis. To include a total of four projects: two projects from the East and two projects from the west, with one large and one small in each region.

Evaluate Adequecy of Existing Protocols

Technical Approach – Advisory Boards

Collection of input from stakeholders and scientific experts through the development of Oak Ridge National Lab (ORNL) Advisory Boards



Public Outreach: hydropower.ornl.gov

Mission Advisory Board

hydropower industry sectors

- Electric Utilities
- Environmental and Other NGOs
- Hydropower Asset Owners
- Project Development Interests
- Regulatory and Policy Agencies
- Resource Managers
- Technology Developers
- Tribes
- Water Management and Allocation

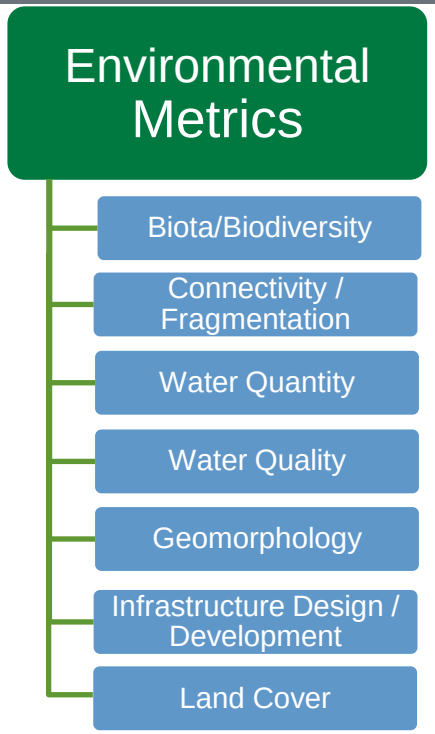
Scientific Advisory Board

bring scientific expertise in the environmental categories

Scientific Framework

ORNL has established:

- Science categories
- Relevant environmental terminology
- General ecological concepts to foster communication about environmental issues pertaining to hydropower development and operation.



Stakeholder Engagement

- Developed Mission and Science Advisory Board Stakeholder Charters
- Conducted and documented 18 Mission Advisory Board Interviews
- Enlistment invitations for Mission Advisory Board (19–25)
- Enlistment invitations for Science Advisory Board members (7–9)
- Kick-Off Advisory Board Meeting planned for February 7–8, 2016.

Project Plan & Schedule – Jan 2016 – Dec 2018

Schedule slip:

Original start date of was October 2015

- Delayed start date to Jan2016 per DOE-HQ request.

Delayed initial Advisory Board establishment to FY17

FY17 Q4 Go/No-Go:

Assess the adequacy of existing protocols to characterize environmental sustainability

Description: DOE-HQ and ORNL will convene to discuss the conclusions drawn from the case studies. These results are instrumental in determining the future direction of the Environmental Metrics for Hydropower Project. Potential directions could include a recommendation for the development a new protocol, produce another form of guidance or product such as a "State of the Science" or similarly comprehensive report.

Criteria:

1) Mission and Scientific Advisory Boards assessment of the adequacy of existing protocols based on the Environmental Metrics case studies of hydropower reference sites to characterize environmental sustainability.
2) Direction of Water Power Technologies Office.

Project Budget

Budget History					
FY2014		FY2015		FY2016	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
n/a	n/a	n/a	n/a	$600K	n/a

- No variances have occurred.
- As of Sep 30, 2016, 50% of the available resources have been expended. Note this was less than anticipated due to delays in invoicing processes.

Research Integration & Collaboration

Partners, Subcontractors, and Collaborators:

- Mission Advisory Boards: Representatives from sectors with an interest in hydropower (Electric Utilities, Environmental and Other NGOs, Hydropower Asset Owners, Project Development Interests, Regulatory and Policy Agencies, Resource Managers, Technology Developers, Tribes, Water Management and Allocation)
- Science Advisory Board: Hydropower scientific expertise
- Collaboration and Strategic Communication – Kearns & West

Communications and Technology Transfer:

- Informational interviews with Mission and Science Advisory Board members
- Established website, factsheets, FAQs
- Provided outreach at DOE booth at Hydrovision 2016

Next Steps and Future Research

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FY17/Current research:

- Develop a catalog of hydropower environmental metrics
- Complete enlistment of Advisory Boards
- Kick-Off Advisory Boards meeting planned Feb 7–8, 2016
- Summarization of hydropower environmental metrics literature and regulatory domain documents
- Conduct case studies of hydropower reference sites.

Proposed future research:

An evaluation of project outcomes in December 2018 will inform potential direction including possible development a new protocol, production of another form of guidance, or product such as a “State of the Science” or similarly comprehensive report.