A Tiered Approach to Assessing Stream Ecosystem Condition

Reference SON: *SON-2021-1738, Application of Stream Condition Metrics to Calculate Average Annual Habitat Units to Include Structure, Function and Dynamic Processes*

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Research Need

Stream ecosystems are a major focus of diverse USACE management activities ranging from aquatic ecosystem restoration to multi-purpose flood risk planning to regulatory mitigation. USACE planners, engineers, and regulators require tools for holistically assessing the structure, function, and dynamic processes of streams and rivers.

Historically, the agency has heavily relied on species-specific habitat suitability models developed by the US Fish and Wildlife Service in the early 1980s. These habitat evaluation procedures provided a useful framework for assessing streams relative to effects on focal taxa (e.g., imperiled or sport species). However, these models are well-acknowledged as limited due to factors such as: a myopic focus on a single taxon in a speciose system, minimal accounting of population dynamics, an absence of ecosystem-scale outcomes, and an overemphasis on metrics of ecosystem structure rather than function.

Furthermore, the USACE Civil Works planning process (i.e., SMART Planning) imposes different modeling needs as projects progress. At the Alternative Milestone, teams are often working with sparse data and very rapid timelines (i.e., 1-3 months) to screen sites and management measures. At the Tentatively Selected Plan Milestone (12-20 months), practitioners are working toward conceptual, site-scale designs (e.g., riparian planting, instream structures, or both). At the Agency Decision Milestone and throughout Pre-construction Engineering Design, teams are examining “scales” of an alternative (e.g., varying sizes of instream structures) and reporting ecological benefits to USACE Headquarters and Congress. Following implementation, project teams must monitor the effects of a project to inform adaptive management decisions.

In sum, USACE practitioners require a diverse toolbox of stream assessment procedures that vary in level of effort and the degree of input data resolution. These tools should assess ecological outcomes not only relative to habitat provision but

also ecosystem functions. Additionally, these tools should be conceptually linked such that decisions are made in a consistent and repeatable manner as project planning and implementation proceeds. Ideally, this toolkit would be national in scope and create a standardized approach to stream assessment, which would be comparable across diverse applications.

Project Purpose & Objectives

This project seeks to develop a nested toolkit of methods for stream assessment that align with Civil Works project planning needs by providing varying levels of effort. The toolkit will be designed explicitly to provide a consistent structure to stream assessments at any scale of analysis. Objectives:

- Develop a common and transferrable structure for stream assessment, which can be applied at multiple scales and tailored to local needs.
- Compile tools for assessing stream outcomes associated with this structure at three scales: macro-scale outcomes aligned with "desktop" analysis, meso-scale outcomes associated with rapid field assessment, and local-scale outcomes tailored to regional needs and informed by empirical data collection.
- Develop select tools to fill gaps in the existing toolbox.
- Certify tools for use by USACE practitioners (as appropriate).
- Demonstrate application of the nested, multi-scale model framework as a "go-by" for users.

Value of Research and Development (Payoff)

The proposed approach will save resources and expedite USACE project delivery. Specifically, the development of a consistent framework provides an adaptable structure for teams to use as a basis for local development (analogous to the HGM modeling approach). Consistency in model structure also facilitates comparison of projects at programmatic scales and "roll up" of project benefits for national budgeting and reporting. The toolkits developed at each level of effort will provide users with a menu of options for their particular application.

Products

Journal Articles (JAs)

Stepchinski, L.M., S.K. McKay, and G.T. Menichino. A Tiered Approach to Developing Function-Based Stream Assessments. Submitted.

Stepchinski, L.M., S.K. McKay, and G.T. Menichino. A Synthesis and Inventory of Stream Functions. River Research and Applications. Submitted.

Stepchinski, L.M., S.K. McKay, A.E. Harris, and G.T. Menichino. A Review of Stream Assessment Methods in the United States. Submitted.

Technical Reports (TRs)

A rapid field assessment approach for stream assessment (2025 Sept)

Technical Notes (TNs)

Haring, C.P., L.M. Stepchinski, and G.T. Menichino. Rapid Assessment Tool for Channel Hydraulics and Floodplain Connectivity. U.S. Army Engineer Research and Development Center. [In EPAS Review, anticipated publication 2025 Fall]

Stepchinski, L.M., S.K. McKay, and G.T. Menichino. (2025). Review of Stream Assessments for Evaluating Ecological Impacts and Benefits. ERDC/TN EMRRP-EL-7. U.S. Army Engineer Research and Development Center, Vicksburg, MS. https://dx.doi.org/10.21079/11681/49710

Stepchinski, L.M., G.C. David, and G.T. Menichino. Applying the Tiered Assessment Approach to the Development of a Detailed Assessment in a stream in the Northeastern United States. (Planned 2025 December).

Stepchinski, L.M., G.C. David, and G.T. Menichino. Applying the Tiered Assessment Approach to the Development of a Detailed Assessment in a stream in the Pacific Northwest of the United States. (Planned 2026 May).

Other Reports/Models/Tools/Datasets

Online database of stream assessment methods and tools (2024 July)
https://usace-wrises.github.io/RiverEngineeringResources/

Launch online database of assessments to support nested framework (estimated 2026 June)

Conference Presentations/Webinars/Workshops

Stepchinski, L.M., G.C. David, & G.T. Menichino. (Expected 2026 July). Toolkit for Applying a Tiered Approach for Assessment [EMRRP Webinar]. U.S. Army Engineer Research and Development Center.

Stepchinski, L.M., G.C. David, & G.T. Menichino. (Expected 2026 June). Regionally tailored tools for assessment [EMRRP Webinar]. U.S. Army Engineer Research and Development Center.

Stepchinski, L.M., G.C. David, & G.T. Menichino. (2025 August). Stream Functions Assessment and Rapid Index (SFARI) for Evaluating Ecosystem Condition [EMRRP Webinar]. U.S. Army Engineer Research and Development Center.

Stepchinski, L.M, G.T. Menichino, S.K. McKay. (2025 May). A Stream Tiered Assessment Framework: Stream Assessment Model, Society for Freshwater Sciences.

Stepchinski, L.M, G.T. Menichino, S.K. McKay. (2025 February). A Comprehensive List of Stream Functions for Function-Based Stream Assessments: River Restoration Northwest.

Stepchinski, L.M., G.T. Menichino, S.K. McKay. (2024 December). A Tiered Approach for Assessing Stream Ecosystem Condition, American Geophysical Union Annual Meeting.

Stepchinski, L.M. & G.T. Menichino. (2024 October). Stream Tiered Assessment Framework: Model [EMRRP Webinar]. U.S. Army Engineer Research and Development Center.

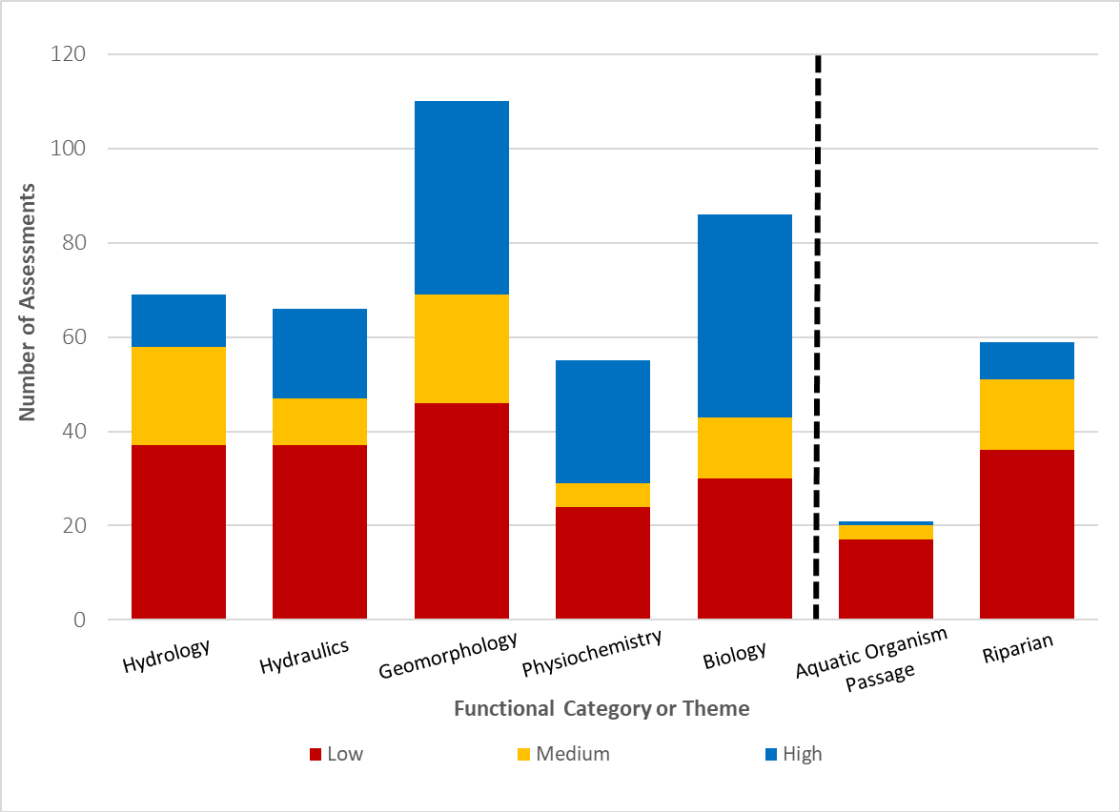
Stepchinski, L.M., G.T. Menichino, S.K. McKay. (2024 September). A Tiered Framework Approach for Stream Assessment: ORISE Postdoctoral Symposium.

Stepchinski, L.M. & G.T. Menichino. (2024 July). Review of Stream Assessments for Evaluating Ecological Impacts and Benefits [EMRRP Webinar]. U.S. Army Engineer Research and Development Center.

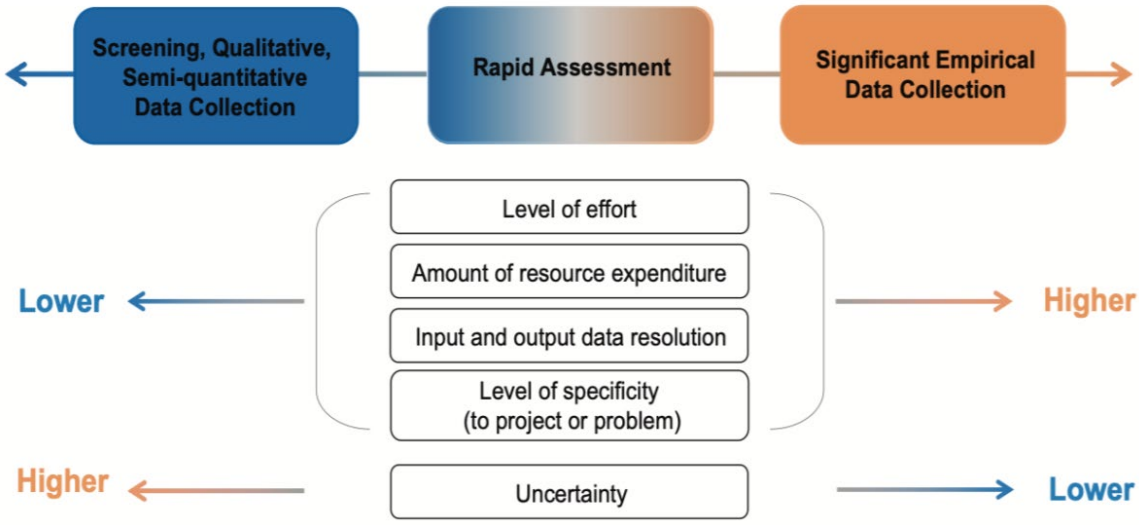
Stepchinski, L.M., G.T. Menichino, S.K. McKay. (2024 June). Developing a Tiered Approach for Assessment of Biological and Ecological Stream Condition: Society for Freshwater Sciences.

Stepchinski, L.M., G.T. Menichino, S.K. McKay. (2024 June). Toward a Tiered Approach for Assessing of Stream Ecosystem Condition: National Stream Restoration Conference.

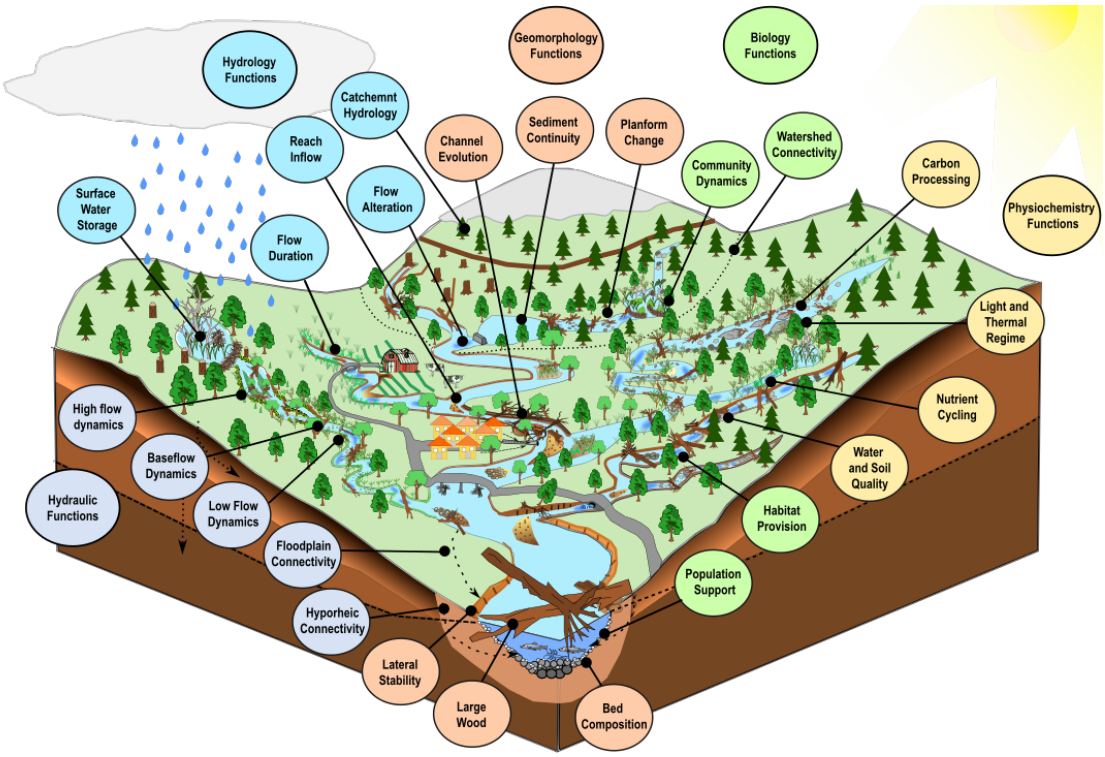
IMAGES



Picture 1. Coverage of stream functions across over 200 available assessments.



Picture 2. Three (3) Tiers within the Tiered Assessment Framework and tradeoffs of level of effort, input/output data resolution, and uncertainty.



Picture 3. Nationally applicable comprehensive list of stream functions capture processes across range of disciplines.