

Developing Ecological Criteria for Sustainable Water Management in Minnesota: the Ecological Limits of Hydrologic Alteration (ELOHA)

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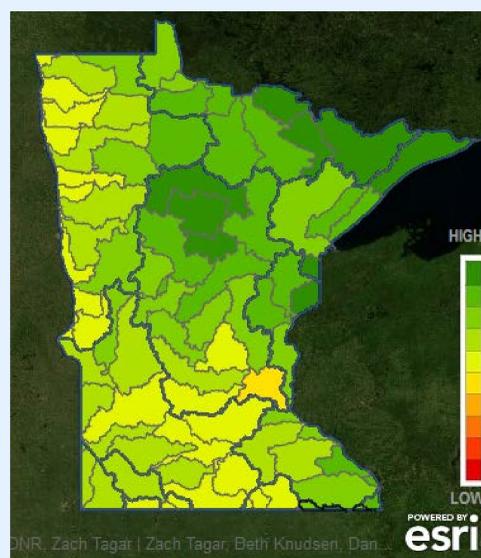
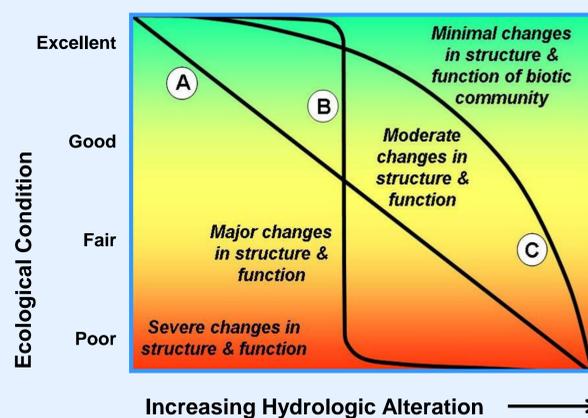
Abstract. Hydrology is increasingly recognized as a primary determinant of aquatic, riparian and shoreland ecological structure and function. Surface and groundwater use, landscape modification, and climate change can all modify basin hydrology and streamflow regimes, but the quantitative connections between these changes and ecological conditions are often poorly understood. This poster will summarize a 2010-2011 initiative led by The Nature Conservancy to advance understanding of ecological flow needs in Minnesota and establish ecological criteria for assessing and preventing flow alteration in aquatic systems based on the Ecological Limits of Hydrologic Alteration (ELOHA) framework (Poff et al, 2009). The Conservancy's effort in Minnesota focused on a) assessing available data, criteria, tools and approaches to development of ecological flow criteria (both science and policy), b) developing consensus on technical approaches to characterizing flow metrics and ecological response, c) and assessing ecological flow response relationships for Minnesota's Great Lakes Basin streams as a pilot to identify and develop flow metrics and criteria needed to protect aquatic systems statewide. Currently, a number of state, regional and university research initiatives are continuing to address gaps in the scientific foundation, policy applications, and/or implementation that were identified in this process. These efforts hold promise for progress on ecological flow protection and sustainable water management in Minnesota.

Applying ELOHA in Minnesota

Flow-ecology curves are designed to illustrate how ecological health or condition varies with corresponding measures of flow alteration. They provide tools for representing thresholds and zones of ecological risk, and are useful to the process of establishing and communicating about protective limits. Because Minnesota has such extensive biological datasets, this goal is imminently feasible wherever measures of hydrologic alteration can be estimated or derived, and should be pursued.

To improve the sustainability of groundwater and surface water use permitting and land use planning in the context of the state's new "One Water, One Plan" approach, Minnesota needs a statewide or regional water use and availability accounting model that can track existing and proposed withdrawals in a cumulative impact framework. Although local and regional groundwater flow models and databases have been developed for specific applications, models are needed that can estimate incremental effects of additional groundwater and surface water withdrawals on streamflow, lake and wetland water levels, accounting for cumulative existing permitted uses, that can interface with online permitting and ecological risk screening.

ELOHA (Poff et al 2010) is a flexible framework for determining water requirements for healthy, sustainable rivers and integrating those requirements into regional water management. ELOHA synthesizes existing hydrologic and ecological databases and literature information from many rivers within a region to generate **flow alteration-ecological response** relationships for rivers with different types of hydrological regimes. These relationships correlate measures of ecological condition, which can be difficult to manage directly, to streamflow conditions, which can be managed through water-use strategies and policies. In practice these relationships are framed as hypotheses backed by quantitative data and/or qualitative information from relevant experts. Concurrent hydrologic, ecological, and social processes combine existing models and methods into a step-by-step framework for broad-scale, comprehensive management of water flows and levels.

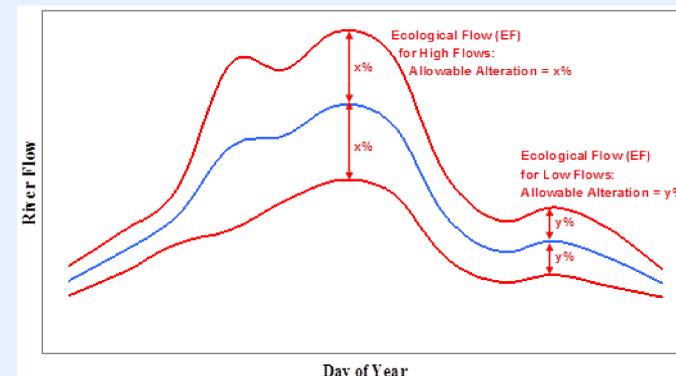


Hydrologic score for Minnesota from the Minnesota Watershed Health Assessment Framework (MN DNR <http://arcgis.dnr.state.mn.us/ewr/whaf/Explore/>)

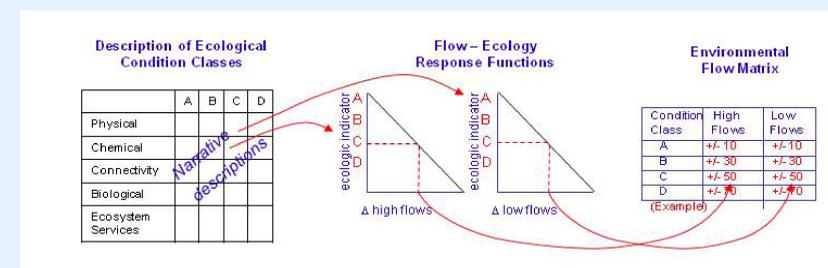
References:

Poff, N.L. et al. (2010). "The Ecological Limits of Hydrologic Alteration (ELOHA): A new framework for developing regional environmental flow standards." *Freshwater Biology* 55: 147-170.

For more information, see ELOHA at the Conservation Gateway: <http://nature.ly/ELOHA>



Above: The concept of sustainability boundaries (Richter 2009) can be used to develop environmental flow criteria (red) around natural hydrograph (blue). **Below:** Process for translating condition classes (left) into environmental flow criteria expressed as degree of allowable flow alteration from baseline (right) for two flow components (high and low flows) for a hypothetical river type.



Potential Applications in MN's Lake Superior Basin

Decisionmakers and planners need to understand ecological risk levels associated with increasing degrees of alteration. ELOHA provides a framework for defining acceptable risk based on flow-ecology response models developed for key biological metrics. For example, what percent flow reduction can still maintain acceptable fish community structure? This process should involve expert scientific opinion, best professional judgment as well as adequate public and stakeholder input and engagement of decisionmakers. Plans should be made for monitoring, periodic review, and risk level revision as new information becomes available.

Climate change models suggest more frequent and intense precipitation events, along with longer periods of drought. Recent climate anomalies have highlighted the potential costs to human communities and infrastructure as well. To support adaptation and mitigation planning, comprehensive land use and water resource management, and maintaining adequate water resources to meet multiple demands into the future, decision makers need to understand how stream flows and water availability will likely respond to land use and climate changes, as well as how those changes are likely to impact water quality, human and aquatic communities. The project "Criteria for Land and Water Management to Sustain Healthy Aquatic Ecosystems in a Changing Climate" seeks to carry out an ELOHA process for Minnesota's Lake Superior tributaries to quantify flow-ecology relationships and to support watershed goal-setting and planning.

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Acknowledgments: USGS Mounds View, MNDNR, MNPCA, University of Minnesota, Natural Resources Research Institute, UMD and all participating individuals & institutions