

GREAT LAKES ADVISORY BOARD
INCORPORATING ADAPTIVE MANAGEMENT INTO THE GLRI PROGRAM
RECOMMENDATIONS OF AN *AD HOC* SUBCOMMITTEE
SUBCOMMITTEE DISCUSSION
Draft, June 15, 2015

On March 17, 2015, the Great Lakes Advisory Board (GLAB) received seven charge questions related to the Science-Based Adaptive Management Process for Great Lakes Restoration Initiative Action Plan II (draft, Nov 26, 2014) (AM Framework). Separately, GLAB leadership asked a subcommittee of the GLAB to propose a specific process for effectively implementing Adaptive Management (AM) into the Great Lakes Restoration Initiative (GLRI). This document provides an initial response to the charge questions and outlines a general process that could set the stage for effectively incorporating AM into the GLRI program.

The process recommended for incorporating AM into the GLRI program includes the following general steps:

1. Identify and evaluate AM procedures and processes already in use in environmental restoration programs;
2. Develop consensus-based management objectives¹ for the GLRI program that include appropriate metrics and indicators that can be used as targets or benchmarks in implementing and evaluating GLRI projects and initiatives;
3. Compile a master list of agency-specific GLRI priorities and projects that collectively are designed to achieve the management objectives.
4. Define a comprehensive monitoring program for the region that includes the minimum monitoring activities required to support the lake specific management objectives and to evaluate progress in achieving GLRI priorities;
5. Create or adopt multi-agency regional information management system capable² of collecting, managing, and making accessible to the agencies and the public the data and information necessary to evaluate the effectiveness of GLRI projects and initiatives and to periodically adapt/refocus the GLRI program to achieve program objectives.

Initial responses to the charge questions are embedded below in the detailed explanation of each of these steps.

¹ Management objectives refer to measureable outcomes in lake condition and must be linked to consensus based metrics and indicators that have been developed to assess the overall health of the Lakes. They would include indicators being solidified through SOLEC and/or the Great Lakes Executive Committee for example. They do not refer to the measures of progress in the Action Plan, which in some cases focus more on quantifying restoration work than trying to qualify how the work is impacting the overall system.

² This sub-committee previously considered information management needs and its recommendations were communicated to the IATF in a memo from GLAB Chair Ullrich dated Feb 20, 2015. The Science and Information Subcommittee is best suited to further explore how an information and management system should be used to arrive at adaptive management decisions.

Step 1: Identify AM procedures and processes currently utilized by each of the federal agencies that receive GLRI funding.

Charge Question 7 asks whether it would be advisable for the agencies to develop terms of reference for the implementation of the AM program to minimize the potential for misunderstandings and inefficiency in the implementation of the AM Framework. We believe consensus-based terms of reference are essential for ensuring that AM is designed, executed, funded, and integrated consistently across the GLRI program. Evaluating existing procedures would enable the agencies to develop consensus-based, multi-agency terms of reference.

The purpose of this effort would be to use existing AM procedures as a basis of identifying AM program improvements, and to assure that limited funds are not used to duplicate existing AM processes. A necessary first step in incorporating AM into the GLRI program is for the agencies to evaluate and disclose the AM procedures and processes already in use in the GLRI and other environmental programs.

When developing an AM process tailored to the Great Lakes region, we recommend that the agencies consider experiences and lessons learned by agencies operating in other large scale aquatic ecosystems (e.g., the Chesapeake Bay, the Everglades). In addition, we recommend the agencies review and evaluate AM processes already in use in their own GLRI-related projects and programs. This latter evaluation could be accomplished as follows:

1. Identify each agency's current top-most priority or priorities when implementing the GLRI.
2. With respect to the identified priority or priorities, detail how the agency has used AM in the past, identifying lessons-learned, examples of successes, and examples of failures.
3. Evaluate existing AM procedures and processes by considering the following:
 - a. Has the agency adopted processes that encourage innovation?
 - b. What kind of on-going monitoring does the agency require?
 - c. What data/information currently are/is collected?
 - d. Where are the collected data retained?
 - e. What suggestions do agency representatives have for data retention/management and distribution?
 - f. Does the agency use the data collected to refine GLRI priorities? If so, how? If not, are the data used in another way?

For example, EPA and the states have an important role in guiding – and accelerating - efforts that already are underway to reduce phosphorus loading in the Lakes. Annex 4 (Nutrients) of the Great Lakes Water Quality Agreement brings a welcome emphasis to the issue and efforts under the GLRI to incorporate an adaptive management approach to complex problems such as phosphorous loading present unique opportunities to tackle this threat in a sustainable manner.

The GLAB endorses an adaptive management approach as one appropriate mechanism for achieving the objective of phosphorus reductions in the Great Lakes. Specifically, in part utilizing the evaluation questions above, the agencies would be well served to engage with other Great Lakes organizations that are working on the nutrient issue to review current approaches to phosphorous reductions and determine if the current course can be expected to reduce phosphorous loading sufficiently to achieve the goal of fishable, swimmable and drinkable Great Lakes.

Reviewing and evaluating each agency's AM procedures would enable agency leadership to combine, streamline, expand, and enhance the procedures to establish a comprehensive definition of AM, both for phosphorous and the GLRI program as a whole.

Step 2: Select management objectives for the GLRI program that include both measures of progress and a suite of ecosystem indicators against which overall progress can be evaluated.

The second step in incorporating AM into the GLRI program is to select specific, realistic, and concrete management objectives for the GLRI program. Management objectives refer to measurable improvement in lake condition and can be used as targets or benchmarks in evaluating GLRI projects and initiatives. Clear, realistic, and consensus-based management objectives can reduce monitoring costs while assuring that progress is being achieved and maintained. They are a core element in any AM program.

The absence of clear and realistic management objectives is one of our concerns about the definition of AM in the AM Framework.

Charge Question 1 asks whether the GLAB has any questions about the agencies' definition of AM in the Framework. The Framework defines AM as "a structured management approach for addressing environmental uncertainties by testing hypotheses, linking science to decision making, and adjusting project implementation, as necessary, to improve the probability of success." Our concern about this definition is that it does not define "success" in the context of the GLRI program. What is meant by use of the phrase "the probability of success"?

As described in the AM Framework, Step 1 of the process requires planning (the development of the Action Plan and annual project planning), but it does not describe how the agencies identify the "priority ecosystem problems" that the Plan and projects are designed to address. Without a reference to specific management objectives that define program success, the AM definition is incomplete.

Management objectives for the GLRI program should include measures of progress (e.g., area of wetland restored), but also desired ecological outcomes (e.g., sustainable wetland ecosystems with high biological integrity). The objectives must be sufficiently inclusive to effectively account for progress at the project level, to incorporate progress attained by individual projects into an annual planning cycle and periodic Action Plans, and to define overall program success on a lake wide and ecosystem scale.

For example, the following general adaptive management principles should be integrated into nutrient reduction programs in the Great Lakes region:

- a. Establish clear and measurable objectives for reducing excess phosphorus in the Great Lakes.
- b. Focus efforts and resources on high priority phosphorus tributaries identified by the federal government (Green Bay, Saginaw Bay, Maumee River of Lake Erie).
- c. Encourage adaptive management plans for nutrient reduction at the appropriate watershed or sub-watershed scale, and enable both point and non-point sources, and groups of sources, of phosphorus to develop such plans as a means of reducing phosphorus loading.
- d. Enable drivers – both regulatory and incentives – that encourage projects/programs that maximize nutrient reduction from the least cost sources. These could include Water Quality

Trading, Public Private Partnerships, Private financing, and voluntary use of innovative technology.

Measures of progress are defined in the Action Plan, but measuring overall program success by reference to desired ecological outcomes will be complicated. It is important to recognize two points:

1. First, until now, the GLRI has used only measures of progress; it is necessary to develop or adopt appropriate indicators that can assess ecological state.
2. Second, AM typically is implemented at the project level, whereas referencing the GLRI Action Plan II in Figure 1 of the AM Framework suggests that AM is primarily used to track the effectiveness of the totality of GLRI activities.

The process of identifying a suite of regional ecosystem indicators already is underway and involves workgroups under the Great Lakes Water Quality Agreement, Great Lakes Executive Committee, the International Joint Commission, the State of the Lakes Ecosystem Conference, and others. Ecosystem indicators developed through one or more of these efforts may be sufficient to define desired ecosystem outcomes under the GLRI program. If the regional indicator system is determined to be insufficient to determine GLRI program effectiveness, additional indicators should be added.

Step 3: Compile a master list of GLRI projects to be implemented by each agency to achieve the management objectives.

The overarching goal of the GLRI program is clear (“to protect and restore the Great Lakes”) and Action Plan II establishes the agencies’ collective priorities for implementing the GLRI program. However, additional planning may be required to identify each individual agency’s GLRI priorities and specific implementation strategy. Agency priorities and strategies should be consistent with Action Plan II and should be coordinated across agencies to achieve overall GLRI management objectives. Collectively, agency priorities and strategies can be combined into a consensus-based master list of GLRI priorities and projects, and can be used for purposes of allocating limited GLRI funding to future project investments. However, transparency with Great Lakes stakeholders during this priority setting process will be integral to achieve the buy in needed from the Great Lakes community for continued support and success of the GLRI program.

Step 4: Determine appropriate monitoring requirements and implement a coordinated Great Lakes monitoring program.

Charge Question 2 asks whether all projects require pre- and post-project monitoring. In our view, not all projects require pre- and post-project monitoring; in fact, some projects may not require any monitoring at all. We recognize that monitoring may compete for dollars that could otherwise be allocated to new projects or increased scale of existing projects. On the other hand, AM by definition requires some mechanism to assess project effectiveness and incorporate learnings from practical experience into planning and decision making. Thus, some monitoring is essential if the GLRI wishes to make AM its guiding framework. Deciding how much to monitor, and where, are challenging issues, particularly for an undertaking as broad and multi-faceted as the GLRI.

Monitoring on the Great Lakes has been underfunded, episodic, and poorly coordinated. But evaluating long term success in achieving GLRI management objectives requires monitoring at appropriate locations, time intervals, and scales. It is perhaps for this reason that the agencies are “exploring ‘how much is enough’ monitoring so that it advances, and does not detract from, the core purpose of the GLRI.” (Charge Questions, March 17, 2015).

At a minimum, monitoring for purposes of GLRI implementation should be performed at two scales: the project scale and the regional (i.e. ecosystem) scale. For some focus areas, it may be appropriate to monitor at an intermediate scale. Overall, the scope of monitoring should be sufficient to evaluate progress in GLRI project-level implementation and to determine if measurable improvement in lake condition (eg, by SOLEC indicators) are is being achieved.

It could be useful for the GLRI to develop a framework that divides projects into three categories.

1. One category would include projects that rarely or never require monitoring. This category would include projects where the effectiveness of a restoration practice is well-established and little risk of failure is anticipated. Following the language of the AM Framework, these projects would use *proven restoration methods* that are established and tested, and have relatively high certainty of success in localized areas.
2. A second category could include projects where the probability of success is less certain than proven methods, and *knowledge of restoration practice is still developing*. This may be because practitioner experience remains modest, projects use methods that have been employed in other situations but application to the Great Lakes is novel, or simply projects considered to be of moderate risk and uncertainty. Here, monitoring could focus on a sub-sample of projects, perhaps aiming for a modest sample that is stratified to encompass a range of restoration methods, habitat settings, or by some other variable of interest.
3. A third category would include restoration projects considered to be *highly innovative, requiring new and emerging restoration methods*. These projects would require a greater investment in monitoring and provide greater return in learning and improved future practice.

Designing a comprehensive monitoring plan presents challenges³ and applying such a triage system to restoration monitoring will be difficult. Many ecologists would argue that the ‘gold standard’ employs pre- and post-project monitoring of the restored site and a similar control or reference site that is monitored but does not receive restoration action. In environmental impact analysis, this is known as the “before-after-control-impact,” or BACI, design. It provides the most robust learning and strongest statistical inference.

Charge Question 4 *questions whether monitoring and assessment efforts should be organized project-by-project, by GLRI focus area, or across focus areas. Monitoring efforts should be organized at different scales depending on the assessment effort being undertaken. In order to adequately assess how proven, developing, and emerging restoration methods are working, a project by project scale assessment will be needed. However, in order to adequately assess how the program is improving the ecosystem as a whole, monitoring and assessment at a regional scale will be needed. In order to understand how the program is improving the health of the ecosystem, it may be necessary to monitor and assess across focus areas as appropriate. Monitoring and assessing on these different scales should be driven by what scale (project*

³ The Science and Information Sub-committee could be asked to further consider appropriate levels of monitoring, including timelines for pre and post-monitoring activities and possible use of models as a substitute for direct measurement.

specific, ecosystem, etc.) of results are being evaluated, not in order to project arbitrary parameters around these efforts.

For example, the GLAB believes that adaptive management plans will be critical for establishing sustainable success for phosphorous reduction projects. These plans should describe specific actions to be implemented by various sources included in the plan to achieve significant reductions in phosphorus loading and contribute toward achievement of water quality goals. Among other relevant components, plans specific to phosphorous loading should:

- a. Identify point and nonpoint sources of phosphorus and any other partners assisting in plan implementation
- b. Include a baseline analysis that documents the frequency, amount, and/or concentration, as appropriate, of significant sources of phosphorus loadings in the watershed
- c. Describe specific actions to be implemented by point and nonpoint sources in the plan to achieve significant reductions in phosphorus loading
- d. Incorporate a monitoring plan to assess phosphorus loadings in the receiving water and to document progress
- e. Identify specific metrics for evaluating the anticipated effectiveness of the plan over specific time horizons
- f. Demonstrate that point and nonpoint sources and other partners assisting in plan implementation have the ability to fund and implement the plan
- g. Demonstrate that conservation implementation will be sustainable, verified on a periodic basis, and of sufficient duration to ensure effective achievement of water quality goals.

We suggest that for practical reasons of cost and effort, many and even most monitoring likely will require a lesser degree of effort. A minimal level of monitoring would provide information on a project at its inception, and after some reasonable time has elapsed for system equilibration following restoration.

Charge Question 5 *asks whether self-validation of project monitoring results is acceptable, or whether an independent third party should validate data and results. Self-validation of monitoring results should be acceptable so long as a protocol for collecting and reporting monitoring results is prepared and shared with all agencies, contractors, and grantees.*

Monitoring can be accomplished by a variety of methods, ranging from site inspection to frequent field sampling. The level of monitoring rigor, as with all aspects of this process, should be governed by the information needed to complete the adaptive management cycle. It may be possible to develop guidance for the use of a triage system by retrospectively inspecting a number of GLRI projects to begin to develop a framework for assigning projects to each of the three suggested categories.

In addition, where it is necessary to evaluate projects on a project by project basis, the GLAB recommends establishing consistent criteria that can be used to evaluate projects of different types and across different focus areas. Regardless of the nature of the project, there are some key questions that could be addressed to define success of a project and start communicating impact. For example, the National Science Foundation (NSF), uses *two merit review criteria* to assess proposals and subsequent outcomes of the project. These criteria could be similarly adapted to the context of GLRI and used as a

filter for defining success. Some of the questions that would be responded to within these two criteria could be:

Conservation Merit*–

1. How does the project advance understanding of the issue?
2. To what extent does the project explore an under-researched issue or topic?
3. How does the project make progress toward one of the five focus areas?

Broader Impacts -

1. How does the project affect the immediate community?
2. How does the project communicate its work/progress/findings to others?
3. To what extent does the project involve other partners?
4. What other lessons learned did the project generate? How can those lessons learned be applied to future projects?

In addition to criteria for merit review, certain projects could benefit from the application of a logic model⁴ identifying the focus area (“situation”), input, outputs, and outcomes for short-term, medium term, and long-term.

A *logic model* is a tool used by funders, managers, and evaluators of programs to evaluate the effectiveness of a program. Logic models are usually a graphical depiction of the logical relationships between the resources, activities, outputs and outcomes of a program. While there are many ways in which logic models can be presented, the underlying purpose of constructing a logic model is to assess the "if-then" (causal) relationships between the elements of the program; if the resources are available for a program, then the activities can be implemented, if the activities are implemented successfully then certain outputs and outcomes can be expected. Evaluating a project in this way helps to identify where the project has succeeded and where changes are needed (adaptive management) to reach the original goals of the project and for the health of the ecosystem.

Specifically, the GLAB recommends looking at the *fidelity of implementation* (FOI) from the logic model in order to draw conclusions that would inform adaptive management decisions for projects under the GLRI. Looking at FOI would prompt the following questions:

1. How closely did the project follow the logic model and its intended path of implementation?
2. Did the project meet the short term, medium term, and long term outcomes that it anticipated? If not, why not?
3. Is the project set up to course correct to meet those outcomes?
4. Were there additional unanticipated outcomes that benefit one of the five focus areas?

Charge Question 3 asks how project-scale monitoring results could be aggregated to reveal ecosystem-scale results. We suggest that the information management and delivery system proposed below would tremendously advance the agencies’ ability to aggregate project-scale monitoring results, and would enable such aggregation across a variety of monitoring parameters. Such a system could be used

⁴ Numerous examples exist of logic models used to evaluate the linkage of science to decision-making, including in environmental grants-making. See <http://www.packard.org/what-were-learning/resource/linking-knowledge-with-action-an-approach-to-philanthropic-funding-of-science-for-conservation/> and http://leopoldleadership.stanford.edu/sites/default/files/Jacobs_2001-02_Connecting.Science.Decisionmaking.pdf

to integrate data collected not only by agencies, but also by contractors and grantees.

A critical first step in implementing and using an information management system would be to ensure that data collected by agencies and others, whether GLRI funded or not, is collected in a consistent manner that supports GLRI priorities and broader Great Lakes restoration goals. Whatever monitoring program is developed, monitoring should be relatively consistent across the basin to assure that lessons learned are transferable. The effective use of an information management system for AM will also hinge on the agency's ability to develop consensus based terms of reference for the GLRI as elaborated on in the answer to Charge Question 7 above. In addition, to maximize the impact of a coordinated monitoring program capable of revealing ecosystem-scale results, long term funding is necessary so that the system includes ecosystem condition data needed to effectively incorporate AM into GLRI implementation.

In addition, for reasons of resource efficiency, the use of existing monitoring systems and equipment (where it exists) should be encouraged. For project-level monitoring, agencies, organizations, or institutions that currently operate monitoring programs could be offered an opportunity (a "first right of refusal") to perform monitoring for project-level purposes, with the understanding that the standard monitoring protocol established for the GLRI would dictate this work. We suggest, however, that the consistency, reliability, and efficiency of regional monitoring programs would be enhanced if the agencies were to identify a lead agency to oversee, coordinate, and/or conduct monitoring activities across the entire GLRI program.

Step 5: Identify and implement a system for collecting, managing, integrating, and making available the data and information that informs GLRI decision making.

An information management system is necessary to ensure that all agencies and levels of government, as well as the public, has access to data about GLRI programs and projects and the outcomes achieved through GLRI investments. An information management system also is necessary to identify and fill critical data and information gaps, enable the agencies to strategically allocate resources and future GLRI investments, and otherwise inform decision-making to maximize the effectiveness of the GLRI program.

Certain currently available platforms, such as the Information Management and Delivery System (www.greatlakesinform.org) and the Great Lakes Observing System (www.glos.us), have potential for collecting and managing GLRI data and information, but additional investigation and evaluation are necessary. We recommend that existing information management systems be evaluated to determine their potential value for collecting, managing, and making GLRI project- and region-level data and information accessible to users and the public.

Charge Question 6 *asks whether the implementation of the AM Framework could be sequenced, and if so, what parts could be funded and implemented before others. We suggest that it may be possible to sequence the incorporation of AM into the GLRI program if resources are insufficient for full program implementation. Initial targeting of AM implementation at a subset of the program would be preferable to overburdening the monitoring and AM implementation process. One purpose of the*

master list of consensus priorities recommended in Step 3 is to create a strategy for implementing projects that achieve the agencies' highest GLRI priorities. Limited resources could be applied to incorporating AM into decision making that involves these highest priorities.

The adoption and implementation of an information management system also could be sequenced. Once a system suitable for use in the GLRI context is selected, the agencies may be able to implement the system in stages. The earliest stage could include a pilot project using existing project-level data for projects in one focus area that demonstrates the usefulness of the system. Subsequent stages could include additional projects (whether existing or new) in one or more focus areas as budgets allow. Over time, the system would come to include data and information from many projects that users could aggregate across particular focus areas and “scale up” to inform priority-setting and future project investments. To this end, it will be important for ground-level data to be reported in terms of specific geographical references, so that data and information from individual projects is useful at various (nested) geographical scales.

Ultimately, an appropriate budget and long-term funding for the information management system will be required, keeping in mind that there is little reason to select and support a “Cadillac” information management system if the agencies are constrained to a “Chevette” budget.

CONCLUSION

Progress in achieving Great Lakes protection and restoration can be accelerated if agencies adopt and share streamlined procedures. Cooperation is critical. By cooperating, agencies can implement restoration efforts through the GLRI program that achieve outcomes never realized on a scale as grand as the Great Lakes.

Adaptive management is a good way of ensuring that GLRI programs and initiatives are effective in achieving GLRI priorities over the long term. AM allows GLRI programs and initiatives to be refined to optimize the use of limited GLRI resources. However, inherent in AM is the ability to measure progress periodically, so that the path forward can be modified or refined (“adapted”) in response to data and information collected along the way.

A structured process is necessary for using the data and information developed during GLRI implementation to revise GLRI priorities and identify and implement additional or alternative GLRI projects and initiatives. This structured process completes the AM cycle, ensuring that future project implementation reflects lessons learned, and that future GLRI implementation reflects an improved understanding of restoration priorities.

Strategic, reliably-funded monitoring and information management are critical elements of the AM process. If consistent funding for monitoring and information management is not secured, GLRI investments are likely to be suboptimal over the long term. Likewise, developing AM processes and procedures that are realistically ‘fundable’ within the current context of GLRI funding is critical to the success of this effort.