

SAB Great Lakes Restoration Initiative Action Plan Review Draft Report (August 29, 2011)

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4 XXXX, XX, 2011
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7 EPA-SAB-11-xxx
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9 The Honorable Lisa P. Jackson
10 Administrator
11 U.S. Environmental Protection Agency
12 1200 Pennsylvania Avenue, N.W.
13 Washington, D.C. 20460
14

15 Subject: Great Lakes Restoration Initiative Action Plan Review
16

17 Dear Administrator Jackson:
18

19 The Environmental Protection Agency is the lead agency for the Great Lakes Interagency Task
20 Force. With its federal partners, the EPA developed the *Great Lakes Restoration Initiative Action*
21 *Plan FY 2010 - 2014*. The Action Plan is a comprehensive multi-year plan that identifies goals,
22 objectives, measurable ecological targets, and specific actions for five major focus areas.
23 Restoration efforts, measures of progress, and principal actions have been developed to address
24 toxic substances and areas of concern, invasive species, nearshore health and nonpoint source
25 pollution, habitat restoration and wildlife protection. The Action Plan identifies actions to
26 monitor and evaluate the GLRI's progress and ensure its accountability. It also addresses the
27 need to educate the public, to enhance collaboration among its partners, and to ensure public
28 participation.
29

30 EPA Region 5 requested that the Science Advisory Board review the Action Plan. The SAB
31 formed an ad hoc panel, The Great Lake Restoration Initiative Action Plan Review Panel, to
32 perform this task. The panel met on July 12-13, 2011 and held a follow-up public teleconference
33 on September 16, 2011 to discuss an initial draft report. The chartered SAB conducted a quality
34 review of the Panel's report on [insert date]. Public comments were received and considered
35 throughout the advisory process.
36

37 The SAB acknowledges the EPA's thoughtful effort and leadership that guided the development
38 of the *Great Lakes Restoration Initiative Action Plan FY 2010- 2014*. The SAB supports the
39 premise that there is enough known about the issues confronting the Great Lakes, as well as the
40 underlying causes and potential remedies, to take action, and agrees that the Action Plan
41 identifies the important actions that should be undertaken. The Action Plan is consistent, for the
42 most part, with previous plans and strategies, reflecting a continuation of collaborative planning
43 in the region. This continuity in planning is good, but such consistency does not guarantee
44 sufficiency and the SAB has a number of comments and recommendations to improve future
45 efforts.

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1
2 The SAB recognizes there is an extensive backlog of restoration projects in the Great Lakes
3 region that need to be pursued, and supports the agenda of putting primary emphasis on
4 implementing those projects. The Action Plan recognizes that as these projects are completed, an
5 evaluation and reprioritization of efforts will need to be accomplished, ideally using an adaptive
6 management framework. This evaluation procedure will require that a solid **science plan** be in
7 place to drive the restoration plan, but the SAB notes that such a plan appears to be missing.
8 Creating a science plan will support the current efforts and will identify future directions that can
9 take advantage of, and support, development of new restoration technologies, methods, and
10 approaches.

11 Another important organizational tool that seems to be missing is a **standing science panel**. A
12 well-integrated panel could influence the program's evolution by providing assessments of
13 progress in key areas, by shepherding the design and implementation of monitoring and
14 evaluation efforts and by helping provide a scientific basis for setting priorities across disparate
15 actions. This panel should contain social as well as natural scientific expertise, and the social
16 science represented should go beyond economics. Social scientists can provide many kinds of
17 insights and advice, ranging from assistance in targeting education and outreach efforts to critical
18 insights into the likely workability of particular institutional arrangements.

19
20 The SAB agrees with the agency's goal to develop an accountability system and recognizes that
21 the current Great Lakes Accountability System is a work in progress. The SAB also notes that a
22 great deal of effort will be necessary in order to upgrade the current system from an accounting
23 system to one that provides transparency, tracks project outputs and outcomes and provides a
24 solid basis for programmatic evaluation. In developing such an **accountability system** the SAB
25 urges the agency to develop metrics of progress that are more in line with the under lying science
26 of restoring the Great Lakes rather than the Government Performance Results Act measures that
27 currently comprise the Action Plan.

28
29 The Action Plan continues to build on the considerable history and experience studying and
30 **controlling toxic chemicals** in the Great Lakes. This is a sound approach. However, the agency
31 should carefully consider whether the current focus on priority "legacy" contaminants addresses
32 the totality of the restoration required, or whether the focus should be tailored to account for
33 other contaminants of concern. Additionally, as the agency addresses emerging contaminants, it
34 should rely on the strong science and protocols developed by scientists in the Great Lakes region
35 to identify which contaminants occur at levels of concern and should therefore be priority
36 contaminants for action. The SAB also notes that the goal of delisting five areas of concern by
37 2014 is laudable, but is an extremely aggressive goal given historical rates of de-listing, program
38 logistics and system response times.

39
40 There are a number of laudable long term goals and objectives to eliminate the **introduction of**
41 **invasive species** in the Action Plan. Several parallel activities are under way to address specific
42 invasive species (i.e., Asian carp) and vectors (i.e., ballast water controls) in addition to the
43 recommendations on surveillance programs the agency requested. We find these issues important
44 and timely. We recommend that all these parallel efforts be evaluated together to develop a

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1 comprehensive invasive species program. The SAB endorses developing a basin-wide invasive
2 species surveillance program and strongly recommends that surveillance and rapid response
3 protocols be coordinated to ensure that the various states, provinces, and other participating
4 organizations use the same methodology and protocols to provide meaningful information and
5 effective rapid response.

6
7 The Action Plan's intent to identify, map, and target the highest priority Great Lakes
8 subwatersheds to **protect nearshore health** is the best strategy for producing measurable
9 positive outcomes and provides a unique opportunity to form the basis for a long-term restoration
10 vision. In order to sustain that vision, strategic planning that includes mechanisms for assuring
11 sound science and measurement of progress must be performed. Robust monitoring programs
12 should be continued and developed to measure the status and progress of restoration. Monitoring
13 will also be needed to assess global change impacts on the Great Lakes and to assess how global,
14 regional, and subwatershed factors interact. A balance of effort between restoration projects and
15 monitoring the eventual success (or lack thereof) of these projects is needed.

16
17 **Protecting and restoring habitat and wildlife** will require the development and application of a
18 range of critical management actions and sound decision-making. The SAB agrees that restoring
19 resiliency is an appropriate goal for this focus area. However, the Action Plan does not clearly
20 articulate the concept of resiliency in the context of this plan. In addition, adequate information
21 was not presented to judge whether the actions associated with habitat and wildlife protection
22 and restoration would be effective at attaining enhanced ecosystem resilience in the face of
23 disturbances. A clear, working definition of resiliency should be developed along with metrics
24 that can be used to track changes in the resiliency over time as restoration measures are
25 implemented.

26
27 The SAB agrees that **accountability, education, monitoring, evaluation, communication, and**
28 **partnerships** are important to the success of the GLRI, but concludes that the monitoring and
29 other elements in this focus area may be better addressed in the specific focus areas rather than
30 as a combined focus area and notes that a strategic management plan to implement synthesis and
31 integration across the focus areas should developed to bolster the accountability goals of the
32 GLRI. There is also a need to enforce the incorporation of educational and outreach activities as
33 an overarching theme for all projects in the GLRI. Outreach and education activities provide
34 highly laudable goals, but overall the Action Plan lacks a strategic approach to achieve the stated
35 objectives. The SAB recommends that the EPA and its partners consider explicit peer review
36 criteria, in parallel with the peer-review process of the National Science Foundation, for all
37 activities (internally and externally funded) that include education and outreach. The criteria
38 should advance the knowledge and understanding of Great Lakes issues, promote teaching,
39 increase participation of underrepresented groups, and broadly disseminate information to
40 enhance the scientific and technological understanding of the public.

41
42 In closing, the SAB encourages EPA to continue efforts under the GLRI and collaborate with its
43 interagency partners to develop the best available science to support remediation and restoration
44 efforts and develop a sustainable program. We appreciate the opportunity to provide advice on
45 this important effort and look forward to your response.

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Sincerely,

Chair
Science Advisory Board

Chair
SAB Panel on the Great Lakes Restoration
Initiative Action Plan Review

Enclosure

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This report has been written as part of the activities of the EPA Science Advisory Board (SAB), a public advisory group providing extramural scientific information and advice to the Administrator and other officials of the Environmental Protection Agency. The SAB is structured to provide balanced, expert assessment of scientific matters related to problems facing the agency. This report has not been reviewed for approval by the agency and, hence, the contents of this report do not necessarily represent the views and policies of the Environmental Protection Agency, nor of other agencies in the Executive Branch of the Federal government, nor does mention of trade names of commercial products constitute a recommendation for use. Reports of the SAB are posted on the EPA Web site at <http://www.epa.gov/sab>.

1
2 **U.S. Environmental Protection Agency**
3 **Science Advisory Board Great Lakes Restoration Initiative Action Plan Panel**
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5
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Table of Contents

1

2 **1. EXECUTIVE SUMMARY.....1**

3 **2. INTRODUCTION.....7**

4 2.1. BACKGROUND7

5 2.2. CHARGE TO THE PANEL.....8

6 **3. RESPONSE TO CHARGE QUESTIONS9**

7 3.1. CHARGE QUESTIONS ON THE OVERALL STRUCTURE OF THE GLRI ACTION PLAN9

8 *The Consistency of the Action Plan with other Great Lakes collaborative plans and science9*

9 *Recommendations on tracking GLRI projects and accountability.....11*

10 *Recommendations on how to improve or clarify the Action Plan.....12*

11 3.2. CHARGE QUESTIONS ON TOXIC SUBSTANCES AND AREAS OF CONCERN.....13

12 3.3. CHARGE QUESTIONS ON INVASIVE SPECIES17

13 3.4. CHARGE QUESTION ON NEARSHORE HEALTH AND NONPOINT SOURCES22

14 3.5. CHARGE QUESTIONS ON HABITAT AND WILDLIFE PROTECTION AND RESTORATION26

15 3.6. CHARGE QUESTIONS ON ACCOUNTABILITY, EDUCATION, MONITORING, EVALUATION, COMMUNICATION,

16 AND PARTNERSHIPS.....32

17 **REFERENCES R-1**

18 **APPENDIX A: CHARGE TO THE SAB A-1**

19

1. EXECUTIVE SUMMARY

In 2010, President Obama announced and Congress appropriated \$475 million in new funding for the Great Lakes Restoration Initiative (GLRI) to “protect and restore the chemical, biological, and physical integrity of the Great Lakes.” To guide the efforts of the GLRI, EPA and its Federal partners, through the Great Lakes Interagency Task Force (IATF)¹ developed a comprehensive multi-year Action Plan that identifies goals, objectives, measurable ecological targets, and specific actions for five major focus areas.

The *Great Lakes Restoration Initiative Action Plan FY 2010 - 2014*, hereafter referred to as the Action Plan, describes the measures of progress and principal actions to address toxic substances and areas of concern, invasive species, nearshore health and nonpoint source pollution, habitat and wildlife protection and restoration. The Action Plan also provides a fifth focus area to address the GLRI’s effort to improve accountability, education, monitoring, evaluation, communication and partnerships.

In response to the Department of the Interior, Environment, and Related Agencies Appropriations Act of 2010, EPA as the lead agency for the GLRI requested that the SAB review the Action Plan. The SAB formed an ad hoc panel, The Great Lake Restoration Initiative Action Plan Review Panel, to perform this task. The panel met on July 12-13, 2011 to hear EPA technical presentations, public comment, and discuss responses to the Charge to the SAB (Appendix A). The panel met on a follow-up public teleconference on September 16, 2011 to discuss an initial draft report. The chartered SAB conducted a quality review of the Panel’s report on [Insert date]. Public comments were received and considered throughout the advisory process.

The Panel supports the basic premise that there is enough known about the issues confronting the Great Lakes, as well as the underlying causes and potential remedies, to implement remedial activities, and agrees that the Action Plan identifies the important actions that should be undertaken. The Plan’s actions are consistent, for the most part, with previous plans and strategies, and reflect a continuation of collaborative planning in the region. This continuity in planning is good, but such consistency does not guarantee sufficiency. The Panel provides recommendations for improvement in a number of areas.

The Panel recognizes there is an extensive backlog of restoration projects in the Great Lakes region that need to be pursued, and supports the agenda of putting primary emphasis on implementing those projects. The Action Plan recognizes that as these projects are completed, evaluation and reprioritization of efforts will need to be accomplished, ideally using an adaptive management framework. In order to achieve success, the Panel notes that a solid science plan is

¹The Great Lakes Interagency Task Force (IATF) brings together eleven U.S. cabinet and Federal agency heads to coordinate restoration of the Great Lakes. Created by Executive Order from President Bush on May 18, 2004, the IATF is to focus on environmental outcomes like cleaner water and sustainable fisheries, and target measurable results. The IATF helps coordinate GLRI implementation.
<http://www.epa.gov/greatlakes/iatf/index.html>

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1 necessary to drive the restoration plan, and that such a plan is missing. Creating a science plan
2 would not only support the current efforts, but also lay out future directions that can support and
3 take advantage of development of new restoration technologies, methods, and approaches.
4

5 When developing and implementing a program as large, expansive, and hopefully sustained as
6 the GLRI will be, scientific investment in increasing the understanding of critical ecological
7 functions and pathways is needed to ensure effective restoration, to improve restoration methods,
8 and to monitor, track, and evaluate progress. The Panel is concerned that the Action Plan is not
9 placing enough emphasis on the area of evaluation and adaptive management. Indeed,
10 evaluations of programs and projects, and their success, should be considered as “actions” in this
11 Plan, and not be seen as activities that impede the overall ability to undertake additional
12 restorative activities.
13

14 The Panel agrees with the agency’s goal to develop an accountability system and recognizes the
15 current Great Lakes Accountability System (GLAS) is a work in progress. However, much work
16 will need to be done to upgrade the current system from an accounting system to one that
17 provides transparency and is able to track project outputs and outcomes and provide a solid basis
18 for programmatic evaluation. In addition, the Panel notes that the ability to integrate outcomes
19 across hundreds of projects, essential for evaluation at the theme (e.g., Toxics Substances), or at
20 the overall GLRI program level, is missing. GLAS may not be an appropriate vehicle for this
21 type of integration, as it appears designed to function at the project level, and the diversity and
22 granularity of those projects would make integration within GLAS difficult. An effective
23 integrative assessment will require additional effort, perhaps building from GLAS inputs.
24 Therefore, the Panel recommends a new, focused, and perhaps independent scientific evaluation
25 process.
26

27 While the Action Plan is consistent with previous efforts in the Great Lakes region, there appears
28 to be a serious disconnect in that very few of the research, monitoring, and integrative
29 assessment needs identified in the earlier documents (e.g., the State of the Great Lakes
30 Conferences, or SOLEC; www.epa.gov/solec/) are carried through to the Action Plan. Comments
31 on the adequacy of the identified endpoints and measures are addressed in each section, but
32 overall the measures often appear naïve or narrow, and without proper context or benchmarking.
33 Measures should be cognizant of historical context and variability; metrics to identify change or
34 progress toward restoration should be developed such that they can be detected statistically.
35 Otherwise, it is not clear if, or when, a metric is met. This requires an understanding and explicit
36 documentation of both historical baselines and their variability, and the universe within which
37 the metric is couched.
38

39 The current plan suggests that restoration and protection can be accomplished through natural
40 science and engineering processes alone. This is rarely the case in environmental decision-
41 making. Significant roadblocks to action can come from social, economic, political, and other
42 human dimensions. Investments in social science analysis of the science-policy interfaces in the
43 region, while relatively small compared to other natural science and engineering efforts, can
44 provide important information, help to avoid implementation pitfalls and overcome impediments
45 to action. Therefore, the social sciences should be included in the science plan.

1
2 One important organizational tool that seems to be missing is a standing science panel. A well-
3 integrated panel could influence the program's evolution by providing assessments of progress in
4 key areas, by shepherding the design and implementation of monitoring and evaluation efforts,
5 and by helping provide a scientific basis for setting priorities across disparate actions. Members
6 should be independent experts drawn from universities and other research institutions, the private
7 sector, and government agencies, but selected for their expertise and not to represent their
8 agencies. Such a panel could make substantial contributions to the development of both robust
9 monitoring efforts and the adaptive management plan that would be a logical outgrowth of well-
10 designed monitoring. The panel should have social as well as natural scientific expertise, and the
11 social science represented should go beyond economics. Social scientists can provide many
12 kinds of insights and advice, ranging from assistance in targeting education and outreach efforts
13 to critical insights into the likely workability of particular institutional arrangements.
14

15 **Toxic Substances and Areas of Concern**

16
17 The Action Plan builds on the considerable history and experience studying and controlling toxic
18 chemicals in the Great Lakes, and the Action Plan is clearly directed towards continuing this
19 effort. This is a sound approach.
20

21 A major strategy for addressing so-called "legacy" contaminants is the accelerated clean-up of
22 areas of concern (AOCs). Contaminated sediments are often a continuing chronic source of
23 persistent chemicals to Great Lakes biota; therefore, a strategy based on cleaning up contaminant
24 "hot spots" has a high probability of reducing pollutant levels and effects to biota on a regional
25 basis and may have similar success on a basin wide basis. However, as noted in the GLRI, there
26 are a number of other possible impacts from a wide range of chemical contaminants, and the
27 Panel cautions the agency to favor an approach that balances the need to remediate known
28 problems (e.g., PCBs in sediments) while systematically addressing previously under studied
29 "legacy" contaminants. The Panel notes that the goal of delisting five AOCs by 2014 is laudable
30 but extremely aggressive given historical rates of de-listing, program logistics and system
31 response times.
32

33 Performance management of the AOC restoration program is critical, and needs to go beyond
34 program tracking to include scientifically-defensible metrics of success. These evaluation
35 mechanisms are missing from the Action Plan. The Panel notes that while such efforts will
36 require resources that might otherwise go to additional site clean-up actions, and that these
37 resources may be required for many years after the clean-up operations are completed, assessing
38 success, partial success or failure of these AOC clean-up programs is essential to improving the
39 overall Great Lakes restoration.
40

41 The Action Plan briefly covers emerging contaminants in a principal action and an action that
42 links measuring progress of AOC clean-ups and assessing new toxic threats. The choice of which
43 emerging contaminants to focus must be led by their potential to affect aquatic species and
44 human health at the levels found or anticipated in the Great Lakes. The Panel notes that the Great
45 Lakes science community has made significant progress using the Muir and Howard analysis to

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1 prioritize emerging contaminants. The approach recently developed by the USEPA Midwest
2 Ecological Research Laboratory for personal care products and pharmaceuticals (Brooks and
3 Ankley 2006?) is an example of such a framework. Recommendations made by the International
4 Joint Commission Work Group on Chemicals of Emerging Concern (2009?) should be
5 incorporated into the GLRI Action Plan. More details about how this work is influencing basin-
6 wide monitoring and risk assessment programs are needed in the Action Plan.

7 8 **Invasive Species**

9
10 This section of the Action Plan sets out a number of laudable long term goals and objectives. On
11 the other hand, relatively few specific details are provided to explain what *exactly* will be done
12 regarding surveillance, and especially about the technologies to contain and/or control invasive
13 species. While the charge to reviewers notes that there are parallel actions under way to address
14 specific invasive species (i.e., Asian carp) and vectors (i.e., ballast water controls) and that the
15 Action Plan focuses on other methods to control invasive species, the Panel finds these parallel
16 issues important and timely. Therefore, the Panel cites some examples developed under these
17 efforts that may be important to consider in developing an early detection surveillance program.

18
19 One of the Action Plan's objectives is to develop methodology and protocols for a basin-wide
20 invasive species surveillance program. The Panel agrees with this action and strongly
21 recommends that surveillance and rapid response protocols be coordinated to ensure that the
22 various states, provinces, and other participating organizations use the same methodology and
23 protocols to provide meaningful information exchange and effective rapid response. However,
24 the Action Plan did not provide information about prevention and control technologies for
25 invasive species that are under consideration by the agency; in addition, the charge requested the
26 Panel provide technologies that could be applied to invasive species in the Great Lakes. This is a
27 difficult task given the paucity of information provided. The Panel discussed technologies and
28 provides some general guidance and bibliographic citations and encourages the agency's
29 consideration. The Panel strongly recommends the agency develop criteria to evaluate these and
30 additional studies to develop preventative and control technologies. The panel also recommends
31 that the agency assess known and probable invasive species and prioritize which species present
32 the greatest threats to the Great Lakes.

33 34 **Nearshore Health and Nonpoint Sources**

35
36 While the Action Plan is a five-year plan, it provides a unique opportunity to form the basis for a
37 long-term restoration vision that could guide subsequent renewals of the Action Plan. In order to
38 sustain that long-term vision, strategic planning that includes mechanisms for assuring sound
39 science and measurement of progress must be performed in order to meet the goal to restore
40 nearshore health and reduce impacts from nonpoint source pollution.

41
42 As identified in the objectives for this focus area, monitoring programs apparently will be a
43 strong part of this part of the Action Plan as restoration progress can best be measured by status
44 and trend analysis. The adaptive management approach proposed by the Action Plan also
45 requires adequate and timely monitoring. Monitoring will also be needed to assess global change

1 impacts on the Great Lakes and how global, regional, and subwatershed factors interact. A
2 balance of effort between restoration projects and monitoring of these projects is needed.

3
4 How future development and climate change will affect the Action Plan targets needs to be
5 considered in more detail. From the establishment of Detroit in early 1700's to the present
6 human development has been the major driving force in altering the Great Lake ecosystems.
7 Global climate change needs to be added as a major driving force. The Action Plan does not
8 address this in an integrated fashion, and further detail acknowledging this important new factor
9 and how restoration may be affected is needed.

10
11 The Action Plan's intent to identify, map, and target the Great Lakes subwatersheds that show
12 severe signs of stress for focused restoration activities is the best strategy for producing
13 measurable positive outcomes. Overall, severely stressed systems usually respond positively and
14 measurably to stressor relief. This is particularly true for stresses associated with excess nutrient
15 loadings. While the focus on stressed watersheds and subwatersheds is good, the Panel notes that
16 the selection process needs to be more understandable and transparent.

17 **Habitat and Wildlife Protection and Restoration**

18
19
20 Achieving the five goals of this focus area will require the development and application of a
21 range of critical management actions and sound decision-making. The Panel finds that restoring
22 resiliency is an appropriate goal for this focus area; however, the Action Plan does not clearly
23 articulate the concept of resiliency in the context of this Plan. In addition, adequate information
24 was not presented to judge whether the actions associated with Habitat and Wildlife Protection
25 and Restoration would be effective at attaining enhanced ecosystem resilience in the face of
26 disturbances. A clear, working definition of resiliency should be developed along with metrics
27 that can be used to track changes in the resiliency over time as restoration measures are
28 implemented.

29
30 The Panel was asked to identify additional ecological elements and measures to improve
31 resiliency that the agency should consider as it evaluates the progress of the Action Plan and
32 plans next steps. The Panel notes that there are certain ecosystem characteristics that have been
33 shown to contribute to ecosystem capacity to resist state changes in the face of disturbances. This
34 capacity is frequently what is meant by resilience. Restoration actions that enhance these
35 ecosystem characteristics, therefore, should contribute to resilience. The Panel urges the agency
36 to consider the recommendations presented in this section of the Advisory Report and
37 incorporate them as appropriate.

38 **Accountability, Education, Monitoring, Evaluation, Communication, and Partnerships**

39
40
41 The topics addressed under this diverse and disparate focus area are important to the success of
42 the GLRI. The Panel concludes that the monitoring and other elements of this focus area may be
43 better addressed in the specific focus areas noted above, rather than as a combined focus area.
44 The Panel also notes that, instead, a strategic management plan to implement synthesis and
45 integration across the focus areas should be included in the Action Plan as this focus area, in

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1 order to bolster the accountability goals of the GLRI. The Panel further provides
2 recommendations to achieve greater accountability, considerations to increase collaboration
3 among partners, and to enhance educational and outreach opportunities.
4

5 The Panel notes that combining the accountability, monitoring and evaluation actions together
6 into a single section may come at the cost of them being developed separately from the focus
7 area or in a cursory manner. The Action Plan addresses a wide variety of management activities
8 and seeks to coordinate them through an adaptive management process. Without an explicit
9 representation of the management layer, however, the GLRI faces substantial challenges
10 implementing performance evaluation based on principles of adaptive management. Monitoring
11 and evaluation in this focus area should provide for the analyses of focus area integration and
12 synthesis of actions to achieve overarching goals and the accountability of the GLRI as a whole.
13 These analyses should also address uncertainties or data gaps. Additionally, measures of progress
14 need to identify benchmarks for expected outputs and outcomes. The GLRI should consider
15 using an overall geographic information system (GIS) framework to evaluate the integration,
16 synthesis, and coordination of all program elements across all the focus areas. This type of
17 analysis can be used to identify 'hotspots', areas of improvement, or highlight the success or
18 failure of best management practices (BMP), both in terms of location or scale.
19

20 The Action Plan lists the federal department level members of the Interagency Task Force and
21 Regional Working Group that developed the Action Plan. It also alludes to approximately 200
22 organizations at the federal, state and sovereign tribal nation levels. While it is clear that a great
23 many stakeholder organizations are involved in the program, it is not apparent which are the key
24 parties, or what their interests and their roles are within the Action Plan. A functional approach
25 to explicit partnerships needs to be described, what they are (e.g., science or outreach), and
26 where they fit within the other focus areas is needed.
27

28 The Panel agrees that there is a need to enforce the incorporation of educational and outreach
29 activities as an overarching theme on all projects. Outreach and education activities provide
30 highly laudable goals, but overall there is a lack of a strategic approach in the Action Plan to
31 achieve the stated objectives. Measures of progress were ambiguous and will be difficult to track.
32 Currently, there are no specific indications in the Action Plan of the amount or type of resources
33 allocated to these aspects of the program. The Panel recommends that EPA and its partners
34 should consider explicit peer review criteria, in parallel with the peer-review process of the NSF,
35 for all activities (internally and externally funded) that include education and outreach with
36 significant weighting as it implements projects under the GLRI. The criteria should advance the
37 knowledge and understanding of Great Lakes issues, promote teaching, increase participation of
38 underrepresented groups, and broadly disseminate information to enhance scientific and
39 technological understanding of the public.
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2. INTRODUCTION

2.1. Background

In 2010, President Obama announced and Congress appropriated \$475 million in new funding for the Great Lakes Restoration Initiative (GLRI) to “protect and restore the chemical, biological, and physical integrity of the Great Lakes.” To guide the efforts of the GLRI, EPA and its Federal partners, through the Great Lakes Interagency Task Force (IATF) developed a comprehensive multi-year Action Plan that describes how the Initiative will be executed from 2010 through 2014. The GLRI Action Plan identifies goals, objectives, measurable ecological targets, and specific actions for five major focus areas:

- Toxic Substances and Areas of Concern – focus on pollution prevention and cleanup of the AOCs and BUIs in the Great Lakes;
- Invasive Species – develop and implement measures to control invasive species to maintain the health of the Great Lakes ecosystem;
- Nearshore Health and Nonpoint Source Pollution – identify priority watersheds for reduction in polluted runoff from urban, suburban and, agricultural sources;
- Habitat and Wildlife Protection and Restoration – provide an assessment of Great Lakes coastal wetlands and strategically target restoration and protection efforts for wetlands and other habitat restoration; and
- Accountability, Education, Monitoring, Evaluation, Communication and Partnerships - implement goal- and results-based accountability measures, learning initiatives, outreach and strategic collaborative partnerships.

In the 2010 Department of the Interior, Environment, and Related Agencies Appropriations Act, Congress specified that “conferees expect [EPA] to establish a process that engages an independent, scientific panel to review the scientific credibility of the Action Plan to optimize the likelihood of successful restoration at appropriate scales.” In order to meet this requirement, the EPA Great Lakes National Program Office has requested that the SAB review the *Great Lakes Restoration Initiative Action Plan FY 2010- 2014*, hereafter referred to as the “Action Plan.”

The SAB formed an ad hoc panel, The Great Lake Restoration Initiative Action Plan Review Panel, to perform this task. The panel met on July 12-13, 2011 to hear EPA technical presentations, public comment, and to discuss responses to the Charge to the SAB (Appendix A). The panel met on a follow-up public teleconference on September 16, 2011 to discuss an initial draft report. The chartered SAB conducted a quality review of the Panel’s report on [Insert date]. Public comments were received and considered throughout the advisory process.

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1 **2.2. Charge to the Panel**

2
3 The Charge to the SAB included three overarching questions on the framework of the Action
4 Plan, specific questions on each of the five focus areas, and requested recommendations to
5 further develop the action plan and collaborations to meet GLRI goals as progress was made on
6 focus area projects. The full charge is included as Appendix A. Relevant charge questions are
7 included at the beginning of each section of the Panel's report.

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3. Response to Charge Questions

3.1. Charge Questions on the overall structure of the GLRI Action Plan

4 Charge questions 1, 2, and 3 address overarching issues and request that the Panel comment on
5 the overall scope of the Action Plan. The Panel provides comments and recommendations on 1),
6 the consistency of Action Plan with previous plans and their science, 2), how to identify methods
7 to enhance the accountability of the program, and 3), recommend actions the agency could take
8 to improve and clarify the GLRI and the Action plan as it implements further actions. The
9 specific questions and Panel responses are detailed below.

10

11 **The Consistency of the Action Plan with other Great Lakes collaborative plans and science**

12

13 *Question 1 - As presented in the scientific background document, the goals, objectives,*
14 *measures, and actions of the Action Plan are based on the best available scientific analysis of*
15 *environmental challenges and are consistent with the multitude of strategic plans and governing*
16 *structures for the Great Lakes. Since the Action Plan is an “action driver”, we are most*
17 *interested in the SAB’s recommendations on the identified principal actions to achieve progress.*

18

19 *Question 1a: Are the principal actions proposed in the Action Plan consistent with the actions*
20 *and/or recommendations of the previous collaborative plans and strategies for the Great Lakes*
21 *(e.g. Great Lakes Regional Collaboration Strategy) as identified in scientific background*
22 *document and other information of which you are aware?*

23

24 The Panel supports the conclusion that there is enough known about the issues confronting the
25 Great Lakes, as well as the underlying causes and potential remedies, to take action, and agrees
26 that the Action Plan identifies the important actions that should be undertaken. The Action Plan’s
27 actions are consistent with previous plans and strategies, reflecting a continuation of
28 collaborative planning in the region. While continuity in planning is good, the Panel also finds
29 that such consistency does not guarantee sufficiency and in some cases it might even reflect a
30 lack of innovation. Innovation comes from strong connections between research and action, and
31 that connection does not appear strongly throughout the Action Plan. In addition, while the
32 Action Plan’s actions are consistent with the previous efforts, there is a serious disconnect in that
33 very few of the research, monitoring, and integrative assessment needs identified in the earlier
34 documents (e.g., SOLEC 2009) are carried through to the Action Plan. These gaps are addressed
35 in more detail in the following sections.

36 The Panel also concludes that the relationship between the Action Plan and lake-specific goals
37 developed through the EPA-facilitated Lake Management Plan (LaMP) processes or the Great
38 Lakes Fishery Commission-facilitated Lake Technical Committee processes is unclear. Specific
39 water-quality and fishery goals are established through these processes that engage the full range
40 of appropriate stakeholders (i.e., scientific community, policy makers, and members of the

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1 public). It is important that the Action Plan support achieving those goals, but it is not clear that
2 it does, or how it will do so, based on the material provided to the Panel.

3
4 *Question 1b: Are there other actions that we should consider for inclusion in the Action Plan*
5 *that will better achieve the goals of the Action Plan?*

6
7 The Panel finds that for a program as large, expansive, and hopefully sustained as the GLRI will
8 be, scientific investment in increasing the understanding of critical ecological functions and
9 pathways is needed to ensure effective restoration, improve restoration methods and monitor,
10 track and evaluate progress of the GLRI. Scientific evaluations should be considered as “actions”
11 in this Action Plan, but they are currently missing. Such efforts should be considered integral to
12 the Action Plan, rather than being viewed as competing with other actions. While some
13 monitoring appears to exist at project levels (see responses to the specific focus areas), the
14 structure, process, and funding for integrated program outcome evaluation appears to be lacking.
15 While science is only one basis for taking particular action (e.g., others can include availability
16 of matching funds, state and local priorities, and partner development), evaluation of
17 effectiveness of the outcomes is a scientific process and needs to be included within the Action
18 Plan.

19 As identified in the objectives for several focus areas, monitoring programs will apparently be a
20 strong part of the Action Plan as restoration progress can best be measured by status and trend
21 analysis, which require a stream of data through time. The adaptive management approach
22 proposed by the Action Plan also requires adequate and timely monitoring. Monitoring will also
23 be needed to assess global change impacts on the Great Lakes and how global, regional and
24 subwatershed factors interact. A balance of effort between restoration projects and monitoring of
25 these projects is needed.

26
27 In its current form, it is not possible to determine that the Action Plan and Scientific Background
28 documents are based on best available science or that it is consistent with other strategic plans.
29 We understand that these documents are intended for a broad audience of stakeholders,
30 scientists, and public, and that it is not necessary to add a lot of detail on the science supporting
31 the Action Plan. However, more detail needs to be included that explains key concepts and the
32 basis for the actions. This includes detail on how the Action Plan elements and actions are
33 connected. More linkage to technical documents and publications used to formulate the Action
34 Plan also needs to be included. This would make the Action Plan a better summary of the overall
35 GLRI with a bibliography that will point to studies for those interested in follow up on details.
36 Examples of the kind of detail needed in the Action Plan would be a complete listing of all
37 geographically targeted areas with a figure showing locations, and what is meant by severe
38 stress. A clear articulation of the definition of severe stress is central to the action plan. For
39 example, a short case study or sidebar explaining what went into the selection of the Maumee
40 River would be very informative to readers of the Action Plan.

1

2 **Recommendations on tracking GLRI projects and accountability**

3

4 *Question 2 – As presented in the scientific background document, we have developed and*
5 *currently operate the Great Lakes Accountability System (GLAS)² as the primary mechanism for*
6 *collecting information to monitor and report on GLRI progress. GLAS is still a work-in-progress*
7 *at this time and it is not ready for external review. However, given the scope of the Action Plan*
8 *and the nature and types of projects funded under the GLRI, we are interested in the SAB’s*
9 *recommendations on how best to track the progress and accountability for a large ecosystem*
10 *restoration program. What critical environmental elements, endpoints, or other measures would*
11 *you include to those identified in the Action Plan?*

12

13 The Panel recognizes GLAS is a work in progress, but notes that the current system appears to be
14 primarily an accounting - as opposed to accountability – system; one that tracks where the
15 funding is going and who will be responsible for those projects. This is important information
16 and tracking it is needed. However, it should be noted that less than half the agencies have
17 entered information and, for some, there appears to be a lack of transparency on where funds
18 ultimately end up. There is a potential for also tracking project outputs and potentially outcomes
19 in this transparent system, and if pursued carefully it could provide a solid basis for evaluation.

20 However, the ability to integrate outcomes across hundreds of projects, essential for evaluation at
21 the theme (e.g., toxics) level, and for evaluation of the overall GLRI program, is missing. GLAS
22 is probably not an appropriate vehicle for this type of integration, as it appears designed to
23 function at the project level, and the diversity and granularity of those projects would make
24 integration within GLAS difficult. An effective integrative assessment will require additional
25 effort, perhaps building from GLAS inputs. The Panel recommends a new, focused, and perhaps
26 independent scientific evaluation process. This recommendation is discussed further in specific
27 focus areas, below.

28 Comments on the adequacy of the identified endpoints and measures will be addressed in the
29 response to charge questions for the focus areas, but overall the measures often appear naïve or
30 narrow, and without proper context or benchmarking. Measures should be cognizant of historical
31 context and variability; metrics to identify change or progress toward restoration should be
32 developed such that they can be detected statistically. Otherwise it is not clear if or when the
33 metric is met. This requires an understanding and explicit documentation of both historical
34 baselines, the variability in the metric, and the universe within which the metric is couched.

35 Most metrics identified in the Action Plan measure outputs as opposed to outcomes. These
36 distinctions are important for reporting under the Government Performance and Results Act, and
37 the agencies have an opportunity with the Action Plan for the GLRI to make progress in outcome
38 evaluation and reporting. The agencies should consider continuing to report the more typical
39 project-level outputs, but also outline for OMB an innovative program for evaluating and
40 reporting outcomes integrated across projects at the theme (e.g., nearshore) and program level.

² Available online at <http://glri.us/projects.html>

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1 By investing a modest portion of the overall budget on an innovative, science-based, integrated
2 outcome evaluation program, there is the potential for GLRI to not only move toward its
3 restoration goals, but provide restoration efforts in general a new path toward evaluation and
4 reporting at more meaningful levels. **[NOTE to Authors: The Puget Sound Partnership June
5 2011 Summary was discussed as a source of examples to support this recommendation. No
6 text was provided. Does the panel want to insert an example or cite this summary?]**

7 **Recommendations on how to improve or clarify the Action Plan**

8

9 *Question 3 – Please comment on the overall scope and framework of the Action Plan and its*
10 *ability to organize environmental issues in a way that directs restoration actions. Does the SAB*
11 *have any specific recommendations on how to improve or clarify the Action Plan?*
12

13 The Panel discussions on the overall scope and framework noted that the Action Plan addresses
14 many of the important actions that should be taken. However, the Panel identified several key
15 actions that will assist the agency in sustaining the GLRI to create opportunities for innovation,
16 improve future action plans to overcome impediments, implement an adaptive management
17 approach through focus area integration and increase the transparency of actions addressing the
18 complexity of the Great Lakes region.
19

20

21 *An Opportunity for Innovation -* The Panel recognizes there is an extensive backlog of
22 restoration projects in the Great Lakes region that need to be pursued, and supports the agenda of
23 putting primary emphasis on implementing those projects. However, the level of sustained
24 funding that is in place and anticipated provides the agencies with an opportunity to be
25 revolutionary, as opposed to evolutionary, in its implementation. This level of funding should not
26 only satisfy the myriad long-standing needs, but also provide a new model for how large-scale
27 restoration can be effected – an opportunity for innovation. This argues for a solid science plan
28 behind the Action Plan, and the Panel concludes that such a plan appears to be missing. Creating
29 a science plan would not only support the current efforts, but would also lay out future directions
30 that can take advantage of, and support, development of new restoration technologies, methods,
31 and approaches.

32 *Understanding and Overcoming Impediments –* The current plan suggests that restoration and
33 protection can be accomplished through natural science and engineering processes alone. This is
34 rarely the case in environmental decision making. Significant roadblocks to action can come
35 from social, economic, political, and other human dimensions. Investments in social science
36 analysis of the science-policy interfaces in the region, while relatively small compared to other
37 natural science and engineering efforts, can provide important information on avoiding
38 implementation pitfalls and overcoming impediments to action. Therefore, the social sciences
39 should be included in the science plan.

40 *A Need for Integration -* Creating a science plan may also help re-organize the overall Action
41 Plan because, at this point, there does not seem to be an overall goal or strategy. Rather, the
42 Action Plan addresses a series of critical stresses (e.g., toxics, etc.) with little overt recognition of
43 the potential for synergistic or antagonistic actions among the silos potentially created by the
44 focus areas. It may make sense to reshape the Action Plan such that “habitat restoration”

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1 becomes an overarching goal and strategy, and each of the remaining focus areas are redesigned
2 to support habitat restoration. This would be more consistent with the ecosystem management
3 paradigm discussed often in Great Lakes management circles and cited in the Great Lakes Water
4 Quality Agreement, and would allow for integration across focus area goals and objectives (an
5 effort now absent from the Action Plan). To accomplish this requires a specific Synthesis and
6 Integration focus area, and this is discussed in more detail under Focus Area 5.

7 *The “Great Lakes” is not an ecosystem* – The Action Plan is focused around stress issues (e.g.,
8 toxics) and most of the language suggests the Great Lakes can be viewed as a single ecosystem.
9 This is like considering the Everglades, Chesapeake Bay, Puget Sound, and Georges Bank as one
10 ecosystem. Each Lake has unique characteristics, stresses, and likely restoration goals, and it
11 would be more effective, especially in terms of measuring and reporting progress, if the goals
12 and objectives were lake-focused. There already is a basis for this approach. Each Lake has a
13 Lake-wide Management Plan (LaMP) or the equivalent (Lake Huron is treated differently),
14 facilitated by EPA and engaging stakeholders at several levels of government, that focused on
15 water quality, with recent movement toward broader ecosystem goals. Each Lake also has a set
16 of fisheries goals, established by Technical Committees facilitated by the international Great
17 Lakes Fishery Commission and engaging all appropriate stakeholders. Recent efforts have
18 moved toward habitat and broader ecosystem contexts.

19 The GLRI is a new opportunity to both work toward satisfying the goals and objectives of the
20 LaMPs and Technical committees and facilitate their integration. To move in this direction, the
21 Action Plan needs to recognize the current Great Lakes management structures and be more
22 explicit in how the GLRI integrates, as opposed to duplicates, their efforts.

23

24 **3.2. Charge Questions on Toxic Substances and Areas of Concern**

25 Focus Area 1 of the Action Plan addresses toxic substances, with emphasis on continuing or
26 enhancing long-term declines in ‘legacy’ pollutants (Question 4) and on managing ‘emerging
27 contaminants’ (Question 5). The Action Plan builds on the considerable history and experience
28 studying and controlling toxic chemicals in the Great Lakes, and the Action Plan is clearly
29 directed towards continuing this effort. This is a sound approach. However, as discussed above,
30 the Panel finds that both the overall GLRI and the toxic substances focus area would benefit
31 greatly from a strategic science plan that prioritize actions and assists in choosing remediation
32 sites. Actions linked to the goals and objectives within the strategic planning for the toxics focus
33 area should be based on a risk characterization that reflects current and anticipated future
34 conditions in the Great Lakes.

35

36 *Question 4* – *The presence, significance, and trends of many historically-regulated (or “legacy”)*
37 *contaminants in the Great Lakes are well-documented. Through the Action Plan, we are working*
38 *to fully implement and enhance existing programs to eliminate releases of many of these*
39 *contaminants. For example, the GLRI is working to accelerate the rate of sediment remediation*

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1 *in Areas of Concern (AOCs) through the Great Lakes Legacy Act³ among other programs.*
2 *Similarly, the Action Plan calls for initiating strategic pollution prevention and toxics reduction*
3 *efforts to minimize releases and emissions of many of these same contaminants.*
4

5 *Question 4a: Please comment on the Action Plan's approach for addressing so-called "legacy"*
6 *contaminants through sediment remediation and toxics reduction efforts.*
7

8 The Action Plan's stated goal of delisting five AOCs by 2014 is laudable but extremely
9 aggressive given historical rates of de-listing, program logistics and system response times. This
10 'measure of progress' in the Action Plan should be clarified—is the goal to delist five AOCs by
11 2014 or is it to complete the management actions thought necessary to lead to a delisting? Both
12 are stated in the Action Plan. Some quantitative analysis should be included on the implications
13 for other GLRI toxics measures of progress if the goal of de-listing five AOCs is not met by
14 2014. Stated another way, what is the incremental benefit to the Great Lakes derived from each
15 successive AOC delisting, and what extent of AOC clean-up (number of sites, intensity of clean-
16 up at each site) will be required to meet the toxics goals? Further analysis is needed to explore
17 how the toxics 'measures of progress' work together—for example how does delisting a given
18 AOC contribute to the goal of reducing fish tissue PCB concentrations and therefore the number
19 and frequency of fish consumption advisories?
20

21 Over the past decades, the record of 'delisting' Great Lakes AOCs is poor, with only four AOCs
22 cleaned up in approximately 20 years, due in part to the large cost of implementing source
23 controls and dredging, disposing, and capping of contaminated sediments. Even with the
24 resources available through the GLRI, not all Great Lakes AOCs can be addressed immediately,
25 and a rational method to prioritize and rank sites is needed. The Action Plan and supporting
26 documents should provide further detail describing how the GLRI prioritizes the order of clean-
27 up activities. Prioritization of AOCs should be clearly linked to the remedial action plans already
28 established for each AOC in a manner that *integrates* the stated objectives in the Action Plan.
29 We recognize that the selection of AOC projects is often driven by factors beyond science, and
30 includes the availability of willing local partners and matching funds. However, there should be
31 an independent, scientifically-based ranking of AOCs to determine which site clean-ups will best
32 assist in meeting the GLRI toxics goals.
33

34 *Question 4b: Please comment on whether the Action Plan addresses the reduction of "legacy"*
35 *contaminants at all geographic scales sufficiently to restore the Great Lakes ecosystem.*
36

37 A major strategy for addressing so-called "legacy" contaminants is the accelerated clean-up of
38 AOCs. Contaminated sediments are often a continuing chronic source of persistent chemicals to
39 Great Lakes biota. Therefore a strategy based on cleaning up contaminant 'hot spots' has a high
40 probability of reducing pollutant levels and effects to biota on a regional basis and may have
41 similar success on a basin wide basis. However, as noted in the Action Plan there are a number
42 of other possible impacts from a wide range of chemical contaminants, and the Panel cautions

³ Funding under the Great Lakes Legacy Act is now part of the GLRI.

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1 that the agency favor an approach that balances the need to remediate known problems (e.g.,
2 PCBs in sediments) while systematically addressing previously understudied “legacy”
3 contaminant issues. Such balance could be achieved by conducting a rigorous hazards evaluation
4 within an adaptive management framework.

5
6 *Question 4c: Are there other actions that we should consider?*
7

8 The Panel identified several additional actions the agency should consider as it implements the
9 Action Plan. Rigorous analysis of the anticipated and realized benefits of proposed AOC
10 cleanups should be conducted using established methods in a transparent manner. This includes
11 both evaluative models relating the magnitude of benefit to the extent of proposed clean-up
12 (bang for the buck) before the restoration as well as a post-clean up effectiveness assessment.
13 These evaluations should include the anticipated and realized benefits to the AOC area itself as
14 well as the adjacent Great Lakes open water. Both types of evaluation should include estimations
15 of the links between reduced sediment concentrations and biologically-derived endpoints (e.g.,
16 tissue residues or biological effects), and the overall impact of the AOC delisting on contaminant
17 body burdens in Great Lakes fish (and therefore fish consumption advisories).
18

19 Performance management of the AOC restoration program is critical, and needs to go beyond
20 program tracking to include scientifically-defensible metrics of success. We recognize that this
21 work will require resources that might otherwise go to additional site clean-up actions, and that
22 these resources may be required for many years after the clean-up operations are completed.
23 Nonetheless, assessing success, partial success, or failure of these AOC cleanup programs is
24 essential to improving the Nation’s ability to clean up the Great Lakes.
25

26 The Action Plan has few biologically-based indicators and the current SOLEC (2009) analysis
27 only includes external lesions in fish as the sole biologically-based effects indicator.
28 Development of additional biologically-based effects monitoring is required. Many human health
29 indicators and environmental health indicators were not evaluated in the 2009 SOLEC report due
30 to lack of data and this gap must be addressed by GLRI-supported projects. The toxics ‘measures
31 of progress’ are focused on polychlorinated biphenyls (PCBs) and seem to underemphasize the
32 role of mercury despite the greater contribution of the latter to fish consumption advisories
33 across the Great Lakes basin [**NOTE to Authors: Is there a reference for this statement**].
34 Polycyclic aromatic hydrocarbons (PAHs) also warrant more defined actions in the GLRI, given
35 recent findings showing the effects of low levels of these compounds on early life stages of a
36 wide variety of fish species [**NOTE to Authors: Is there a reference for this statement**]. We
37 recognize that focusing on PCBs will likely have a “multiplier effect” for other compounds (e.g.,
38 they too will be reduced) and that other initiatives exist to address some of the other persistent,
39 bioaccumulative and toxic (PBT) compounds in the Great lakes. However, the Action Plan does
40 not address the nature of these efforts in any detail.
41

42 *Charge Question 5 – The Action Plan also acknowledges the threats posed to the ecosystem by*
43 *chemicals of emerging concern, such as flame retardants, surfactants, pharmaceuticals and*
44 *personal care product constituents. To devise and implement effective control strategies, EPA*

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1 *and the other federal agencies are coordinating efforts to identify significant sources and*
2 *impacts of new toxics to the Great Lakes ecosystem through robust surveillance and screening.*

3
4 *Question 5a: Please comment on our approach for assessing and managing the risks posed by*
5 *chemicals of emerging concern.*

6
7 The Action Plan briefly considers emerging contaminants in a single principal action. This action
8 links measuring progress of AOC clean ups and assessing new toxic threats. The Action Plan
9 states that the program will develop an approach of comprehensive monitoring and assessment to
10 identify significant sources and impacts of new toxic substances to the Great Lakes. Based upon
11 this surveillance, the agency will “devise and implement effective control strategies” and
12 coordinate with efforts to update the Toxic Substances Control Act (page 21). The Panel agrees
13 that leveraging multiple statutes and regulatory mechanisms is an appropriate action under which
14 to consider emerging contaminants. However, the Panel cannot determine if these actions are or
15 are not sufficient given the presentation in the Action Plan and provides additional commentary
16 in its response to Question 5b.

17
18 *Question 5b: Are there other actions or specific chemicals of emerging concern that we should*
19 *consider?*

20
21 The Panel notes that the Great Lakes science community has made significant progress towards
22 prioritizing emerging contaminants by using the Muir and Howard (2006?**[NOTE to Authors:**
23 **Bibliographic citation needed]**) analysis. Further details about how this work is influencing
24 basin-wide monitoring and risk assessment programs are needed in the Action Plan. GLRI
25 requires a scientifically-sound framework to address and prioritize emerging contaminants, in
26 order to avoid pursuing an unwieldy number of chemicals. The Panel notes that the approach
27 recently developed by the U.S. EPA Midwest Ecological Research Laboratory for personal care
28 products and pharmaceuticals (Brooks and Ankley 2006? (2007? **[NOTE to Authors:**
29 **Bibliographic citation needed]**) is an example of such a framework. The choice of which
30 emerging contaminants to focus upon must be led by the contaminants’ effects on aquatic species
31 and human health at the levels found or anticipated in the Great Lakes. With a few important
32 exceptions (brominated flame retardants, fluorinated surfactants) consumption of Great Lakes
33 fish is not likely to be a major health risk exposure pathway for emerging contaminants.
34 Unfortunately, for many of these chemicals, there is little or no ecotoxicological information,
35 making a ranking of emerging contaminants difficult. Further research with Great Lakes species,
36 coupled with biological effects-monitoring, will be required.

37
38 Recommendations made by the International Joint Commission Work Group on Chemicals of
39 Emerging Concern (2009?) should be incorporated into the GLRI Action Plan. These include:

- 40
41
- 42 • Improved binational cooperation and coordination on the underlying principles and
 - 43 processes by which emerging chemicals will be prioritized and then on the design and
 - 44 implementation of monitoring programs that set common objectives;
 - 45 • Development of appropriate tools to adequately assess the exposures and impacts of
- emerging chemicals in the Great Lakes;

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- 1 • Targeted studies to resolve significant gaps in the current state-of-the-science;
- 2 • Further emphasis on moving ‘upstream’ and adopting sustainable solutions to the
- 3 design, production and consumption of chemicals of emerging concern;
- 4 • Strengthening pre-manufacturing notification and transparency in chemical
- 5 production and use; and
- 6 • Adopting innovative approaches to chemical management in the Great Lakes that
- 7 goes beyond one-by-one chemical approaches.

8
9 Finally, the Action Plan and associated documents should recognize the interplay between all
10 current and emerging stressors, including physical stressors such as increased UV penetration
11 and those resulting from climate change (timing and magnitude of annual water temperature
12 cycles, and acidification, as examples).
13

14 **3.3. Charge Questions on Invasive Species**

15 Focus Area 2 of the Action Plan sets out a number of laudable long term goals and objectives
16 designed to eliminate and control invasive species. However, the Plan offers relatively few
17 specific details as to what *exactly* will be done regarding surveillance, and, in particular, about
18 the technologies that will be developed, refined, and employed to contain and/or control invasive
19 species. The charge to reviewers notes that there are separate, parallel actions under way to
20 address specific invasive species (i.e., Asian carp) and vectors (i.e., ballast water controls), and
21 seeks recommendations on detection and surveillance of invasive species. The Panel notes the
22 Action Plan includes other methods to control invasive species and the Panel finds these parallel
23 issues important, timely, and of value to the Action Plan. Therefore, the Panel cites some
24 examples developed under these parallel efforts that may be important to consider while
25 developing an early detection surveillance program or implementing other actions for early
26 detection and species removal.
27

28 *Question 6 – Invasive species have dramatically altered the Great Lakes ecosystem. New species*
29 *continue to threaten the Great Lakes. The Action Plan identifies a set of actions intended to*
30 *eliminate new introductions, control the spread, and minimize the risks of invasive species. EPA*
31 *has initiated separate reviews for some of the principal actions in this focus area. Ballast water*
32 *technology is being reviewed by a separate SAB panel. The Asian Carp activities are being*
33 *addressed through the Asian Carp Control Strategy Framework that is being elevated to a*
34 *program unto itself in coordination with GLRI. Therefore, we are asking the SAB’s for advice*
35 *and recommendations on the remaining actions to address invasive species.*
36

37 *Question 6a: What are the key scientific data needed in an early detection surveillance network*
38 *to provide up-to-date critical information for evaluating rapid response options?*
39

40 One of the Action Plan’s objectives is to develop consistent methodology and protocols for a
41 basin-wide invasive species surveillance program. The Panel concludes that this is a good action,
42 and strongly recommends that surveillance and rapid response protocols be coordinated to ensure
43 that the various states, provinces, and other participating organizations use the same

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1 methodology and protocols to provide meaningful information and effective rapid response. This
2 coordination will be necessary to make the program effective.

3
4 In order to know which species are potential invaders, good information on what has occurred in
5 similar regions, and in the Great Lakes region in the near past, is needed. Literature reviews and
6 risk assessments that evaluate potential invaders in the Great Lakes, those that have become
7 invasive elsewhere and the vectors by which they could arrive will be critical sources of
8 information (Johnson et al., 2001; Kolar and Lodge, 2002; Anderson et al. 2004). The quality
9 and quantity of these risk assessments will be the major determinants of the success of
10 prevention and rapid response efforts. Data on the transport and sale of live organisms for bait,
11 food, and pets (including backyard ponds) should also help inform these risk assessments and
12 further identify which species are potential invaders in the Great Lakes. Indeed, as ballast water
13 comes under control, other vectors, such as those cited above, may become the most likely
14 sources of new invaders.

15
16 It is important to recognize that climate change is likely to facilitate invasion by many invasive
17 species, including pathogens. However, it is also important to recognize that the adjustment of
18 species' ranges is an important mechanism through which ecosystems will adapt to climate
19 change.**[Note to Authors: Should this recommendation amplify the facilitated invasion and
20 range expansion of invasive species in the Great Lakes Region and references to support
21 both topics.]**

22 Recent and emerging technologies for measuring deoxyribonucleic acid (DNA) have great
23 potential for surveillance, however probes must be developed for the different species that are of
24 concern. Jerde et al. (2011) located the Asian carp invasion front using a technique called
25 environmental DNA or "eDNA." They analyzed over 1,000 water samples from the Chicago
26 Sanitary & Ship Canal, and other water bodies in the area. Using genetic tools, they screened the
27 samples to find traces of eDNA from species, including Asian carp. In addition to showing that
28 the invasive fish were much closer to the Great Lakes than people believed, the research
29 demonstrated that eDNA is better than traditional methods for locating and monitoring aquatic
30 species invasions. Assessment and, if warranted, adoption of this technology should move
31 forward as rapidly as possible.

32 The availability of taxonomic expertise to identify and recognize many potentially invasive
33 species may constrain efforts at early detection, especially for phytoplankton and microbial
34 species. The Panel notes that there is currently a scarcity of taxonomic expertise, and an aging
35 taxonomic workforce that will be available for species identification, especially considering
36 surveillance of such diverse ecosystems requires expertise in many different types of organisms.
37 This may be an additional consideration for the outreach and education programs discussed
38 under Focus Area 5.

39
40 Rapid detection and then response to invading organisms are complicated tasks, and must be
41 supported by an intensive monitoring program in order to detect nonindigenous invasive species
42 (NIS) (unless they are large and conspicuous) before they become very abundant. However, such

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1 a program can also serve other purposes such as ecosystem monitoring, thus providing multiple
2 benefits.

3
4 A single, rapid response plan should be adopted by all states and provinces that will provide for
5 collective effort and will cut through jurisdictional barriers in advance. Otherwise, there will be
6 excessive delays in responding and possibly shortfalls in resources, reducing the chance of
7 successful eradication when there is still time to do so.

8
9 *Question 6b: Does the SAB have any recommendations on demonstrated preventative and*
10 *control technologies that could be applied to invasive species in the Great Lakes?*

11
12 The Action Plan did not provide prevention and control technologies that are under consideration
13 by the agency and requested that the SAB provide technologies that could be applied to invasive
14 species in the Great Lakes. The Panel discussed some technologies and is providing general
15 techniques for the agency to consider with references and bibliographic citations. The Panel
16 encourages the agency to consider these technologies and strongly recommends the agency
17 develop criteria to evaluate these and additional studies to develop preventative and control
18 technologies.

19
20 *Selective Piscicides* -- It is vital that selective poisons are truly selective for the invasive species
21 under consideration. It is difficult to find a chemical that is toxic to certain fishes and not to
22 others. Conover et al. (2007) provide information on selective poisons for Asian carp. Another
23 important consideration is some of the fishes most sensitive to piscicides are among the most
24 endangered fish species (e.g., sturgeons and native lampreys) in the Great Lakes basin (Boogard
25 et al. 2003; McLaughlin et al. 2003). Therefore, while such an approach may have merit, care
26 must be taken to ensure that unwanted consequences do not occur.

27
28 *Pheromones* --Pheromones to attract or scatter the Asian carp appear to be more promising in
29 terms of not harming non-target species. Improvements to lamprey control such as more
30 effective traps using attracting pheromone attractants (Sorensen and Hoye, 2007; Li et al., 2007)
31 are being developed, as are repellants (Wagner et al., 2011). These are an improvement over
32 existing chemical control, since lampricides are not entirely selective (Boogard et al., 2003).

33
34 *Ballast Water Technologies*– There are plans to test the performance of the many technologies
35 that have already been developed to treat ballast water. This lab work should lead to bench and
36 pilot scale testing providing additional information. Genomic techniques could also be used for
37 monitoring the ballast water to see if it needs treatment.

38
39 The report, [*Efficacy of Ballast Water Treatment Systems: a Report by the EPA Science Advisory*](#)
40 [*Board*](#), provides advice on technologies and systems to minimize the impacts of invasive species
41 in vessel ballast water discharge (SAB 2011). The Panel notes the following as germane to the
42 Action Plan, and recommends careful consideration of the report:

43
44 The Ballast Water Advisory report’s “overarching recommendation is that the
45 EPA adopt a risk-based approach to minimize the impacts of invasive species in

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1 vessel ballast water discharge rather than relying solely on numeric standards for
2 discharges from shipboard [ballast water management systems (BWMS)]. The
3 [Ballast Water Advisory Panel] found that insufficient attention has been given to
4 integrated sets of practices and technologies that could be used to systematically
5 advance ballast water management. These practices include managing ballast
6 uptake to reduce the presence of invasive species, reducing invasion risk through
7 operational adjustments and changes in ship design to reduce or eliminate the
8 need for ballast water, development of voyage-based risk and/or hazard
9 assessments, and treatment of ballast water in onshore reception facilities. The
10 Panel recommended that a comprehensive analysis be done to compare biological
11 effectiveness, cost, logistics, operations and safety associated with shipboard
12 BWMS and onshore reception facilities. These practices include managing ballast
13 uptake to reduce the presence of invasive species, reducing invasion risk through
14 operational adjustments and changes in ship design to reduce or eliminate the need
15 for ballast water, development of voyage-based risk and/or hazard assessments, and
16 treatment of ballast water in onshore reception facilities. The [Ballast Water
17 Advisory Panel] recommended that a comprehensive analysis be done to compare
18 biological effectiveness, cost, logistics, operations and safety associated with
19 shipboard BWMS and onshore reception facilities.”
20

21 *Management of NIS Flora* – Management activities for *Phragmites australis* provide an example
22 of how management of plant species may need to consider a wider array of factors and
23 biological or chemical control options. For wetland plants (and other species), one should
24 evaluate the actual damage that they do, as well as the possible positive ecosystem services the
25 species may provide before starting wide-scale eradication (Hershner and Havens 2008). The
26 capacity of an invasive species to provide valued ecosystem services, such as contributions to
27 food webs (Wainwright et al. 2000; Weis et al. 2002), improved habitat (Weis and Weis, 2001;
28 Yuhas et al. 2005), sequestration of pollutants (Windham and Meyerson, 2003; Windham et al.
29 2001, 2003) – as has been found with *Phragmites* in tidal marshes - should be considered in its
30 management. In addition, it is critical that a biological control agent be well studied and is highly
31 specific to the desired invasive species and not attack other plants (Tewksbury et al., 2002).
32 Other control methods for invasive plants involve the use of large amounts of herbicides, which,
33 like piscicides, tend to be harmful to other species beyond the target species. One commonly
34 used herbicide, glyphosate (Round-up), is toxic to a wide variety of plants, to various aquatic
35 animals (Tsui and Chu, 2003) and to soil microbes that perform important ecosystem services
36 (Busse et al. 2001).
37

38 *Physical Separation Technologies* – The separation study for the Mississippi River and Great
39 Lakes system provides considerations for the agency. Fences are being used to provide physical
40 separation between the river and Lake Michigan in order to keep Asian carp out of the lake
41 (Rasmussen et al. 2011). However, during spring high water, fish may be able to go through
42 wetland areas to access lakes Erie and Michigan (Hochanadel, 2010; US Army Corps of
43 Engineers, 2010). It should be noted that, in general, erecting barriers could impair any
44 migrations of native species as well.
45

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1 *Education and Outreach programs* -- Well considered education programs (not just “contact”)
2 for the general public about releasing pets, and anglers releasing bait fish, are crucial. In
3 addition, surveillance for juvenile carp and other invasive fishes among bait fish is needed.
4 Target groups for intensive training should include field technicians, commercial fishermen,
5 naturalists, subsistence fishers, and others already involved in observing, sampling, and handling
6 of Great Lakes fauna and flora. People involved with GLRI should work together with the Sea
7 Grant Extension staff in all Great Lakes states on these education programs in order to avoid
8 duplication of efforts.

9
10 The Panel also recommends that the agency assess potential and current invasive species and
11 prioritize which species present the greatest problem(s) for the Great Lakes. The Panel concludes
12 it would be wise to spend most of the effort and money on the most problematical species, and
13 avoid reactions to all non-native species (Davis et al. 2011; Schlaepfer et al. 2011).

14
15 *Question 6c: Are there other actions that we should consider?*

16
17 In general, a better understanding of which ecosystem characteristics increase susceptibility or
18 resistance to invasions is needed (Bulleri et al. 2008; Kuhn and Klotz, 2007; Milbau and Nijs,
19 2004). This understanding should be applied to manage the Great Lakes. Focus Area 4, Habitat
20 and Wildlife Protection and Restoration, has a goal that includes restoring access of migratory
21 fish species at fish passage barriers. While generally a positive goal, this may exacerbate
22 problems with movement of problematic non-native species from the Great Lakes into their
23 drainage basins. Therefore the positive and negative impacts of barrier removal should be
24 considered in each instance.

25
26 As noted generally above in the commentary for charge question 2, more meaningful and
27 measurable metrics of improvement are needed. Some of the metrics in the Action Plan are not
28 practical. For example: How can one measure if an average of 1.4 or 1.3 new species arrive?
29 While the Panel recognizes that averages can be calculated over the longer term, such a measure
30 is of little value in assessing whether the threat from invasions has been reduced. In addition,
31 some measures need further specificity. For example, removing “5,000 lbs.” of invasive species
32 is not a helpful measure, when one could be addressing either microbes, water fleas or Asian
33 carp.

34
35 The positive and negative impacts of developing a fishery for Asian carp in the Mississippi
36 should be evaluated. Once a species has proliferated, and prevention is no longer possible, other
37 management options must be considered, and for carp this may include commercial and
38 recreational fishing. While humans are good at overfishing, it is not likely that this will
39 eliminate the Asian carp completely. However, it could keep them at a lower population density
40 in the rivers and thereby reduce the probability of their invasion of the Great Lakes. An Asian
41 Carp Marketing Summit was convened in Illinois in the fall of 2010 to identify opportunities to
42 market the fish as a way to reduce their numbers, and recommended that eating bighead and
43 silver carp may be a feasible approach. Representatives from restaurants, commercial fishing,
44 processing and related businesses, government agencies and academic institutions attended the
45 summit. They agreed that high value Asian carp fillets marketed to restaurants and retailers could

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1 provide a financial incentive for extensive harvesting of these fish. They further recommended
2 that the harvested fish be exported in large numbers to Asian markets where they are popular
3 food fish, and that carp by-products be converted into pet food to eliminate waste and maximize
4 efficiency and profit. They felt it was important for people with different expertise, for example,
5 natural resource professionals and entrepreneurs, to work together to successfully market Asian
6 carp. When the final summit report is completed, a summary of recommendations will be
7 available online and updated as information progresses (From: ACES News
8 <http://www.aces.uiuc.edu/news> [NOTE to Authors: This citation does not link to the Asian
9 Carp study or articles. A more direct citation is needed])
10

11 An ecosystem context is desirable for management of invasive species (Arkema et al. 2006;
12 Schlaepfer et al. 2011) and management plans for ecosystems should include possible new
13 invasive species. Wise management requires the interaction of information and models.
14

15 **3.4. Charge Question on Nearshore Health and Nonpoint Sources**

16 Key elements of any restoration plan for the Great Lakes will have to target the principal sources
17 of stress to reduce their effect on the Lake ecosystems, and the Action Plan does address these
18 key elements. The Panel's responses to charge question 7 address the adequacy of the principal
19 actions proposed for the Nearshore Health and Nonpoint Sources Focus Area and evaluate how,
20 if implemented, these actions would improve the Great Lakes and lead to a successful
21 restoration. Many of the comments made relative to this charge question also can be applied to
22 other focus areas as many of the issues raised are crosscutting.
23

24 Overall, the GLRI and its Action Plan would be greatly improved by a comprehensive plan to
25 demonstrate and ensure the following key elements are addressed:

- 26 • Provide the logic supporting how selected projects fit the Action Plan;
- 27 • The timely availability of monitoring data; and
- 28 • Assessment of project outcomes, both positive and negative.

29 The Panel's responses to the specific charge questions below are framed to address the adequacy
30 of actions and impacts associated with key stressors in the nearshore region that the agency
31 should consider as it evaluates the GLRI and applies adaptive management techniques to identify
32 priorities. As identified in the Action Plan, the primary stressors are soluble reactive phosphorus,
33 soil erosion, pollutants, *Cladophora* biomass, dreissenid biomass, and water-borne bacterial
34 contamination. The primary targets of restoration are aquatic living resources and human use.
35

36 *Question 7 - The report State of the Great Lakes 2009 has documented that "phosphorus loads*
37 *may be increasing after a long period of decrease, and that an increasing proportion of the*
38 *phosphorus is an available, dissolved form." The increased phosphorus loads along with other*
39 *stressors are degrading nearshore water quality as evidenced by eutrophication, harmful algal*
40 *blooms (e.g. Cladophora and Microcystis) and avian botulism. To address these problems, the*
41 *Action Plan identified a set of principal actions to improve the health of the nearshore areas and*
42 *reduce nonpoint source pollution to levels that do not impair nearshore waters of the Great*

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1 *Lakes. These principal actions include identifying sources and reducing loadings of nutrients*
2 *and soil erosion and targeting watershed plan implementation in high priority watersheds.*

3
4 *Question 7a: Please comment on the adequacy of the principal actions to address the impacts*
5 *associated with nearshore soluble reactive phosphorus, Cladophora biomass, and dreissenid*
6 *biomass.*

7
8 **[Note to authors: The Action Plan does not reference dreissenids and the response doesn't**
9 **directly address Cladophora biomass actions]**

10
11 As stated above, while the Action Plan is a five-year plan, it provides a unique opportunity to
12 form the basis for a long-term restoration vision that could guide subsequent renewals of the
13 Action Plan. In order to sustain that long-term vision, strategic planning that includes
14 mechanisms for assuring sound science and measurement of progress must be performed.

15
16 A reduction in soluble reactive phosphorus is one of the more important measures of progress as
17 it is a key stressor throughout the Great Lakes ecosystem. Are the proposed reduction targets big
18 enough to make a difference? Are they even measurable or statistically different? In addition,
19 water quality will be an important part of assessing nearshore health, but water quality
20 measurements are highly variable in space and time. This could lead to bias or a large degree of
21 uncertainty in assessing performance if sufficient attention is not given to development of sound
22 science based sampling designs. Failure to consider soundness of sampling designs for targeted
23 projects and long-term monitoring increases the likelihood that the Action Plan will not reach its
24 goals.

25
26 Documentation is lacking to support the selection of measures and their target quantities. While
27 the Panel recognizes that the targets were developed as first-cut policy measures, some
28 explanation is needed as to how they will relate to restoration. Do the quantities reflect
29 significant or measurable improvement? For example, the increase in the percentage of good
30 beach days seems very small. In the table on Measures of Progress (page 29 of the Action Plan),
31 percentage of beaches meeting bacteria standards 95% or more of beach days has a 2006
32 baseline of 86%. The target for 2010 was 86%, then 87% for 2011 and 2012. The target increases
33 to 88% for 2013 and 89% for 2014. These are small changes in the targets for such an important
34 measure of human health and restoration progress. Are they meaningful or significant changes?
35 The Panel was unable to make such conclusions. Bacterial problems in the nearshore appear to
36 be acute and can lead to serious human health problems. A critical evaluation of what is a
37 significant target to achieve in restoration is needed for this measure, in particular, and also for
38 other targets.

39
40 The baseline for the target parameters is provided in the Action Plan tables but the universe for
41 these parameters is not always defined. It is very important that data on the parameters universe
42 be given so readers can assess the magnitude of change associated with restoration efforts. Some
43 discussion of the relative size of target numbers to universe is needed in the Scientific
44 Background document. For example, the USDA conservation practice acreage baseline is
45 165,000 acres. This represents about 0.4% of the total agricultural land in the US lakes

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1 watersheds (165,000/38,629,000 acres). The target percent increases out to 2014 would raise this
2 percentage to 0.6%. While this change represents a 50% increase in conserved acreage, is this
3 meaningful to the system? Details on where and how this percentage improvement will
4 potentially result in positive restoration would be helpful.

5
6 Will real ecological benefit result from achieving the target numbers? For soluble reactive
7 phosphorus, using an across-the-board reduction in all of the targeted watersheds may result in
8 correspondingly different ecological benefits, which would be interesting to compare. No such
9 mention of this is made in the Action Plan.

10
11 Unexplained connections between actions and measures need to be addressed. For example, it is
12 not clear how actions to “Identify sources and reduce loadings of nutrients and soil erosion” (the
13 second principal action to achieve progress on page 30) will lead to a reduction in “the number
14 and severity of incidences of ecosystem disruptions, including *Cladophora*, HABs, [avian]
15 botulism and other issues associated with eutrophication.” Will the target reduction figures be
16 enough to result in any improvement in the ecosystems and reduction in stress? While this is a
17 weakness in the Action Plan, the GLRI recognizes this and imbeds research and modeling efforts
18 as the principal actions to establish the linkage between actions, measures, and targets. This
19 research and modeling effort would be a strength in the Action Plan, and an essential strategic
20 activity that should be clearly identified and highlighted in the Actoin Plan as a separate activity.
21 As presented, the research and modeling effort is minimized.

22
23 *Question 7b: Are there other actions that [EPA] should consider?*

24
25 How future development and climate change will affect the Action Plan targets needs to be
26 considered in more detail. From the establishment of Detroit in early 1700’s to the present,
27 human development has been the major driving force in altering the Great Lake ecosystems. In
28 particular, Lake Erie is prone to development of hypoxia (Delorme 1982). Now, global climate
29 change needs to be added as a major driving force. Acknowledging climate change issues and
30 how efforts restoration may be affected should be integrated throughout the Action Plan.

31
32 The Action Plan was released in February 2010; however, the tables in the Action Plan, prepared
33 for a 2009 start, have not been updated since the release. The Action Plan would be improved if
34 a column were added to the tables showing what was accomplished in 2010 and 2011 relative to
35 target figures. Hundreds of projects have been funded and it is necessary to include some
36 information on what has been accomplished. Footnote 19 (page 29 of the Action Plan) is a prime
37 example of why the Action Plan will need to be updated or revised and tables reset for 2012. The
38 agency should consider developing a separate mechanism to update the public and interested
39 members of the scientific community, perhaps by using a status update or an annual report card.

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1 *Question 7c: Please comment on the Action Plan's intent to target Great Lakes subwatersheds⁴*
2 *that show severe signs of stress for focused restoration activities as opposed to a broader*
3 *approach that targets all watersheds (stressed and currently unstressed).*
4

5 The Action Plan's intent to identify, map, and target the highest priority Great Lakes
6 subwatersheds that show severe signs of stress for focused restoration activities is the best
7 strategy for producing measurable positive outcomes. Overall, severely stressed systems respond
8 positively and measurably to stressor relief. This is particularly true for stresses associated with
9 excess nutrient loadings. Rabalais et al. (2010) documented at least 50 cases where hypoxia was
10 reduced or eliminated by reductions in nutrient or organic matter loading. An approach that
11 targets a broader range of watersheds in the Great Lakes would likely require significantly more
12 resources.
13

14 While implementing projects at the subwatershed level based on severity of stressed habitats is
15 appropriate, consideration for restoring physical habitat needs to include other stressors acting
16 outside the subwatershed that may keep the restored habitat from functioning. For example,
17 restoring headwater habitat for anadromous fish may be irrelevant if they are blocked by
18 degraded downriver water quality. A subwatershed approach needs to be backed by a sound plan
19 for the entire watershed that considers the how the ecosystem functions as a whole.
20

21 Targeting best management practices (BMPs) is also a very good idea and may demonstrate the
22 value of targeting to a broader community. In particular, mention should be made of how
23 agricultural BMP performance can be assessed. Some portion of the implementation resources
24 needs to be targeted towards accounting for agricultural BMP performance, including selective
25 monitoring and evaluation. The GRLI is not the first program developed to improve the Great
26 Lakes' degraded ecosystems. Some mention of previous and ongoing programs needs to be
27 included so external observers can assess progress. One example would be to integrate the
28 ongoing efforts on TMDL development and implementation with the recommended activities.
29

30 The focus on stressed watersheds and subwatersheds is good, but the selection process needs to
31 be more understandable and transparent. It would be desirable to include a list of stressed
32 watersheds by Lake, at a minimum, in support of this discussion. It is likely that the value of this
33 approach, to focus on the most stressed systems, can be made by the GLRI by 2014, if
34 recommendations for outreach and monitoring are implemented. As the GLRI evolves and
35 selects the next group of watersheds it will be important to demonstrate successful restoration
36 and positive trends in metrics. Overall the Action Plan's vision, goals, actions, and performance
37 assessment need to be made clearer.
38

⁴ These include the targeted geographic watersheds identified on pages 16 and 28 of the Action Plan and other Areas of Concern

1 **3.5. Charge Questions on Habitat and Wildlife Protection and Restoration**

2 Focus Area 4 seeks to contribute to the improved health of the Great Lakes ecosystems through
3 the restoration of key habitats. The goal is to implement these restorative measures in a manner
4 that achieves five overarching goals:

- 5 • Improve aquatic ecosystem resiliency;
- 6 • Maintain, improve or enhance populations of native species;
- 7 • Enhance wetlands, wetland-associated uplands, and high priority coastal upland and
8 island habitats;
- 9 • Identify, inventory and track progress on Great Lakes habitats including coastal wetlands
10 restoration; and
- 11 • Restore habitat functioning in areas of concern.

12
13 Achieving the five goals of the focus area will require the development and application of a
14 range of critical management actions and sound decision-making. These management actions
15 will be focused on the implementation of high priority actions, including the protection and
16 restoration of critical habitats and species, and executing these activities in an environmentally
17 sensitive manner. Included in this focus area is the restoration of habitat functions in, and native
18 species use of, AOCs where contaminant remediation actions will be taken.

19
20 *Question 8 – One of the Action Plan’s principal actions to protect and restore habitat and*
21 *wildlife is aimed at improving “aquatic ecosystem resiliency.” “Resiliency” is loosely defined in*
22 *the Action Plan as providing an ecosystem with the capability to buffer the impacts of potential*
23 *problems such as climate change.*

24
25 *Question 8a: Please comment on the concept of “resiliency” in restoring and protecting aquatic*
26 *habitats in the Great Lakes ecosystem. Does the SAB have any recommendations on actions to*
27 *increase “resiliency?”*

28
29 The Panel finds that restoring resiliency is an appropriate goal for this focus area. However, we
30 also find that the Action Plan does not clearly articulate the concept of resiliency in the context
31 of this Action Plan. Also, adequate information was not presented to judge whether the actions
32 associated with Focus Area 4 would be effective at attaining enhanced ecosystem resilience in
33 the face of disturbances.

34
35 A clear, working definition of resiliency should be developed along with metrics that can be used
36 to track changes in the resiliency over time as restoration measures are implemented. The topic
37 of resilience of ecosystems is wide-ranging, and often misunderstood. It has received very little
38 attention with respect to habitat restoration. It is critical that the Action Plan strive not just for
39 resilience, but for resilience associated with desirable future ecosystem conditions. Resilience
40 can be high in systems dominated by invasive species (e.g., *Phragmites*) and low in some
41 pristine systems (e.g., some oligotrophic lakes). Therefore resilience alone does not define a
42 desirable ecosystem condition. The resilience of an ecosystem condition that supports habitats of
43 native and desirable aquatic and terrestrial species should be the goal.

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1 A variety of stressors have challenged the resiliency of the Great Lakes over the past century.
2 Excess nutrients, invasive species and toxic chemicals have caused fundamental changes in
3 ecosystem characteristics. Climate change represents a stressor that will impact the Great Lakes
4 with increasing severity over the next century. Focus Area 4 is the only place in the Action Plan
5 that climate change is explicitly identified as an issue, however, climate change also will affect
6 efforts to achieve the objectives of the other focus areas. As has been noted earlier, the effect of
7 climate change should be considered, as appropriate, for all focus areas of the Action Plan.
8

9 Climate-forced changes in conditions in the next few decades may negatively influence the
10 effectiveness of actions implemented to address Focus Area 4 objectives. Some potential effects
11 of climate change include increased frequency and severity of major storms, increased
12 temperature and elevated evapotranspiration. The increase in evapotranspiration may contribute
13 to a drop in water level, threatening coastal wetlands and other aquatic habitats. We recommend
14 that as a first step the program evaluate climate change model predictions for the region and use
15 this information to develop a habitat restoration strategy that will enhance the resiliency of the
16 Great Lakes ecosystem to climate change. This strategy should include the consideration of the
17 extent to which climate change may compromise the effectiveness of proposed restoration
18 projects, the identification of particularly vulnerable key habitats and the development of
19 methods to secure these vulnerable areas.
20

21 *Question 8b and 8c: Are there additional ecological elements or measures that should be*
22 *considered to better improve resiliency or buffering capacity and our progress in habitat*
23 *restoration and ecosystem protection projects? What about actions in other focus areas?*
24

25 Questions 8b and 8c of the Charge are closely related. The Panel's responses equally apply to
26 both questions and are presented together. The Panel concludes that these recommendations may
27 increase the resiliency of an ecosystem and identify additional ecological elements and measures
28 the agency should consider as it evaluates the progress of the Action Plan and plans next steps.
29

30 Resiliency is not explicitly discussed in the other focus areas of the Action Plan. The Panel finds
31 that it should be a key consideration in the program. The general principles and concepts
32 provided in the response to Question 8a, 8b and 8c are applicable to other four focus areas and
33 should be incorporated in the decision framework as appropriate.
34

35 There are certain ecosystem characteristics that have been shown to contribute to ecosystem
36 capacity to resist state changes in the face of disturbances. This capacity is frequently what is
37 meant by resilience. Restoration actions that enhance these ecosystem characteristics, therefore,
38 should contribute to resilience. The Panel urges the agency to consider these following
39 recommendations as appropriate to restoration actions:
40

41 **[NOTE to Authors: This is a rather long bulleted list with varying degrees of discussion for**
42 **each bullet. Options to present a recommendation on improving resiliency are: 1)**
43 **summarize the list with appropriate references or, 2) summarize the list and include an**
44 **appendix that present a hierarchy or change in the order that the Panel would like EPA to**

1 **evaluate as it considers resiliency and restoration, or 3) an option developed in discussion**
2 **on the teleconference.]**
3

- 4 • Reconnect the landscape elements (e.g. remove hydrological barriers) to enhance the
5 flow of energy, materials and species throughout the ecosystem.
- 6 • Consider natural habitat complexity as a key feature to enhance resilience. Use reference
7 sites as models where appropriate.
- 8 • Consider size and quality of buffers to enhance buffering capacity relative to stressors
- 9 • Protect areas that are currently in good condition and supporting habitat forming
10 processes and sustaining biodiversity in a region. Plan restoration actions that take
11 advantage of these anchor sites. By locating restoration projects near these high-quality,
12 protected sites, the benefits associated with these anchor sites can be extended. The
13 anchor sites provide the needed materials (e.g., sediment) and species to “restored” sites
14 located downstream or down coast.
- 15 • Design and implement restoration efforts at multiple spatial scales. Strategic distribution
16 of restoration projects will enable the development of a restored landscape. Locating
17 restoration projects so that restored sites interact can greatly enhance the re-establishment
18 of habitat forming and maintaining processes. The condition of the landscape and sites
19 proximate to the site that is to be restored are critical factors in determining the rate at
20 which the restored site develops desired habitat conditions.
- 21 • Nurture sources of renewal. For example, preserve sources of native species such as
22 biodiversity ‘hot spots’.
- 23 • Determine the abundance, density, or productivity of a population required to achieve a
24 reasonable probability of persistence in the face of natural variation. Restoration efforts
25 can then be designed that will create sufficient habitat carrying capacity to meet these
26 demographic targets for focal species.
- 27 • Identify and predict potential system tipping points, and factors that would lead to a
28 tipping point. A tipping point can be defined as the level of system degradation at which
29 a disturbance event can cause a fundamental shift in the state of an ecosystem. Once a
30 tipping point is reached, even a relatively minor disturbance event (e.g., regional weather
31 anomalies) can trigger an abrupt change in system condition. Restoring the original
32 ecosystem properties can often be very difficult and expensive once a tipping point has
33 been reached; in some cases restoring ecosystem conditions is not feasible. An example
34 of a tipping point is increased turbidity in a shallow lentic habitat that reaches a level
35 sufficient to reduce light reaching the lake bed enough to prevent the growth of
36 submerged aquatic vegetation (SAV). The loss of the SAV leads to changes in habitat,
37 causing a consequent shift in the animals occupying the site. The time required to return
38 to the original state can be protracted. Reducing the turbidity would represent the initial
39 first step in this process and may require nutrient and sediment abatement actions. Once
40 light conditions are appropriate to support SAV again, revegetation of the site may occur
41 very slowly, if a source population of the plants is not proximate to the site. In some
42 cases, moving vegetation from a donor site to the affected site may be required. Once this
43 shift in ecosystem condition occurs, great effort and expense often is required to restore
44 such a site. Identifying these tipping points and implementing corrective actions before

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1 they are reached is far more efficient and effective than attempting to restore conditions
2 after they have shifted.

- 3 • Select restoration projects with some understanding of the “return time” of disturbances.
4 Disturbances during early stages of habitat development following implementation of a
5 restoration action can reduce the effectiveness of the project. Some understanding of the
6 frequency and severity of disturbance events a restored site is likely to experience
7 provides useful information regarding project design and effectiveness. This
8 understanding also supplies information required for decisions on what to do if the site is
9 not meeting performance expectations.

10
11 The Panel concludes that considering and incorporating these elements, as appropriate, in the
12 Action Plan will enhance ecosystem resilience and therefore, contribute to long-term
13 sustainability of habitat conditions and improved levels of native of biodiversity.

14
15 *Question 9 – The Action Plan broadly defines “restoration” to encompass physical, biological,*
16 *and chemical functions and processes. Are the actions listed in the Action Plan “restoration”*
17 *actions?*

18
19 The simple answer to this question is that most of the actions listed under Focus Area 4 are
20 “restoration” actions. The more relevant question for the GLRI is whether these actions will
21 enable the attainment of the Focus Area 4 objectives. The Panel finds that the italicized parts of
22 the principal actions (page 34 of the Action Plan) may be more appropriate as goals for the
23 protection and restoration of habitat and wildlife. More specific actions would further describe
24 the efforts to achieve these goals. This change would represent the first step towards addressing
25 the ambiguity in the links between vision, long-term goals, objectives, and principal actions in
26 the Action Plan. Additionally the Panel recommends that the Action Plan tie monitoring
27 elements more directly to goals. The more clearly and transparently the agency can communicate
28 the connection between the monitoring metrics and the goals, the easier it will be to document
29 how well the actions are working to meet the goals

30
31 The Action Plan includes stocking native fish and other aquatic species as a critical management
32 activity under long-term goal 2 of this Focus Area. The Panel notes that using fish stocking
33 programs as a viable tool for restoration raises questions. There are many examples where
34 stocking has hurt native populations, and generally degraded ecosystem conditions. Although we
35 can see the need for this type of action, application of fish stocking programs requires careful
36 evaluation. [**Note to Authors: can we provide an example and citations?**]

37
38 The Panel recognizes and acknowledges the unprecedented scale of the GLRI. It bounds on
39 intractable in terms of size and complexity. For these reasons, the Panel recommends that
40 specific actions that are implemented have at least a moderate probability of working at a scale
41 and in locations where they have the potential greatest positive impact on the ecosystem. In order
42 to determine the specific action potential to succeed at an appropriate scale the Panel provides
43 the following list of considerations that are intended to stimulate discussion by the action
44 agencies as actions or projects are solicited, implemented, and evaluated:

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6 **on the teleconference.]**

7
8 *Defining Restoration Goals*

- 9
- 10 • What is wrong, where and why? Answering this question is fundamental to developing a
11 plan. We assume that answers are reasonably well developed, but it was not apparent to
12 us, through our review of the documents, whether this was the case.
 - 13 • At what scale are damages and stressors active, and potentially limiting restoration? This
14 comment is related to responses provided to the questions above and involves a more in
15 depth investigation of problems in the ecosystem.
 - 16 • What are the specific characteristics of a “restored” Great Lakes ecosystem? Program
17 objectives that clearly articulate the desired future condition for the ecosystem should be
18 developed. The National Research Council (NRC 1992) defined ‘restoration of aquatic
19 ecosystems’ as returning an ecosystem to a close approximation of what it was like prior
20 to disturbance by humans (NRC 1992). This goal may not be appropriate for the Great
21 Lakes given their current condition. However, the Action Plan does not specifically
22 define a set of goals. The scientific literature on restoration has developed some generic
23 restoration goals, provided below. It is likely that the restoration goals for the Great
24 Lakes will vary spatially and included elements for most of the broad strategies below.
25 But these goals should be fully developed. An overarching set of program goals will
26 greatly help in setting priorities for restoration projects.
 - 27 ○ Restore to prehistoric conditions – conditions before man was present.
 - 28 ○ Restore to historic conditions – man was present but had a minimal impact on natural
29 ecosystems.
 - 30 ○ Enhance selected attributes – improve conditions of habitat and landscapes by
31 enhancing ecological attributes of the systems.
 - 32 ○ Conserve biodiversity – some disturbance can be present but the native biodiversity is
33 intact.
 - 34 ○ Protection – all human-related disturbances and stressors are barred from the system.
35 Protection differs from restoration in that there is no net gain associated from
36 protection alone. However, protection of areas of the ecosystem can support other
37 restoration projects through supplying materials and species to restored sites, and by
38 preventing future habitat loss.
 - 39 ○ Habitat creation – Constructing a habitat that is different than what existed
40 historically or pre-historically in an area. In cases where there are considerable levels
41 of disturbance on the landscape and site scales, creation may be the only viable
42 option. In general, maintenance of created habitats requires expenditures of energy
43 and funds because the processes that would normally maintain them are not present or
44 a poorly developed.

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- How sure are predictions of the response of the ecosystem and populations to specific actions? There is a need to specify the uncertainties associated with the goals. In the long run, identifying key uncertainties will aid in developing directed research questions that will help guide the restoration program in the future.

-

Prioritizing Actions

What are specific links between actions and goals? This needs clarification, and more specific information because it helps develop more robust restoration plans that clearly target specific actions.:

The process that will be used to determine what needs to be done where was not clearly explained in the Action Plan. The Panel expressed concern about the lack of detail as to how projects would be prioritized and suggests the following recommendations for the agency to consider:

- Define and identify priority areas of the ecosystem, where actions would have the greatest benefit. This analysis forms the foundation of a comprehensive restoration plan that identifies best actions and best locations.
- As opportunities arise, these opportunities can be assessed against the comprehensive plan maps to determine if actions are high priority.
- Clearly articulate the restoration strategy set that will be deployed in each action
- Develop a set of case studies for each of the types of restoration actions that will be implemented to develop some understanding of effectiveness. This understanding will help design subsequent projects.
- Clearly define elements and criteria of prioritization process such as,
 - Habitat forming processes
 - Landscape features
 - Site condition
 - Adjacent site conditions
 - Self-maintenance
 - Resilience potential
 - Time frame for development toward goal.
- Develop a *Project Proposal Template* that articulates goals, performance metrics and criteria, location, size, time period to attain goal, effectiveness monitoring, uncertainties, and direct relationship to prioritization criteria.

Measuring Progress Toward Goals:

- Develop a transparent method and set of metrics to measure net ecosystem improvement that is sustained by building resilient systems. Some methods and attributes for doing this include sources and 'levels' of evidence, detectable 'signals' in the broader ecosystem, and quantification of cumulative effects of multiple actions.
- Formalize an integrated adaptive management program with the following elements-
 - Clearly articulate the goal - everything hinges on a clear and explicit statement of what the program seeks to accomplish.

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- 1 ○ Develop a system-level model for goal attainment - identify all factors (natural
- 2 and anthropogenic) that could potentially affect goal attainment and rank their
- 3 relative importance.
- 4 ○ Assess the current management efforts - which will identify gaps/overlaps in
- 5 existing management programs addressing the important factors affecting goal
- 6 attainment.
- 7 ○ Develop management strategy - through coordination and implementation
- 8 planning by stakeholders.
- 9 ○ Develop monitoring program- monitoring can only be designed after the goals
- 10 and management strategy has been determined. Assessing management
- 11 performance is the first priority to support adaptive management.
- 12 ○ Assess performance - the criteria for success/failure of management efforts should
- 13 be known when the strategy is developed and the monitoring program is designed.
- 14 This is the analysis that informs adaptation and involves defining uncertainties
- 15 around intermediate targets and establishes decision thresholds that trigger a
- 16 change in management actions.
- 17 ○ Manage adaptively - based on the monitoring assessment, the system-level model
- 18 for goal attainment is amended and monitoring strategies revised to improve
- 19 performance.
- 20

21 *Products and Tools for the GLRI*

22 Outcomes from an effective adaptive management approach may include:

- 23 ○ Report cards
- 24 ○ Model runs to predict outcomes of future actions based on what has been learned
- 25 ○ Recommendations for improvements and research to reduce uncertainty of actions
- 26 ○ Annual report that summarizes progress and provides recommendations, defines
- 27 the decision process, and develops action recommendations
- 28

29 **3.6. Charge Questions on Accountability, Education, Monitoring, Evaluation,**

30 **Communication, and Partnerships**

31 The topics addressed under Focus Area 5 are important to the success of the GLRI. Question 10

32 focuses on critical data gaps and tools to increase collaboration and implement the GLRI focus

33 areas. Question 11 addresses outreach and education to incorporate Great Lakes stewardship into

34 curricula across the Great Lakes region. As previously discussed, the Panel concludes that the

35 monitoring and other elements in this focus area may be better addressed in each of the specific

36 focus areas rather than a combined focus area and noted that synthesis and integration across the

37 focus areas should be included in the Action Plan to bolster the accountability goals of the GLRI.

38 The panel further provides recommendations to provide greater accountability, increase

39 collaboration among partners, and enhance educational and outreach opportunities.

40

41 *Question 10 – Focus Area 5: Accountability, Education, Monitoring, Evaluation,*

42 *Communication, and Partnerships, is intended to provide the “necessary backbone” of the entire*

43 *GLRI through oversight, monitoring and assessment, education and outreach, and partnerships.*

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1 *This focus area is intended to implement assessment and evaluation actions to address gaps in*
2 *knowledge and an inadequate understanding of complex and emerging issues.*

3
4 *Question 10a: Does the SAB have any recommendations of critical data gaps for which*
5 *programs or tools should be implemented in the other focus areas?*

6
7 The Panel has discussed data gaps, tools, and other implementation recommendations for each
8 of the focus areas in the response to the charge questions. The Panel notes that combining the
9 accountability, monitoring and evaluation actions together into a single section may come at the
10 cost of them being developed separately from the focus area or in a cursory manner. Monitoring
11 and evaluation in this focus area should provide for the analyses of focus area integration and
12 synthesis of actions to achieve overarching goals and the accountability of the GLRI as a whole.
13 These analyses should also address uncertainties or data gaps. Additionally, measures of progress
14 need to identify benchmarks for expected outputs and outcomes. Completed objectives and
15 measures of progress should be reported.

16
17 Some topics and important tools to develop and present a convincing argument that the GLRI is
18 a holistic approach are missing. The panel notes that the specific mechanisms to implement the
19 actions of this section are not discussed. A technical support document that defines the processes
20 would be beneficial. Most notably there is no discussion of management itself and the
21 arrangements by which key commitments are established and maintained to document the
22 scientific basis for GLRI decisions and results. For example, indentifying which entities,
23 projects, or actions most contribute to the achievement of which goals and how progress is being
24 measured are can only be evaluated through integration and synthesis using metrics that examine
25 trends and meaningful change.

26
27 The GLRI should consider using an overall GIS framework to evaluate the integration, synthesis,
28 coordination of all program elements across all the focus areas. This type of analysis can be used
29 to identify 'hotspots', areas of improvement, or highlight BMP success or not (both in terms of
30 location and scale).

31
32 The discussion of monitoring and evaluation seems to be a gap that especially suffers from the
33 way it is organized into Focus Area 5. It comes across as an afterthought, rather than the key
34 integrating link across disparate actions and plan elements that it should be. Monitoring and
35 evaluation is a key ingredient of accountability, and the LaMP framework, as the review panel
36 understands it, seems to be a good place to focus development of monitoring efforts. Monitoring
37 should be tied explicitly to each of the focus areas in the Action Plan, rather than discussed in
38 separate sections that are disconnected from the focus areas.

39
40 Future iterations of the GLRI would benefit from the inclusion of a section that explicitly
41 addresses synthesis and integration. Synthesis and integration are relevant to the Great Lakes
42 effort in many ways, including how efforts in one action area may be synergistic or antagonistic
43 with goals in other areas, how well the missions and mandates of different managing entities line
44 up, and how efforts under one LaMP or a case study on one AOC can provide "lessons learned"
45 for others.

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1
2 The Action Plan addresses a wide variety of management activities and seeks to coordinate them
3 through an adaptive management process. Without an explicit representation of the management
4 layer, however, the GLRI faces substantial challenges implementing performance evaluation
5 based on principles of adaptive management. Management of the stressors affecting the health of
6 the Great Lakes involves direct and indirect actions. Regulatory policies, for example, address
7 stressors indirectly and depend upon various management agencies for implementation. For
8 example, fisheries regulation and regulation of point source discharges of contaminants address
9 stressors directly. Management decisions concerning remediation action fall in between.
10 Oversight of the Action Plan ultimately depends upon attribution of changes in state of a Great
11 Lake's ecosystem to a management action through a scientifically defensible monitoring and
12 assessment framework. In its present form, the Action plan lacks both an explicit representation
13 of the management layer and a comprehensive evaluation framework. The need for overall
14 program management that provides program integration, monitors and evaluates
15 outputs/outcomes, drives an adaptive management process, identifies uncertainties and data gaps,
16 and examines trade-offs in management decisions is thus unmet. Without an accountability
17 framework, the GLRI will do little to advance coordination and collaboration among Great Lakes
18 partners to address key scientific issues.

19
20 The Panel recommends that EPA initiate three actions to provide greater accountability for GLRI
21 project and results:

- 22 • Place all project decisions in an explicit management accountability framework. The
23 framework should include identification of the goal or objective addressed by the project,
24 stressors affected and scale of effects, and identification of specific management action
25 and responsible parties. The revised version of GLAS could provide a central repository
26 for this information.
- 27 • Require all focus areas to improve the logical connection of goals, objectives, actions,
28 and metrics for evaluation sufficiently to permit an integrative assessment of the
29 effectiveness of funded projects.
- 30 • Create a formal mechanism for overall program evaluation of the GLRI Action Plan that
31 is explicitly linked to adaptive management.

32
33 *Question 10b: Please comment on the Action Plan's approach for enhancing coordination and*
34 *collaboration among Great Lakes partners to address key scientific issues.*
35

36 The Action Plan lists the federal department level members of the Interagency Task Force and
37 Regional Working Group that developed the Action Plan. It also alludes to approximately 200
38 organizations at the federal, state and sovereign tribal nation levels. While it is clear that a great
39 many stakeholder organizations are involved in the program, the key members of in this complex
40 constellation of interests and the roles key entities play are not apparent. There is little
41 information on the participation at the international or state level. How is intergovernmental
42 cooperation directed at Great Lakes recovery and how is it sustained? How does the current

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1 program build on existing efforts of the federal agencies, the states, and carried out under treaty
2 agreements with Canada? A functional approach to explicit partnerships needs to be described,
3 what they are (e.g., science or outreach), and where they fit within the other focus areas.
4

5 Given the lack of specifics it was difficult for the review panel to determine whether there are
6 missing organizations. One important organizational tool that seems to be missing however is a
7 standing science panel integrated into the management system. A well-integrated panel could
8 influence the program's evolution by providing assessments of progress in key areas, by
9 shepherding the design and implementation of monitoring and evaluation efforts, and by helping
10 provide a scientific basis for setting priorities across disparate actions. Members should be
11 independent experts drawn from universities and other research institutions, the private sector,
12 and government agencies, but selected for their expertise and not to represent their agencies.
13 Such a panel could make substantial contributions to the development of both robust monitoring
14 efforts and the adaptive management plan that would be a logical outgrowth of well-designed
15 monitoring. The panel should have social as well as natural scientific expertise, and the social
16 science represented should go beyond economics. Social scientists can provide many kinds of
17 insights and advice, ranging from assistance in targeting education and outreach efforts to critical
18 insights into the likely workability of particular institutional arrangements. The panel finds it
19 unlikely that there are not significant gaps in scientific understanding likely to impede progress
20 in the program, and a science panel would be instrumental to identifying those and providing
21 advice on how they can be addressed. The science panel should develop a strategic science plan
22 and update it on a regular (e.g. biennial) basis.
23

24 Increased coordination and collaboration could be achieved by engaging in social media and
25 increasing the availability of data and information resulting from GLRI projects. For example,
26 web based GIS tools can be used to provide public connectivity site specific data and data
27 analyses at different scales. The GLRI could be informed by the experiences of other large
28 restoration efforts (e.g., Chesapeake Bay, Puget Sound), and smaller efforts (e.g., Tahoe Basin).
29

30 *Question 11 - Outreach and education are crucial in the effort to restore the Great Lakes. The*
31 *Action Plan identifies the need to educate future generations to extend restore efforts. Please*
32 *comment on the Action Plan's approach to incorporate Great Lakes stewardship into*
33 *environmental education curricula.*
34

35 Outreach and education activities provide highly laudable goals, but overall there is a lack of a
36 strategic approach in the Action Plan to achieve the stated objectives. Measures of progress were
37 ambiguous and will be difficult to track. Currently, there are no specific indications in the Action
38 Plan of the amount or type of resources allocated to these aspects of the program. The EPA needs
39 to describe allocation of resources to educational efforts, and take a systematic approach to
40 building new efforts and tapping into existing efforts (e.g., Centers for Ocean Sciences Education
41 Excellence) to further the GLRI goals.
42

43 The Panel questioned whether there were any education planners involved in the production of
44 the Action Plan. If not, then educators and planners need to be engaged early in the process.
45 Otherwise, the incorporation of educational materials into the curriculum will be problematic.

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1 For example, the Action Plan did not address the reality that new curricula in K-12 are difficult
2 to introduce unless they help teachers meet assessment standards or state mandates. If
3 environmental education about the Great Lakes is not part of a district's or State's Graduation
4 Test, chances are that new modules will not be incorporated into the curriculum. An element of
5 outreach that is not discussed in the Action Plan would be a benchmarking effort on State(s)
6 guidelines for how these activities could be included into State electives or requirements.
7

8 The emphasis in this focus area seems to be in K-12 education and outreach, with the implied
9 assumption that these activities will extend into higher education and graduate education. In
10 terms of curriculum development, the focus at the beginning should be teaching the teachers.
11 Unless the teachers are equipped, they won't know what to do with the information. In addition,
12 the development of human capital – the scientists, engineers, managers, and educators of the
13 future - is an essential part of this program and should be explicitly considered. During
14 discussions with the Panel, EPA stated that they use cooperative agreements to do many of these
15 activities using graduate students and post doctoral researchers, but this is not indicated as a goal
16 or measure of progress in the GLRI Action Plan. The Panel recommends that the development of
17 human capital within the higher education network should be a specific goal.
18

19 The Panel discussed the need for explicit requests for activities within the program to enhance
20 educational and outreach opportunities. The Panel noted that in the 2010 round of funding, there
21 were a number of funded outreach activities, but only one curriculum development project was
22 listed. The EPA should consider targeted outreach and curriculum development projects that
23 include not only science-based, but also social science and humanities based activities. For
24 example, modules could be developed to incorporate ethical (such as European vs. Tribal
25 worldviews) or environmental justice concepts into eco-curriculum or into history/philosophy,
26 etc. (e.g., in an American and World Cultures class). In addition, good opportunities exist within
27 this framework for service learning and citizen science (esp. in monitoring section). (e.g., NSF's
28 Science Education for New Criteria Engagements and Responsibilities program)
29

30 The Panel agreed that there is a need to enforce the incorporation of educational/outreach
31 activities as an overarching theme on all projects. During discussions with the Panel, EPA stated
32 that education and outreach activities are considered in peer-review, but this is not indicated as a
33 goal or measure of progress in the GLRI Action Plan. The panel recommends that EPA and its
34 partners should consider explicit peer review criteria for all activities (internally and externally
35 funded) that include education and outreach with significant weighting. This is parallel with the
36 peer-review process of the NSF (2011a, b.). The NSF's statement [**NOTE to Authors:**
37 **bibliographic citation needed for the quote**] on the integration of research and education is:
38

39 *"One of the principal strategies in support of NSF's goals is to foster*
40 *integration of research and education through the programs, projects*
41 *and activities it supports at academic and research institutions. These*
42 *institutions provide abundant opportunities where individuals may*
43 *concurrently assume responsibilities as researchers, educators, and*
44 *students, and where all can engage in joint efforts that infuse*

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1 *education with the excitement of discovery and enrich research*
2 *through the diversity of learning perspectives."*

3
4 The Panel agrees with this principle and recommends that the Action Plan incorporate and utilize
5 the same or similar criteria in its funded projects.

6 **[NOTE to Authors: This is a rather long bulleted list with varying degrees of discussion for**
7 **each bullet. If needed can it be referenced in the text with a summary paragraph and**
8 **moved to an appendix?]**
9

10
11 1. Intellectual Merit – Defines the importance of the activity to advancing knowledge and
12 understanding within its own field or across different fields; qualifications of the proposer to
13 conduct the project; extent the activity suggests and explores creative, original, or potentially
14 transformative concepts; conceptual and organizational quality; and level and quality of
15 resources available to the activity.
16

17 2. Broader Impacts – Defines how well the activity advances discovery and understanding while
18 promoting teaching, training, and learning; how well the activity broadens the participation of
19 underrepresented groups; the extent and activity will enhance the infrastructure for research and
20 education; the extent results will be disseminated broadly to enhance scientific and technological
21 understanding; and the benefits of the proposed activity to society.
22

23 For the GLRI Action Plan in particular, the Panel recommended specific elements that
24 incorporate one or more of the following would be relevant.

- 25 • under-represented stakeholder involvement
- 26 ○ ethnic, social, economic, tribal
- 27 • social outreach
- 28 • human capital development
- 29 • critical thinking training
- 30 • adaptive management training
- 31 • environmental justice activities
- 32 • social science activities
- 33 • scientific and business ethics training
- 34 • exploration of alternative world views
- 35 • service learning
- 36 • citizen science

37
38 3. Evaluation and Assessment Plan – Defines the quality and specificity of plans to evaluate and
39 assess the effectiveness of the activities. This is often undertaken by independent parties that
40 specialize in evaluation and assessment activities and are included as part of the direct costs of
41 the project.
42

43 4. Data Management Plan – Defines the extent and quality of the kind of data to be collected,
44 standards employed, and how long will data be retained; the physical and/or cyber resources and

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1 facilities (including third party resources) to be used to store and preserve the data; the data and
2 metadata formats, media and dissemination methods to be used to make the data and metadata
3 available to others; the policies for data sharing and public access; and the rights and obligations
4 of all parties with respect to their roles in and responsibilities for the management and retention
5 of research data.

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APPENDIX A: Charge to the SAB

Great Lakes Restoration Initiative Action Plan Science Advisory Board Review

Charge to the SAB panel reviewing the GLRI Action Plan

I. Scope of Review

The SAB panel is charged with reviewing the Great Lakes Restoration Initiative's (GLRI or Initiative) Action Plan. A separate scientific background paper was developed to provide the review panel with an overview of the key ecological problems in the Great Lakes, and help the panel navigate through the extensive literature, strategies, and plans that informed the GLRI Action Plan. The SAB panel is requested to use the scientific background paper (and other relevant documentation cited in the background paper) in the review of the Action Plan.

II. Introduction

In 2010, President Obama announced and Congress appropriated \$475 million in new funding for the GLRI to protect and restore the chemical, biological, and physical integrity of the Great Lakes. The Great Lakes contain 20 percent of the world's surface freshwater, accounting for 95 percent of the surface freshwater in the United States. The watershed includes two nations, eight U.S. States, two Canadian provinces, more than 40 tribes, and more than one-tenth of the U.S. population. Led by the United States Environmental Protection Agency (EPA), the GLRI targets some of the most serious threats to the Great Lakes including toxic substances and contaminated sediment, invasive species, non-point source pollution, and habitat degradation.

To guide the efforts of the GLRI, EPA and our Federal partners, through the Great Lakes Interagency Task Force (IATF)⁵ chaired by EPA Administrator Lisa Jackson, developed a comprehensive multi-year Action Plan. The GLRI Action Plan identifies goals, objectives, measurable ecological targets, and specific actions for five major focus areas:

- Toxic Substances and Areas of Concern
- Invasive Species
- Nearshore Health and Nonpoint Source Pollution
- Habitat and Wildlife Protection and Restoration
- Accountability, Education, Monitoring, Evaluation, Communication and Partnerships

III. Directive for Review of the GLRI Action Plan

⁵ The Great Lakes Interagency Task Force (IATF) brings together eleven U.S. cabinet and Federal agency heads to coordinate restoration of the Great Lakes. Created by Executive Order from President Bush on May 18, 2004, the IATF mission is to focus on environmental outcomes like cleaner water and sustainable fisheries, and target measurable results. The IATF helps coordinate GLRI implementation.

<http://www.epa.gov/greatlakes/iatf/index.html>

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1
2 The Congressional Conference Report accompanying H.R. 2996⁶ further specifies the need for
3 EPA to "engage an independent, scientific panel to review the scientific credibility of the Action
4 Plan to optimize the likelihood of successful restoration at appropriate scales."
5

6 7 **IV. Charge Questions on the overall structure of the GLRI Action Plan**

8
9 Question 1 - As presented in the scientific background document, the goals, objectives,
10 measures, and actions of the Action Plan are based on the best available scientific analysis of
11 environmental challenges and are consistent with the multitude of strategic plans and governing
12 structures for the Great Lakes. Since the Action Plan is an "action driver", we are most interested
13 in the SAB's recommendations on the identified principal actions to achieve progress. Are the
14 principal actions proposed in the Action Plan consistent with the actions and/or
15 recommendations of the previous collaborative plans and strategies for the Great Lakes (e.g.
16 Great Lakes Regional Collaboration Strategy) as identified in scientific background document
17 and other information of which you are aware? Are there other actions that we should consider
18 for inclusion in the Action Plan that will better achieve the goals of the Action Plan?
19

20 Question 2 – As presented in the scientific background document, we have developed and
21 currently operate the Great Lakes Accountability System (GLAS)⁷ as the primary mechanism for
22 collecting information to monitor and report on GLRI progress. GLAS is still a work-in-progress
23 at this time and it is not ready for external review. However, given the scope of the Action Plan
24 and the nature and types of projects funded under the GLRI, we are interested in the SAB's
25 recommendations on how best to track the progress and accountability for a large ecosystem
26 restoration program. What critical environmental elements, endpoints, or other measures would
27 you include to those identified in the Action Plan?
28

29 Question 3 – Please comment on the overall scope and framework of the Action Plan and its
30 ability to organize environmental issues in a way that directs restoration actions. Does the SAB
31 have any specific recommendations on how to improve or clarify the Action Plan?
32

33 **V. Charge Questions on Toxic Substances and Areas of Concern**

34
35 Question 4 – The presence, significance, and trends of many historically-regulated (or "legacy")
36 contaminants in the Great Lakes are well-documented. Through the Action Plan, we are working
37 to fully implement and enhance existing programs to eliminate releases of many of these
38 contaminants. For example, the GLRI is working to accelerate the rate of sediment remediation
39 in Areas of Concern (AOCs) through the Great Lakes Legacy Act⁸ among other programs.
40 Similarly, the Action Plan calls for initiating strategic pollution prevention and toxics reduction
41 efforts to minimize releases and emissions of many of these same contaminants. Please comment

⁶ Public Law 111-88, the Department of the Interior, Environment, and Related Agencies Appropriations Act, 2010.

⁷ Available online at <http://glri.us/projects.html>

⁸ Funding under the Great Lakes Legacy Act is now part of the GLRI.

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1 on the Action Plan’s approach for addressing so-called “legacy” contaminants through sediment
2 remediation and toxics reduction efforts. Please comment on whether the Action Plan addresses
3 the reduction of “legacy” contaminants at all geographic scales sufficiently to restore the Great
4 Lakes ecosystem. Are there other actions that we should consider?

5
6 Question 5 – The Action Plan also acknowledges the threats posed to the ecosystem by
7 chemicals of emerging concern, such as flame retardants, surfactants, pharmaceuticals and
8 personal care product constituents. To devise and implement effective control strategies, EPA
9 and the other federal agencies are coordinating efforts to identify significant sources and impacts
10 of new toxics to the Great Lakes ecosystem through robust surveillance and screening. Please
11 comment on our approach for assessing and managing the risks posed by chemicals of emerging
12 concern. Are there other actions or specific chemicals of emerging concern that we should
13 consider?

14
15 **VI. Charge Question on Invasive Species**

16
17 Question 6 – Invasive species have dramatically altered the Great Lakes ecosystem. New species
18 continue to threaten the Great Lakes. The Action Plan identifies a set of actions intended to
19 eliminate new introductions, control the spread, and minimize the risks of invasive species. EPA
20 has initiated separate reviews for some of the principal actions in this focus area. Ballast water
21 technology is being reviewed by a separate SAB panel. The Asian Carp activities are being
22 addressed through the Asian Carp Control Strategy Framework that is being elevated to a
23 program unto itself in coordination with GLRI. Therefore, we are asking the SAB’s for advice
24 and recommendations on the remaining actions to address invasive species. What are the key
25 scientific data needed in an early detection surveillance network to provide up-to-date critical
26 information for evaluating rapid response options? Does the SAB have any recommendations on
27 demonstrated preventative and control technologies that could be applied to invasive species in
28 the Great Lakes? Are there other actions that we should consider?

29
30 **VII. Charge Question on Nearshore Health and Nonpoint Sources**

31
32 Question 7 - The report *State of the Great Lakes 2009* has documented that “phosphorus loads
33 may be increasing after a long period of decrease, and that an increasing proportion of the
34 phosphorus is an available, dissolved form.” The increased phosphorus loads along with other
35 stressors are degrading nearshore water quality as evidenced by eutrophication, harmful algal
36 blooms (e.g. *Cladophora* and *Microcystis*) and avian botulism. To address these problems, the
37 Action Plan identified a set of principal actions to improve the health of the nearshore areas and
38 reduce nonpoint source pollution to levels that do not impair nearshore waters of the Great
39 Lakes. These principal actions include identifying sources and reducing loadings of nutrients and
40 soil erosion and targeting watershed plan implementation in high priority watersheds. Please
41 comment on the adequacy of the principal actions to address the impacts associated with
42 nearshore soluble reactive phosphorus, *Cladophora* biomass, and dreissenid biomass. Are there
43 other actions that we should consider? Please comment on the Action Plan’s intent to target

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1 Great Lakes subwatersheds⁹ that show severe signs of stress for focused restoration activities as
2 opposed to a broader approach that targets all watersheds (stressed and currently unstressed).

3
4 **VIII. Charge Questions on Habitat and Wildlife Protection and Restoration**

5
6 Question 8 – One of the Action Plan’s principal actions to protect and restore habitat and wildlife
7 is aimed at improving “aquatic ecosystem resiliency”. “Resiliency” is loosely defined in the
8 Action Plan as providing an ecosystem with the capability to buffer the impacts of potential
9 problems such as climate change. Please comment on the concept of “resiliency” in restoring and
10 protecting aquatic habitats in the Great Lakes ecosystem. Does the SAB have any
11 recommendations on actions to increase “resiliency”? Are there additional ecological elements or
12 measures that should be considered to better improve resiliency or buffering capacity and our
13 progress in habitat restoration and ecosystem protection projects? What about actions in the other
14 focus areas?

15
16 Question 9 – The Action Plan broadly defines “restoration” to encompass physical, biological,
17 and chemical functions and processes. Are the actions listed in the Action Plan “restoration”
18 actions?

19
20 **IX. Charge Question on Accountability, Education, Monitoring, Evaluation,
21 Communication, and Partnerships**

22
23 Question 10 – Focus Area 5: Accountability, Education, Monitoring, Evaluation,
24 Communication, and Partnerships, is intended to provide the “necessary backbone” of the entire
25 GLRI through oversight, monitoring and assessment, education and outreach, and partnerships.
26 This focus area is intended to implement assessment and evaluation actions to address gaps in
27 knowledge and an inadequate understanding of complex and emerging issues. Does the SAB
28 have any recommendations of critical data gaps for which programs or tools should be
29 implemented in the other focus areas? Please comment on the Action Plan’s approach for
30 enhancing coordination and collaboration among Great Lakes partners to address key scientific
31 issues.

32
33 Question 11 - Outreach and education are crucial in the effort to restore the Great Lakes. The
34 Action Plan identifies the need to educate future generations to extend restore efforts. Please
35 comment on the Action Plan’s approach to incorporate Great Lakes stewardship into
36 environmental education curricula.

37
38

⁹ These include the targeted geographic watersheds identified on pages 16 and 28 of the Action Plan and other Areas of Concern