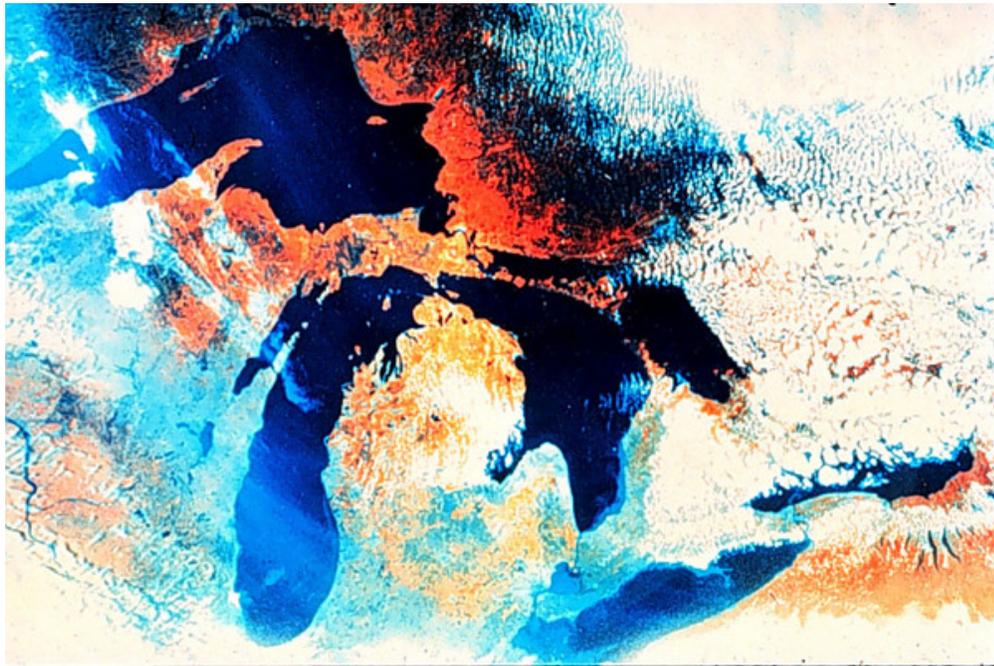


**BUILDING AN INTEGRATED MODELING AND FORECASTING FRAMEWORK FOR  
LAKE-WIDE MANAGEMENT IN THE GREAT LAKES: A COLLABORATIVE  
WORKING GROUP**

**WORKSHOP REPORT**



**ACKNOWLEDGEMENTS:**

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## I. EXECUTIVE SUMMARY

On December 9 and 10, 2010, a group of scientists and resource managers met to discuss a framework for collaborating in respect to ecosystem modeling and forecasting efforts in the region. During the workshop, the participants evaluated lakewide ecosystem modeling and forecasting working groups as the appropriate mechanism to implement the collaboration framework. The working groups are designed to address modeling and forecasting needs identified by management priorities, modelers and resource managers in the Great Lakes. Ultimately workshop participants agreed that a Lake Michigan working group would act as a test case prior to expanding the concept to other lakes.

On a lakewide scale, a Lake Michigan modeling and forecasting working group would bring together existing management priorities such as the Lake Michigan Lakewide Management Plan (LaMP), the International Joint Commission, the Great Lakes Interagency Task Force, the Lake Michigan Committee of the Great Lakes Fishery Commission, legislation, and so forth. In addition to meeting management priorities, the working group brings together resource managers and users to determine information needs which would then inform model development and product delivery.

Some Intended outcomes of the working group are to improve the ability to implement ecosystem-based management, help improve decision-making by meeting information needs of resource managers, increase the capacity for the modeling and forecasting community to address lakewide issues, improve the usefulness and functionality of models and model products, and advance the modeling and forecasting field by creating standards, integrating best practices and sharing resources.

To meet the overarching goals of the working group, workshop participants identified key roles of working group members; 1) *leaders in the field* of modeling and forecasting and 2) *brokers* or connectors. As leaders in the field, members and partners share and merge expertise, data and resources. In this capacity, working group members could identify best practices, gaps and continuities, and set standards and priorities in the field that are aligned with Great Lakes management priorities.

Secondly, the working group could act as *brokers*. For this document, *brokers* are individuals or groups that bring together model end-users (i.e., policy-makers, resource managers and other users of model outputs) and model developers to facilitate communication, coordination, and collaboration. As *brokers*, the working group helps facilitate improved decision-making as well as the usefulness and functionality of models by identifying modeling needs of resource managers and other users, and determining appropriate modeling approaches to meet those needs. In effect, the working group helps improve the delivery of models and model products.

Workshop participants suggested a formal working group structure, consisting of a core standing committee which would create permanent or temporary sub-committees or task

groups to achieve objectives outlined by the working group. Members and partners of the Lake Michigan working group could consist of federal, state, local and tribal agencies, academic institutions, NGOs, and the private sector. Partners were suggested as having many possible roles from providing education and advocacy to consulting and modeling expertise.

The Great Lakes Observing System (GLOS) was identified by workshop participants as the preferred choice for facilitating the Lake Michigan working group. GLOS was described by some workshop participants as having the interests of all agencies in its mission. The goals of the working group align with GLOS, which seeks to develop a coordinative body for modelers to share tools, resources and knowledge. GLOS is basin wide and has resources to support staff time to facilitate and coordinate operations of the working group.

Participants also explored possible challenges to the working group and as well as strategies to overcome these challenges and foster collaboration, promote trust and respect, and ensure long-term maintenance of the working group.

Since the workshop, Don Scavia, Professor and Director of the Graham Environmental Sustainability Institute, agreed to serve as interim chair of the Lake Michigan Working group. In addition, the Great Lakes Observing System hired Sara Katich to help facilitate and coordinate working group activities based on the findings from this workshop.

## **II. NEXT STEPS**

Lake Michigan management priorities will drive all future working group activities. The working group coordinator is beginning to compile documented management priorities for the founding meeting where future members and partners will begin to discuss possible working group activities.

As this report is circulating among the Great Lakes community, future member and partner entities should begin to brainstorm opportunities to collaborate in the near or long-term. Representatives of agencies and organizations could potentially serve on the core standing committee, participate in future sub-committees, act as temporary members or fill other roles identified by the group.

At a minimum, the core membership needs to include a representative from the relevant federal, state, local, and tribal agencies in the region. These agencies need to designate a formal liaison to the working group to ensure their interests are represented and that entities with authority over decision-making are present. Future members should be individuals who are able to consistently represent their agency or organization in working group activities and serve to gain professionally from collaborating with members of the modeling and forecasting community.

Partner and member agencies and organizations should contact Sara Katich with the name and contact information of the person that will act as the member or liaison for the group, along with any ideas for possible future working group activities. Once a core group is identified, GLOS will organize the group's first meeting.

Sara Katich, Working Group Coordinator  
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## **II. BACKGROUND**

The Great Lakes Restoration Initiative provides resources to better manage the environmental issues impacting the Great Lakes. A key component of this regional initiative is the use of models that help explain the components of Great Lakes ecosystems and the processes that impact them. Similarly, ecosystem forecasts allow scientists and resource managers to develop and evaluate alternative management strategies to address these environmental issues.

The shared management responsibility of Great Lakes ecosystems has established a tradition of collaboration between states and various U.S. and Canadian federal and provincial agencies. As modeling and forecasting efforts in the Great Lakes develop, it is crucial that federal, state, and provincial agencies, as well as other relevant entities in the Great Lakes coordinate their activities to prevent duplication, identify opportunities to fill management priorities, leverage resources, and deliver more useful and effective products to users to increase the effectiveness of modeling and forecasting efforts.

To address this need, the Cooperative Institute for Limnology and Environment Research, EPA's Large Lakes Research Station, Illinois-Indiana Sea Grant, NOAA's Great Lakes Environmental Research Laboratory, USGS Great Lakes Science Center, and the Great Lakes Observing System hosted a regional workshop to develop a framework for coordinating ecosystem modeling and forecasting activities in the Great Lakes. The overarching goal a community-driven framework is to provide a formal continuous mechanism through which relevant agencies and organizations can come together to collaborate on the improvement, development, and application of models and forecasts.

A summary of the workshop proceedings and findings is presented next.

### III. WORKSHOP

#### A. Introduction

##### *i. Purpose of the Workshop*

On December 9 and 10, 2011, members of the Great Lakes modeling and forecasting community gathered at a workshop in Ann Arbor, MI to discuss creating a Lake Michigan Ecosystem Modeling and Forecasting working group. Participants from government agencies, non-governmental organizations (NGO), academia, and the private sector discussed the value and development of the working group. Workshop participants discussed the relevant objectives, scope of activities, organizational structure, membership, and partners of the working group. Workshop participants explored using the Lake Michigan working group as a test case prior to implementing the working group in other lakes.

##### *ii. Workshop Overview*

A plenary session was held the morning of the first day of the workshop with talks to demonstrate the need for ecosystem modeling and forecasting, and its value in informing management and policy decisions in the Great Lakes. The workshop began with presentations from Judy Beck, EPA and Marie Colton, GLERL to set the stage for the need for collaboration among the modeling and forecasting community.

Judy Beck, National Program Office, EPA, presented *The Lake Michigan Lakewide Management Plan* which provided an overview of the Lakewide Management Plans (LaMP) using the Lake Michigan LaMP as an example. The LaMP has a primary goal of restoring and protecting the lake's ecosystem integrity.

Marie Colton, GLERL, presented *Toward Establishing an Ecological Forecasting System Framework for the Great Lakes*, which provided rationale for developing an ecological modeling and forecasting framework on a regional scale. The framework could help address regional needs for ecosystem-based resource management, agency plans for producing ecosystem services and integrate the modeling and forecasting community. Marie pointed out that in order for the working group to be a success, participation from all agencies is essential.

The following case studies were presented to demonstrate lessons learned from similar collaborative efforts both inside and outside of the Great Lakes region including: (For summaries of presentations, see appendix A)

- Lake Michigan Mass Balance Study: Successes, Lessons Learned, and Challenges (Russ Kreis; Office of Research and Development, U.S. EPA)

- Beach Health Interagency Coordination Team (BHICT) (David Rockwell; Center of Excellence for Great Lakes and Human Health, NOAA; Cooperative Institute for Limnology and Ecosystem Research, University of Michigan)
- Modeling & the Chesapeake (Kevin Sellner; Chesapeake Research Consortium)
- Community Frameworks for Ecological Modeling and Forecasting: Lessons Learned; An Ecological Forecasting System for the Chesapeake (David Green; National Weather Service, NOAA)

Below are some overarching and consistent messages that were identified as best practices among the case studies:

- Models need to be driven by resource managers and other decision-makers
- Working group members need to communicate regularly
- Engage a broad spectrum of interested parties from multiple disciplines
- Leverage existing resources by building on existing projects
- Have a clear goals and vision for the group that represents the interests of all parties

The plenary session was followed in the afternoon by a breakout session in which participants were separated into four discussion groups, each with a facilitator and rapporteur. All breakout groups were asked to consider a set of questions (see appendix D) intended to guide group discussion. The workshop guiding questions elicited advice from participants on key topics including the objectives; scope of activities; organizational structure; affiliation; and the type of members and their roles.

Finally, the participants considered potential challenges to the implementation of the modeling and forecasting working group as well as activities to overcome those challenges and foster collaboration. On the second day of the workshop, the breakout groups reported the outcome of their discussions to the full group of participants. The full group openly discussed the framework and formation of the Lake Michigan working group at the end of the workshop.

## **B. Workshop Findings**

### *i. Working Group Roles*

Two main overarching themes were identified as key roles of the Lake Michigan working group. First, the working group could serve as *Leaders in the Field*, dedicated to sharing and merging expertise, data and resources, thus advancing the field of modeling and forecasting through

identifying best practices as well as gaps and continuities in modeling and forecasting science. In that respect, the working group acts as a panel with the ability to establish standards, identify priorities, and facilitate a model and data inventory.

Secondly, *brokers* are individuals or groups that bring together model end-users (i.e., policy-makers, resource managers and other users of model outputs) and model developers to facilitate communication, coordination, and collaboration. As *brokers*, the working group helps facilitate improved decision-making as well as the usefulness and functionality of models by identifying modeling needs of resource managers and other users and determining appropriate modeling approaches to address those needs. In this capacity, the working group also helps improve the delivery of models and model products by working to address user needs. Development of actual models was not originally contemplated as a potential activity for the working group. Some participants of the workshop suggested that the working group could be used as a vehicle from which to build comprehensive multi-sector models or sets of single-sector models. However, the majority of participants concluded that direct involvement in model development would be in conflict with the other working group activities.

The workshop findings are organized so that the information elicited from the workshop participants is organized as a set of objectives under the two suggested working group roles. For each objective, a list of potential activities recommended by the participants is also provided.

## 1. Leaders in the Field

Workshop participants identified three key objectives that fall under *Leaders in the Field*. As *Leaders in the Field*, members of the working group act as a panel of experts, advancing the field through integrating the most relevant research into model development, promoting cooperation and collaboration in data development and storage, and setting standards and priorities.

### *Objectives and Activities*

Objective One: Assist developers in integrating and identifying the most current research and best practices into model development by

- encouraging the participation of multiple disciplines throughout the model development process, including scientific, economic and social issues;
- raising awareness of social and economic impacts including cost/benefit ratios and trade-off analysis when possible;
- helping identify gaps and continuities that exist in the field between users and models, models and models and interfaces to understand the usefulness of models in addressing issues;

- using gap analysis to demonstrate justification for future studies or investigations; and
- seeking out best practices to guide future projects and stretch resources.

Objective Two: Promote information and data sharing among stakeholders and help streamline data development and database creation by

- facilitating the creation of relevant model and data inventories and assessments (both for model developers and users);
- helping ensure modeling activities and data integration is occurring on common or interoperable grids;
- helping identify models that are currently not in use but that could be moved forward by an agency that wants to transition it to operation;
- promoting free and open (non-proprietary) exchange of data and models; and
- emphasizing information sharing to users.

Objective Three: Create standards, criteria and priorities for modeling and forecasting by

- developing common definitions of lexicon (definitions for model, forecast, scenario...etc.) in terms of reference or glossary;
- establishing set criteria or a baseline standard for models;
- developing a transparent set of model selection criteria to assist managers and end-users in identifying the appropriate models to address their needs;
- helping define hierarchy of rigor and operational support for various models; and
- standardizing data collection metrics and methods and weigh relative value of optimizing current data collection to new methods.

## 2. Brokers

As *brokers*, the working group acts as connectors, creating an integrated modeling and forecasting community working to proactively manage the Great Lakes. Working group members would help resource managers and end-users define modeling needs, identify appropriate modeling approaches to address Great Lakes issues, and help improve the delivery of models and model products. Members would identify opportunities to educate and foster

continuous communication between the management, end-user, and modeling communities. At times, the working group may not possess the appropriate expertise to evaluate such needs. It would be expected that in such cases the working group would seek out advice from relevant members of the modeling and research management communities.

### *Objectives and Activities*

Objective One: Provide a setting for discussing a broader vision for the role of modeling and forecasting in proactively managing the Great Lakes from an ecosystems perspective by

- maintaining an awareness of the Great Lakes at the lake and basin level;
- understanding lake management from a national and international perspective;
- promoting communication and collaboration across agencies and other relevant organizations to prevent duplication of effort; and
- identifying broader questions needed for lake-wide management and bringing managers and experts together to solve these questions.

Objective Two: Ensure that resource manager and end-user needs are being reached by

- assisting managers in determining if it is possible to meet management and stakeholders needs through modeling and forecasting;
- helping identify manager and end-user needs under a proper management decision framework (Who is making the decision? What information and data is needed? What additional information do they need to make the decision? Who are users and what do they want? How do users make decisions and what information do they need?);
- facilitating communication and connections between end-users and federal, state and local decision-makers to ensure common understanding of needs;
- encourage resource managers and model developers to engage end-users up front at the beginning of the process and involve multiple stakeholders throughout; and
- connecting end-users and management to the correct data, model or method needed to make a specific decision.

Objective Three: Encourage joint problem solving and offer expertise to resource managers regarding the most appropriate modeling approaches to meet end-user needs by

- helping identify optimal modeling approaches;

- ensuring compatibility of model architecture;
- connecting managers and modelers involved with upper and lower trophic levels;
- ensuring commitment to observations and process science for models;
- helping determine the temporal and spatial scales that are the most useful (Approaches need to be flexible enough to address local and small scale as well as whole lake basin);
- encouraging joint problem solving to ease tensions between decisions at the local level and lake wide ecosystem effects and brainstorm how to bridge this gap (This needs to be resolved both for the model scale and to build stakeholder perception that locals are linked to one another);
- helping establish basic data compatibility (grid size, grid location) by using the same spatial framework even if at different scales;
- compiling assessments of management responsibilities (Who is managing what on what space and time scales?); and
- helping determine the standard for acceptable level of risk in a given system.

Objective Four: Support product development and delivery to improve usefulness and functionality of models by

- exploring developing standards for product delivery (i.e., free, well-documented);
- Facilitating the translation of model results in a manner that is understandable to end-users;
- fostering interaction and continuous learning between modelers, managers, and end-users;
- acting as a data and modeling products clearinghouse so users know where to find products and what is available;
- facilitating development of user-friendly models or providing end-users with model results;
- encouraging the development of modeling educational and training opportunities for managers, modelers and end-users;

- helping identify the appropriate temporal (nowcast versus forecast), format and visualization (text, graph, spatial) outputs needed by the end-users;
- encouraging the use of dynamic communication strategies (social media) for getting information to end-users;
- creating a web interface that provides accessibility to relevant models; and
- encouraging post-delivery evaluations of model effectiveness

## *ii. Working Group Structure*

Workshop participants suggested a formal structure for the working group. The Technical Committees of the Great Lakes Fisheries Commission and the Cooperative Science and Monitoring Initiative were identified as two possible organizational structures to follow. The working group could consist of a core standing committee that would determine the activities and champion the process. The core committee would have the flexibility to create permanent or temporary sub-committees to achieve specific goals and objectives outlined by the working group. It was also highly recommended by the participants that a staff person be dedicated to facilitating day-to-day operations of the working group. Ultimately, the organizational structure will be determined by members once the working group meets. A suggested Terms of Reference is available in appendix C.

### 1. Participating Organizations/Representation

The core membership of the working group should include the relevant federal, state, local, and tribal agencies in the region. These agencies will designate a formal liaison to the working group to ensure their interests are represented and that entities with authority over decision-making are present. The working group would also be open to other relevant interested parties. Workshop participants suggested that organizations such as the Great Lakes Observing System (GLOS), Cooperative Science and Monitoring Initiative (CSMI), Lakewide Management Plans (LaMPs), Great Lakes Fisheries Commission (GLFC), International Joint Commission (IJC) and the Great Lakes Commission (GLC) participate in the working group. The types of experts recommended for membership are:

- Modelers (from different areas of interest)
- Biophysical scientists
- Resource managers
- Social Scientists (including economists)

- Communication specialists
- Educators

Below is a list of potential roles of member and partner organizations. Workshop participants discussed roles of bi-national organizations, federal, state, local and tribal agencies, NGOs, academic communities and the private sector.

#### *Bi-national Organizations*

- Coordination, facilitation, dissemination across a range of international issues.
- Sponsor studies and activities relevant to their organization, role and/or mission.
- Help facilitate data sharing and transfer between the United States and Canada.
- Bring bi-national perspective from regions.
- Build partnerships with Canada.

#### *Federal Agencies*

- Provide monitoring data and modeling expertise.
- Coordinate activities to maximize efforts and minimize duplication of resources.
- Establish regulatory uses at the federal level.
- Stakeholder outreach.

#### *State, Local and Tribal Agencies*

- Provide monitoring data and modeling expertise.
- Coordinate activities to maximize efforts and minimize duplication of resources.
- Establish regulatory uses at the state, local and tribal levels.
- Provide stakeholder outreach.
- Provide feedback for modeling activities.

- Interact on a local scale to gain understanding about management, stewardship and model utility.

#### *Academic Institutions, Sea Grant Programs*

- Advise to ongoing and upcoming research.
- Provide research data and modeling expertise.
- Coordinate outreach and extension activities.

#### *NGOs*

- Education and stewardship.
- Advocacy and political support.
- Provide monitoring and research data.
- Coordinate public engagement activities.

#### *Private Sector*

- Consultation and advocacy.
- Provide research data and modeling expertise.
- Collaborative management (commercial fisheries, farmers, marine operations, shipping industry).

## 2. Affiliation

A few participants suggested that the group should begin as a stand-alone entity and change organically over time. However, the broader group agreed to be affiliated with an organization because of the immediate need for resources and a paid staff person committed to the working group. Workshop participants identified the Great Lakes Observing System as the best fit for facilitating the Lake Michigan working group.

#### *Great Lakes Observing System (GLOS)*

The Great Lakes Observing System is a nonprofit association dedicated to connecting data users with data providers in ways that are supportive of policy and decision making. GLOS works

towards a fully integrated, bi-national observing system that provides products and services to decision-makers, resource managers and other data users with input from members and partners, to foster understanding and inform decision-making related to the Great Lakes and St. Lawrence River. As facilitator of the working group, GLOS could provide the proper atmosphere for creating an integrative perspective for the working group and help to fulfill the coordination and facilitation role.

#### Rationale for GLOS as facilitating organization:

- The working group fits the mission, goals and objectives of GLOS, which seeks to develop a coordinative body for modelers to share tools, resources and knowledge.
- Expansion to other lakes may be relatively simple because GLOS is basin wide.
- Allows active involvement with academics and consultants.
- Provides access to an existing network of data, modeling and partnerships.
- Ability to provide resources to facilitate activities of the working group.
- Seen as an independent body, incorporating interests of all agencies.
- Ability to provide links to agencies as a source of “test beds” for development and validation of models and forecasts.

#### Potential Issues:

- Perceived by some as having a stronger connection to one specific agency.
- Long-term uncertainty, currently dependent on grants for its operational costs

#### *Role under a new GLOS Enterprise Architecture*

A team lead by LimnoTech is creating a comprehensive design of the enterprise architecture for GLOS, which will describe how GLOS will deploy observation technologies over the next five years to facilitate effective decision-making by Great Lakes stakeholders. Part of the enterprise includes data management, communication, modeling and delivery to end users, including designing how data is passed on to models and other products. The Working Group would help integrate this process into modeling and forecasting activities in Lake Michigan.

### *iii. Challenges*

Participants brainstormed the possible challenges or roadblocks that exist in forming and implementing the working group. Challenges mentioned by workshop participants include:

- ensuring support from agency leadership that will ensure continued resources and participation by working group members;
- building trust and durable relationships among agencies and other participants that have different missions and goals;
- overcoming personnel turnover within organizations, including keeping parties engaged and ensuring that a mix of disciplines is represented;
- sharing information including data and models;
- matching-up forecasting accuracy/scales/approaches to meet large variety of manager needs;
- keeping participants from discussing technical and other aspects of the project beyond working group objectives;
- involving all interested parties from local to federal managers;
- understanding and managing the dual roles of some agents (such as state managers) as both clients and contributors; and
- managing organizational aspects of the working group efficiently to ensure the maximum amount of resources is spent on working group activities.

### *iv. Fostering Collaboration*

Workshop participants brainstormed possible strategies to foster collaboration, promote trust and respect, and ensure long-term maintenance of the working group. Suggested activities for fostering collaboration include:

- establishing transparency in all working group activities including data collection methods and decision-making processes;
- encouraging consensus based decision-making activities through joint fact finding and learning;

- ensuring members agree and commit to a set of operational principles (i.e., memorandum of understanding, terms of reference) so that members understand expectations and rules of the working group, including frequent and regular communication;
- hiring or elect a facilitator or leader responsible for organizing meetings and workshops;
- identifying a champion that pushes the agenda forward;
- encourage joint proposals to RFPs to promote collaborative efforts among agencies;
- identifying opportunities to save money between groups of common interest;
- promoting a series of seminars for science exchange at rotating locations such as the State of Lake Michigan conference;
- incentivizing members through enhancing current work or saving time by making it easier for participants to perform duties; and
- engaging end-users through a proactive awareness campaign

## V. APPENDICES

### Appendix A. Workshop Presentation Summaries

*The Lake Michigan Lakewide Management Plan (Judy Beck; Great Lakes National Program Office, U.S. EPA)*

The purpose of this talk was to provide a general overview of the Lakewide Management Plan (LaMP) concept using the Lake Michigan LaMP as an example. As a result of the 1987 Great Lakes Water Quality Agreement, LaMPs were developed for each of the Great Lakes in order to provide comprehensive assessments of ecosystem condition and establish through a consultation process viable management strategies to restore and protect the lakes. LaMPs are revised periodically so that management goals and objectives can be updated in accordance to new scientific information and societal environmental goals. The first formal Lake Michigan LaMP was issued in 2000 with the main goal of restoring and protecting the lake's ecosystem integrity. The plan has 12 sub-goals stated as questions addressing issues such as the suitability of key resources (i.e., edible fish, water, and beaches) for human use or consumption, the impact of human activities on ecosystem condition, the role of stakeholders in ecosystem stewardship, and information gaps affecting the management and policy decision-making processes. Additional information on the various LaMPs can be found at <http://epa.gov/greatlakes/lamp/index.html>.

*Toward Establishing an Ecological Forecasting System Framework for the Great Lakes (Marie Colton; Great Lakes Environmental Research Laboratory, NOAA)*

The presentation provided rationale for developing an ecological modeling and forecasting framework on a regional scale. The framework could help address regional needs for ecosystem-based resource management, agency plans for producing ecosystem services and integrate the modeling and forecasting community. The Great Lakes community needs to proactively manage the Great Lakes and address emerging issues such as freshwater resource management, ecosystem engineering and climate change. Modeling and forecasting are needed to protect our natural resource based economy and serve as an integration mechanism across multiple disciplines. Currently, planning and policy documents highlight the need for NOAA and others to develop ecological forecasting capabilities and technology. An Ecological Forecasting System (EFS) is proposed as one way to address these needs. The EFS is a basin-wide effort that needs long-term applications and operations. Without a framework, problems of wasted development, lost leveraging, inefficiency, backlog for new products and lack of integration will only accelerate as the field matures and management demand increases. It is imperative that EFS includes organizational commitment, an evaluation of user needs, observation and data exploitation, model-based forecasting development and integration, sustained operations and distribution, and balances general utility versus specific needs.

*Lake Michigan Mass Balance Study: Successes, Lessons Learned, and Challenges (Russ Kries; Office of Research and Development, U.S. EPA)*

The Lake Michigan Mass Balance Study was planned based on identifying both management and research needs and questions. Managers needed the relative loading rates of pollutants from the atmosphere, tributaries, and sediments to target load reductions and gauge future progress. Researchers needed to develop the predictive ability to determine the environmental benefits of specific load reduction scenarios and the time to realize such benefits. Contaminants were identified as nutrients, Atrazine, PCBs and Trans-Nonachlor. Drivers were identified as legislative authorities and statutes. The modeling framework brought modelers into the planning process, provided a multi-disciplinary setting, and took a multimedia approach concerning air, land, water and biological resources. The mass balance approach was taken using the WASP/QUAL-IC Hybrid model. The monitoring, analyses, database and modeling aspects of the project worked as a continuum. The project committee and working group included multiple sustainable partnerships including federal and state agencies, academics, NGOs and the private sector. A formal structure was created with a program steering committee, technical coordinating committee and specific working groups (air monitoring, biota, chemistry, etc.) Communication was essential – getting the right information, at the right time, in the right manner, to the right people. This was done in the form of peer-reviewed journal publications, technical reports, technical conferences and workshops, Lake Michigan LaMP committees, reports and updates. Information was provided at various conferences including the Lake Michigan State of the Lake Conference, Lake Michigan Technical committee, State of the Lakes Ecosystem Conference, national forums, as well as legislative and regulatory groups and videoconferences. Key messages from the study include establishing management and research needs and questions, bringing modelers into planning up front, study monitoring, analyses, databases and modeling in a continuum, establish sustainable partnerships and communicate.

*Beach Health Interagency Coordination Team (BHICT) (David Rockwell; Center of Excellence for Great Lakes and Human Health, NOAA; Cooperative Institute for Limnology and Ecosystem Research, University of Michigan)*

In 2009, the Beach Health Interagency Coordination Team (BHICT) was created to formalize a tri-agency partnership between NOAA operational forecasting and research, USGS monitoring and modeling research, and U.S. EPA remediation, decision support, and environmental research. The group acts as a coordinating body for beach water quality forecasting between the three agencies. Products and activities of the group include documenting an inventory of beach water quality activities, creating maps showing tri-agency cooperation, supporting rationale for GLRI funding and developing generalized processes for beach quality nowcasting forecasting and product delivery. Examples of working group activities were presented. The success of the working group was attributed to regular phone and video meetings plus face-to-face meetings, capitalizing on agency capabilities, tri-agency operational manager involvement (not a top-down senior management initiative), the coordination of specific tasks (Great Lakes Restoration Initiative) and funding of a dedicated staff position. Possible challenges could have arisen if there was a lack of definite products for the end-users, BHICT being viewed as owned by one agency, turn-over of key agency personnel, and lack of appropriate dedicated coordination staff.

*Modeling & the Chesapeake (Kevin Sellner; Chesapeake Research Consortium)*

The objective of the presentation was to provide lessons learned from the Chesapeake Bay project. These lessons include identifying short and long-term goals for the users of the model, thinking carefully about the grid, being consistent with goals, developing conceptual model of dominant system processes and understanding confidence or uncertainty estimates. The Chesapeake Bay program modeling suite was designed for water quality in the early 1980s. After selecting a model, it is important to establish a confidence limit for the model output or consider using ensemble modeling. Early on, establish future uses of the work including regulatory. Confidence levels are important for providing estimates. Estimates of uncertainty (TDML) are critical when implementation costs exceed billions. Another important lesson was to have a critical assessment and tabulation of the water cycle and nutrient sources needed in a conceptual model to inform any ecosystem model or ecological forecast. The group also had to consider geographic and bathymetric limitations beyond water quality as well as long-term data planning streams. Identifying management goals were needed to decide model types and appropriate data.

*Community Frameworks for Ecological Modeling and Forecasting: Lessons Learned; An Ecological Forecasting System for the Chesapeake (David Green; National Weather Service, NOAA)*

The presentation began by providing a general framework for creating products and services to stakeholders, partners and users. The framework integrates science and services into a community of practice and formalizes cooperation and collaboration to extend regional capacity. The goal of the project was to strengthen model-based predictive science and establish integrated environmental services for the Chesapeake Bay. The purpose was to create near-time applications, climate projections and decision support tools. Pilot forecasts were done for beach and water quality, living resource distribution, dissolved oxygen predictions, harmful algal bloom and disease pathogen progression. To transition the work into sustained services, the objectives were to leverage the National Ocean Service supplied Chesapeake Bay Operational Forecast System model and strengthen systems for operations as well as disseminate products through the National Weather Service. A case study is shown on beach and water quality showing the issue, solution, operational concept, collaborators, output product, dissemination and outcome. The lessons learned are to realize that there are barriers to the project, foster communications and coordination, engage stakeholders, engage partners and users, and use marketing basics to move the project forward. The presentation then describes future plans for the Chesapeake Bay Forecast System.

## **Appendix B. Suggested Terms of Reference for the Lake Michigan Ecosystem Modeling and Forecasting Working Group**

*(Note: The following text is provided as an example of what the Terms of Reference could look like in terms of establishing a set of operational principles to guide the activities of the proposed working groups.)*

### **Purpose**

The Lake Michigan Ecosystem Modeling and Forecasting Working Group (from herein, The Working Group) will implement a framework through which relevant federal, state, and tribal agencies along with other key partners can come together to coordinate their activities related to ecosystem modeling and forecasting in Lake Michigan. This framework will also promote collaboration where appropriate in any existing or new modeling and forecasting efforts. The Working Group and its members are charged with, but are not limited to, completing the following tasks:

- Determining the proper approaches to model and forecast the critical needs identified by the Working Group
- Facilitating the collaboration and coordination of efforts by federal, state, and tribal agencies along with other key partners to develop and implement the models and forecasts necessary to facilitate the management of Lake Michigan
- Seeking and identifying the appropriate input data for the model and forecasts
- Helping to ensure that relevant modeling and forecasting tools are accessible to relevant resource managers and policy makers

### **Membership and Participation**

The Working Group will function as an independent body with support from federal and state agencies, tribal organizations and regional coordinating entities. The membership of the Working Group shall consist of no more than 2 (one primary and one alternate) appointed representatives from each of the Member Agencies and Organizations listed below.

#### *Member Agencies and Organizations*

*(Note: Other agencies and organizations still need to be added to this list.)*

#### Federal

U.S Army Corps of Engineers  
U.S. Department of Agriculture  
U.S. Environmental Protection Agency  
U.S. Fish and Wildlife Service  
U.S. Geological Survey

National Oceanic and Atmospheric Administration

State

Illinois Environmental Protection Agency  
Illinois Department of Natural Resources  
Indiana Department of Environmental Management  
Indiana Department of Natural Resources  
Michigan Department of Natural Resources  
Michigan Department of Environmental Quality  
Wisconsin Department of Natural Resources

Tribal

Chippewa-Ottawa Resource Authority  
Little River Band of Ottawa Indians  
Little Traverse Bay Band of Odawa Indians  
Grand Traverse Band of Ottawa and Chippewa Indians

*Non-Agency Members and Consultants*

Adjunct Members

The Working Group may invite, as appropriate, key regional coordinating bodies to participate as permanent Members. As Members of the Working Group, these entities would provide guidance and advice in respect to science, policy and management issues. Adjunct Members to the Working Group only act in an advisory capacity and shall not have an active role in Working Group decision making.

Temporary Members

When appropriate, the Working Group may choose to invite as Temporary Member(s) individuals that possess expertise necessary to carry out specific activities deemed essential to the mission of the Working Group that is not available from the Working Group's current membership. Temporary membership may not exceed one calendar year. A Temporary Membership may be renewed for subsequent years if the specific activities requiring the Temporary Member(s) have not been completed by the Working Group.

Consultants

The Working Group may on occasion, as appropriate, seek the advice of consultants in order to accomplish specific activities relevant to the Working Group's mission. Such advice may be provided through personal communication with Working Group Members, structured

consultation during regular Working Group Meetings or stand-alone workshops focused on a specific activity or activities of the Working Group.

### *Participation*

All Members to the Working Group are expected to participate, as appropriate, in an equitable manner in Working Group activities and assignments. Participation in the Working Group activities and assignments shall be reflective of the Member's expertise and consistent with their respective agency's or organization's interest in the particular issue being addressed.

### **Secretariat**

The Working Group shall have an official Secretariat including a Chair, a Coordinator, and any other officers and support staff deemed appropriate by the Working Group. The Secretariat will assist the Chair in carrying out all activities necessary to fulfill the Working Group's mission. The nature, staffing, and funding of the Secretariat shall be defined and approved by the Working Group, and be reevaluated every five (5) calendar years to ensure its effective operation.

#### *Chair*

*(Note: The idea of co-chairs could be considered to avoid the perception of the Working Group being primarily federal or state driven)*

The Chair is the presiding officer and is expected to oversee Working Group activities.

#### *Coordinator*

The Coordinator shall provide assistance to the Working Group by facilitating and coordinating meetings and providing support to group activities, as appropriate.

### **Working Group Bylaws and Activities**

#### *Bylaws*

The Working Group shall enact a set of Bylaws that will govern its activities and provide guidance to its mission.

*(Note: Bylaws need to specify how the Working Group will operate, in particular how decisions are made, what constitutes a quorum, how meetings will be conducted, how chairs are selected, etc.)*

#### *Meetings*

It is expected that the Working Group shall hold at least one (1) general meeting every calendar year. Additional meetings, workshops, or conference calls may be held to facilitate the activities of the Working Group and ensure the fulfillment of its mission.

#### *Decisions and Reporting of Activities*

It is expected that the Working Group will provide the Member Agencies an annual report of the progress of its activities to include, but not be limited to, its decisions on:

- Activity A
- Activity B
- Activity C

*(Note: A list of key activities would be included in this section.)*

In addition, the Working Group shall issue, as appropriate, with approval of the Member Agencies in a timely manner, additional reports and outreach materials, to inform resource managers, decision makers, and key stakeholder groups of relevant issues related to ecosystem modeling and forecasting in Lake Michigan.

## Appendix C. Steering Committee and Workshop Participants

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## **APPENDIX D.**

### **BUILDING AN INTEGRATED MODELING AND FORECASTING FRAMEWORK FOR LAKEWIDE MANAGEMENT IN THE GREAT LAKES: A LAKE MICHIGAN WORKING GROUP**

#### **DEVELOPMENT AND IMPLEMENTATION WORKSHOP**

**ANN ARBOR, MICHIGAN**

**DECEMBER 9-10, 2010**

#### **Guiding Questions to Facilitate Discussion**

The goal of this workshop is to address the feasibility and effectiveness of establishing a community framework that will facilitate coordination and collaboration on ecosystem modeling and forecasting activities in Lake Michigan. The framework will be implemented as a Working Group focused on the development and transition to operations of ecosystem models and forecasts for resource management in Lake Michigan. During the workshop, several breakout groups will be assembled and asked to provide comments and suggestions on the feasibility the proposed effort.

In order to facilitate discussions during the general and breakout group sessions, we have put together the following guiding questions:

- What is the appropriate and necessary scope of activities for an ecosystem modeling and forecasting working group?
- Should the working group be implemented as standalone entity or should it be housed under the structure of an existing regional entity such as the Lake Michigan Lakewide Management Plan (LaMP)? If the latter, is the LaMP an appropriate place for the Working Group? If not, where else could the Working Group be housed?
- What are the potential roles and contributions of:
  - Bi-national organizations
  - Federal, state, tribal, and local agencies
  - Academic institutions
  - NGOs
  - Private sector
- What would be a suitable organizational structure for such a group?
- What would be the appropriate operational principles to ensure linkage between science and management communities and facilitate coordination/collaboration in the development, improvement, and implementation of ecosystem models and forecasts?
- How can the Working Group promote cooperation and collaboration amongst the relevant agencies and all other relevant organizations to promote the ecosystem management goals for Lake Michigan?
- What product delivery protocols would be most effective to make models and forecasts available to end-users?
- What are/would be the greatest challenges/roadblocks to implementing the community framework proposed for this Working Group?

## Appendix E. Workshop Notes

(Note: The breakout group transcripts have been edited as appropriate to improve language and correct any grammatical errors without altering the original meaning.)

### Breakout Group 1

Group # 1 Coordinating watershed modeling for Lake Michigan

#### **Q1: What is the appropriate and necessary scope of activities for an ecosystem modeling and forecasting working group?**

Partnership with Canada in building systems is central

1. Understand users' decisions or who the users are? (State managers, local decision makers). What do the users want? How to meet those needs? What it takes to meet those needs?

***“Measure, tracking, ensuring-development of measurable goal- establishment of larger scale of measurable objectives-validating-tangible outcome of the modeling-quantifying or measuring-demonstration or pilot activities-Facilitating meetings-***

2. Focus attention on efforts guided by high priority of usefulness of stakeholders (common understanding)
3. Watershed inventory (what is available, data monitoring...)
4. Identify where models are useful to meet goals rather than looking for other goals

***Determine which model is needed to meet those specific decisions (appropriate model or activities for the problem)***

5. Identify gaps and continuity between users and models, models and models, and interfaces
6. Need to look into “Lake ecosystem” not just water quality: Reconnect upper and lower trophic levels (managers and modelers)
7. The scope goes all the way from BIOLOGICAL to ECONOMIC
8. Demonstration of activities-How to engage social scientists and others in the process?

***Economic-scientific-social- Should they be working together and not after one another!***

9. Develop objectives to validate and measure success
  - How do you demonstrate them the utility of a practice or ask them what they believe will work?
  - Example, how do you convince farmers to implement a specific practice (e.g. buffer strips)?
  - Maybe you should translate what you do to WHAT MATTER TO THEM!
  - Set priorities for watershed activities
10. Education/training
11. Interaction-continuous learning between modelers and users

***Web-base interface---get the easiest part of the model out there or to the USERS—You, as a modeler, can monitor or do the complicated part of the model behind the scene.***

#### **Q2: Should the working group be implemented as standalone entity or should it be housed under the structure of an existing regional entity such as the Lake Michigan Lakewide Management plan (LAMP)?**

LAMP only looks into water quality model; therefore, need to address another organization where LAMP can fit.

- LAMP+GLFC, GLC
- Stability of funding—Entity that covers the Great Lake/scope cost

### **Q3: What are the potential roles and contributions of?**

#### **Bi-national organizations—** Provide requirement

- Coordination, facilitation, dissemination across a range of issues
- Sponsor studies and activities relevant to their organization/role/mission
- Data sharing
- Membership, size, role of academia (workforce development)-interdisciplinary

It is important to consider what we know of the GL communities? What are the impediments? These regions are not federal, rather bi-national waters; so, there are things that are specific to those regions

**Federal:** Data monitoring/modeling, regulatory uses, funding management

Money relationship: Federal and Government organizations can work together

**State/Tribal:** Data monitoring/modeling, regulatory uses, funding, management, outreach

**Local agencies (county planning):** interaction with people is done at the local scale- management, stewardship, model utility

#### **Academic institutions**

- Need to know what science has accomplished and see where it can fit. Academia is central to an effort like this without really being part of the group. It is the way to attract students, and researchers. However, it is also important to emphasize how much research is really needed to accomplish this goal.
- Model development: model application. Get an operational model and need force--continuous development. Consider what is end-to-end
- Research, Outreach (extension)

**NGOs:** Some of them are more involved in education, others in stewardship, advocacy, monitoring/data.

**Private sector:** users (shipping industries, marine operations, commercial fishery, farmers), consulting, modelers, advocacy, equipment. The private sector can also be a stressor, insurance industry, economic needs

### **Q4: What would be suitable organizational structure for such group?**

Steering committee (working group TBD), composition, hosting, examples (LMMB)

e.g. different modeling expertise—different functions.

Recommendation: FORMAL STRUCTURE possible model CSMI?

### **Q5: What would be the appropriate operational principles to ensure linkage between science and management communities and facilitate coordination/collaboration in the development, improvement, and implementation of ecosystem models and forecasts?**

- Transparency in priority decision setting
- Frequent communication
- Avoid DUPLICATION and improve COLLABORATION = Minimize duplication of efforts among existing GL bodies and entities and encourage collaboration
- Promote free and open EXCHANGE OF DATA, nonproprietary
- Looking for best practices that have been implemented somewhere else without having to reinvent
- Maintain awareness across the GL at lake and basin level

### **Q6: How can the Working group, promote cooperation and collaboration amongst the relevant agencies and all other relevant organizations to promote the ecosystem management goals for Lake Michigan?**

- People want to collaborate as long as there is something in the group for them. So, there is a need to identify OPPORTUNITIES, ways to save money between GROUPS of common interests
- Promote collaboration as much as possible
- Engaging the users from the beginning-being proactive-Awareness campaign  
e.g. some institutions such as NASA, NWS, etc, are not necessarily looking for more money but RELEVANCE. So, agencies need to be connected to users to make an IMPACT.

**Q7: What product delivery protocols would be the most effective to make models and forecast available to end-users?**

- What the PRODUCT is? The model itself or the information provided by the model (OUTPUT)
- Looking into the actual STANDARDS for product delivery (Open source, free, well documented)
- Identify the temporal (time step-frequency), format/visualization (text, graph, spatial) output needed by the end-users
- End-user identifies thresholds for delivery of information, e.g. coordinate understanding of information before it is released

**Q8: What are/would be the greatest challenges/roadblocks to implementing the community framework proposed for this Working group?**

- Interagency collaboration
- Develop trust
- Data sharing/openness; over activities, user; interdisciplinary collaboration
- Enable without owning—respect, openness, continuity
- Sustainability of the group
- Leading from below/middle-Need leadership

## Breakout Group #2

### Breakout Group 2 – notes

#### Admin details.

Mary Anne Evans took computer notes and Tom Johengen took easel pad notes during the session. This is a compilation of both sets of notes. The easel pad notes are in **bold** and are used as headings for more (possibly overly) detailed computer notes.

Our group decided not to pick a leader but to have a free-form group conversation. At the end of the session they selected Bo Bunnell to give tomorrow's report for the group.

#### Pre-question discussion

What is the goal product of the workshop?

We want to know: Is this possible? Who would be on the working group? What should the follow-up workshops be? Who are the non-member collaborators of the working group?

We are not focused on forming consensus within groups; we want to record the range of opinions.

We got a bit sidetracked into what was probably a premature discussion of question 2. It was proposed that, given we are all talking about ecosystems rather than just water quality, and even though the LaMP is moving toward an ecosystem approach, does it make sense to put the Working Group in the LaMP or in the fisheries commission?

Responses:

Goal is to bring together folks from both groups (they often do not work together now). Idea is not to have it be housed in the LaMP to give them leadership but just because it is available.

The issue is that the models are supposed to address ecosystem-based management but there is no agency or group that does ecosystem-based management. Everyone thinks it is a good idea, but we do not have a place to integrate them. If the Working Group gets setup, that is its task.

Thus it depends on how the LaMP is perceived, if it is seen as only water quality focused, then it may not be the best place

#### **Question 1: Scope of activities for Working Group**

We put the scope of activities in six categories:

- Self scoping
  - a. **Identify management needs, decisions, time scales**
  - b. **Guidance from who wants it- how it serves missions**
  - c. **Common Definitions – terms of reference – management framework**
- **Modeling approach identification**
  - a. **existing capabilities: use previous assessments (eg. LTI)**
  - b. **large inter – disc.**
  - c. **Getting to the right scales to be useful**
    - i. **Resolving local effects vs. lake wide**
    - ii. **Approaches need to be flexible enough to address local/small scale and lake basin (but working group not directing “local” focused projects)**
- **Make B match A**
  - a. **Product development and delivery**
- **Support data integration/availability so “commonly” useable**
- **Integration of models, research efforts, data collection for common interest**
- **Help define hierarchy of rigor/operational support for various needs**

The full brainstorming list for the scope of activities was:

- 1) Identify user needs and connection to management framework
  - a. who is making decisions?
  - b. what information are they using now to make decisions?
  - c. what information do they need?
- 2) (may proceed 1) Identify who wants this? Who are the users?
- 3) Establish definitions of lexicon: what do we mean by model, forecast, scenario... (write a list of "terms of reference" or a glossary)
- 4) What models are needed to meet established needs? Do we even need models, or are some needs met by connecting decision makers to the right data?
- 5) Can we meet the needs with current or developable capabilities? In other words, is what the managers want currently possible?
- 6) Update inventory of models for the region that was put together by Joe DePinto?
- 7) Pull inventories and assessments that are available (both for models and users needs) so that users do not need to be asked what they want again.
- 8) Compile assessment of manager responsibilities. Who is managing what on what space and time scales, where on map?
- 9) Determine appropriate scale for models; try to match what is desired by stakeholders and possible for models.
- 10) Evaluate tension between decisions at the local level and lake wide ecosystem effects, how to bridge this gap. This needs to be resolved both for the model scale and to build stakeholder perception that locals are linked and affect one another.
- 11) Working group will need to be educated enough to ask the right questions, both in general and about scale
  - a. Three scale combinations were discussed
    - i. Large scale actions cause large scale impacts
    - ii. Small scale actions, collectively, cause large scale impacts
    - iii. Small scale actions cause small scale impacts
  - b. i and ii were seen as in the Working Group scope, and iii as outside of its scope.
- 12) Develop or explore the use of dynamic communication strategies (twitter...) for getting information to users. There seems to be a social shift away from even web pages. May need Working Group representation of a communication specialist.
- 13) Key steps
  - a. ID management groups and needs
  - b. ID steps and do models
  - c. Communicate
- 14) Need to establish basic data compatibility (grid size, grid location even if same size) by using same spatial framework even if at different scales, promote use of these standardizations,
- 15) Promote continuity across time
- 16) Build master database of data across scale
- 17) How does the effort of this group connect with the data collection and provision of GLOS (Jen is on organizing committee)
- 18) Would this WG establish a hierarchy of rigor or operational appropriateness for various models and questions?
- 19) matching data collection to questions, standardizing data collection metrics/methods, and weighing relative value of optimizing current data collection to new methods and question vs. value of continuing long term datasets

20) bringing modelers together and asking for common data collection and grid structure...

21) The group could go beyond the above and say that we are going to tackle some big question with this group of models and that we are going to go out to get funding to do that. Consensus is that this is a likely byproduct of the Working Group activity, and GLOS could funnel \$ to this, but that it does not seem to be a charge of the Working Group. If this does happen, a group could form for writing proposals, or even white papers saying what RFPs the agencies should put out

Question 2: In LaMP? IF not, where?

**Structure of group?**

- **Fits mission, goals, objectives of GLOS very well**
  - **User driven**
  - **Developing models/tools for decision makers**
  - **Modeling sub-component**
  - **Flexibility!** These notes are from the discussion focused on access to NOAA pre-operational “test beds” that could happen through GLOS without it’s having the tight emphasis on operationalization as the main goal that can form within NOAA
    - i. **Help with hierarchal development**
    - ii. **Allow the “useful” vs. “operational” emphasis**
    - iii. **Can be iterative before leaping into operational**
  - **Infrastructure exists**
  - **Neutral from WQ vs fish modeling camps**
  - **Expansion to other lakes easy**
  - **Allow academic involvement**
  - **Connection to data**
  - **GLOS would need to develop other agency support “another client”** to make the Working Group sufficiently not controlled by one agency
  - **Need to improve data collection/dissemination**
    - i. **Working group could “push” this**
  - **Easier to fund/support extra people to be “champions”**
  - **Not seen as single agency**
  - **No QUAPPs**
  - **Disadvantages**
    - i. **“grant” based**
    - ii. **LaMPs had issues “better” identified?**

GLOS was proposed as a logical “house” for the working group. It was pointed out that other observing systems have modeling sub-committees, and GLOS does a little bit of this. The GLOS modeling committee people are also the ones organizing this effort, so why are we duplicating the GLOS committee?

GLOS modeling has started some efforts of the types suggested for the Working Group, but it has not been able to move forward due to lack of (science and management) community support. Putting this Working Group in the GLOS modeling committee could give them the mandate they need to make things go.

If we assign this effort to GLOS it seems a good fit with their other mandates. Their connections at NOAA could facilitate feeding established models into operational phase with the weather service but

their independence as a private organization leaves more flexibility for other products that do not fit directly into the weather service MO. It gives ability to work across levels of operational and useful but less rigorously implemented models.

GLOS provides a link to NOAA “test beds” for running models in real time to test them for possible operational use and iterate them to improve uncertainty estimates and matches uncertainty levels to those needed by different users

Other advantages of GLOS: Infrastructure exists; connection to test beds; it avoids the LaMP vs. fisheries camps (neutral ground); GLOS is already basin wide (so expanding from LM pilot project to whole basin would be easier); connection of data, modeling, and communication already all in one place.

It was pointed out that the beach team was successful due, in part, to one funded leader. Having a funded person to lead the Working Group seems more likely to happen under GLOS than in other groups.

Disadvantages of GLOS: is it sustainable under GLOS given their dependency on grants for funding and the potential to lose such grants if federal administrations change (Working Group would require multi-agency support regardless of where it is), too tied to specific locations in the lake and instrumentation?.

Potential issues: GLOS (and IOOS) connection to NOAA vs other agencies could be perceived as a single agency thing, this would have to be moved away from with open statement of “other clients” and funding/ involvement of other agencies in Working Group. Also, the need to make connections to academics clear and GLOS has such connections established. GLOS is run under grants, if some federal administration kills IOOS, then that kills GLOS unless the regional community steps in with funding (though this uncertainty also exists in any federally sponsored activity or group). So, actually this becomes a GLOS advantages because they can more easily accept funding from anyone.

LAMP is run by volunteers, GLOS could do more getting parties to put up some \$ and have a funded person

Tom gave an intro to GLOS.

Advantage of LaMP, it is its connection to a concrete plan for LM and thus to already established needs. Could still connect GLOS housed modeling committee / Working Group to LaMP plan.

There was discussion of the proposed Working Group being proposed to start on Lake Michigan while GLOS and its current modeling committee activities are basin wide, compared to the Lake Michigan focus of the Lake Michigan LaMP. Would housing the Working Group in GLOS force scaling up to a basin wide Working Group? The general thought was that a GLOS housed committee/ Working Group can work on establishing general principles of modeling partnerships using Lake Michigan as an example, thus allowing any scaling up to a basin wide Working Group or the establishment of Working Groups for the other lakes to take place on the timeframe that makes sense. It was also noted that a LaMP housed Working Group could also be scaled when desired due to the presence of LaMPs for the other lakes.

### Question 3: potential rolls of various partners

- 1) Is bi-nationally focused**
- 2) Free anxiety about jurisdiction if “held” within an agency.**
- 3) Neutral ground for ALL agencies or Line Offices to play together**
- 4) YES Academia/consultants need to play for model development (CILER structure for funding)**

GLOS has bi-national input, so does LaMP. LaMP was formed through bi-national agreement; GLOS is bi-national through self-decision.

GLOS could be easier for agencies to work with than agencies working with one another or between branches of NOAA. Interagency fund transfers can be hard because of need to justify “changes” to between agency budgets, but agencies can contract things to GLOS.

Role of academics and consultants needs to be included (a CILER type structure for funding was suggested)

Under GLOS all the components listed in the question can be involved. All these components need to be involved.

Question 4: How would these groups play? What is structure of working group?

- 1) Multi-agency support for “leadership position” housed within GLOS. To drive activities of the Working Group – which includes all the sectors and agencies described in question 3.**
- 2) Formal “liaison” or agency Rep**
- 3) Fed “buy-in” to support directions/activities identified by working group.**

Working Group should meet often

There was a discussion of volunteer time vs. partners put in \$ to pay for members time and supported activities. Funding would be appreciated by all.

The importance was stressed of having someone who has this Working Group as their job, a funded leadership position.

Working group could both have modelers who are there because they are modelers, but could also have official agency representatives to make sure agencies stay involved. Great Lakes Fisheries Commission has a model for this working (agency representatives who actually participate). Great Lakes Fisheries Commission has commissions for each lake and under the lake commission is a technical committee that implements the commission decisions and can bring in the experts that they need. A key to this working in the fisheries commission is that failure to participate leads to less access to funding, so Working Group needs a similar hook

It may be important for the Working Group to get the official agency representatives to be people with authority to commit their agencies. It was questioned rather this was necessary. Does the Working Group mandate include anything that would impact funding decisions? Will agencies say that they will put an emphasis on funding models that fit Working Group recommendations?

Question 5: Operational principles of Working Group

- 1) Help make sure modeling activities and data integration is occurring on “common” or inter-operable “grids”**
- 2) Compatibility of model architecture**
- 3) Defining common group for multi-agency interests**
- 4) Facilitate integration of multiple models**
- 5) Guide RFPs from agencies. i.e. help develop EFS opportunities**

Help make sure modeling activities and data integration is occurring on “common” or inter-operable “grids” and compatibility of model architecture. Defining common ground for multi-agency interests. A structure was proposed with an upper level steering committee of agency reps and a Working Group of modelers (or several with different topics). Some people thought that this was an overly deep structure and that a single level working group which acts more in a steering committee roll.

Question 6: How to promote collaboration?

- 1) Task-based assignments on Working Group**
- 2) Promote more “science” exchange among agencies. Like Fish. Tech. Committee meetings**
  - a. Rotational around basin**
  - b. Like old GLERL PI annual ‘project’ talks**

- 3) **Can we give existing models/projects common “face” for public and managers that would make this “organism” (the Working Group) more useful**
- 4) **Facilitate “Transitional” activities**
- 5) **Not losing prior efforts**
- 6) **Guide/ synthesize “needs” to common interest**

The Working Group could promote collaboration by:

- Working group having a lead member who is responsible for organizing meetings and workshops for different activities (model identification, outreach), needed tasks and expertise would determine who is needed on different groups or workshops.
- Promoting a series of seminars for science exchange at rotating locations, for field trips to different labs, or at the State of Lake Michigan conference.
- Providing a common web portal for disseminating model results to the public. Clearing house page for results from many agencies.
- Encouraging connections using a similar setup to NOAA Great Lake (something) with twice-yearly meetings and monthly phone calls.
- Helping identify models that are currently collecting dust on the shelf but that could be moved forward by an agency that wants to transition it to operation. Acting as a curator for model museum.
- Moving toward proactive response to issues, white papers on what models we need, dialog with users to develop what models are needed and possible. The “right” question is not always the question that the users are asking but important to work with them to find the “right” question.

Question 7:

Too early to discuss, this is a question for the working group.

Question 8: Challenges

- 1) **Shared funding**
- 2) **Agency buy-in**
- 3) **Match-up forecasting accuracy/scales/approaches to meet large variety of manager needs  
“Getting managers to ask the right questions”**
- 4) **Not getting caught up in technical details i.e., getting right people on Working Group**
- 5) **Continuity, long-term commitment**
- 6) **How to engage needs from local to federal managers**

A brainstormed list of challenges includes:

Funding, who is going to fund this activity given that it does not fall into one agency

Agency buy-in, this will drive funding or lack thereof

Modeling framework, getting models to work together given different resolution, tuning data... How to couple models (EMF, etc.) is not as easy as it looks

Getting managers to ask the right questions

Technical experts/modelers have a tendency to get too far into the technical aspects of their models when left in a room together. Need someone in the room who can pull them back on task. This could be important in selecting leader.

Need continuity of personal, lots of rotation of staff assignment could keep it constantly at the always starting over point. This could be less of a problem in the Great Lakes as many of the people have been around long term. However, they are sometimes known for not collaborating well.

How to involve everyone from local to federal managers  
Understanding and managing the dual roles of some agents (such as state managers) as both clients and contributors

### Breakout Group #3

#### **Lake Michigan modeling framework workshop - Breakout Group 3 - summary of notes**

Sigrid Smith (note-taking), Russ Kreis (facilitating)

Drafted night of 12/9/10 and edited 12/11/10

*(This is a general summary that I wrote after reading through and starting to reorganize my original notes, since our breakout group just had a free flowing discussion the whole afternoon. This is not comprehensive, but touches many of the major ideas put forward.)*

Note-taker's general comment: our group did a lot of talking about problems as well as solutions, didn't stick to the assigned questions much, and didn't officially have a leader...but we did end up touching on most of the questions and a few other issues.

#### What activities should a working group do?

--*considerations:* give us something useful to do with all the data we're getting through monitoring programs; make sure it is adaptable and relevant now and into the future as our problems and goals change

--*solutions:* (process idea #1) gather all of the possible models, gather list of all of the data that will be available, and make plan for matching those up (questions should overlap to nominate a smaller set of models); VERSUS (process idea #2) decide how much to have multiple smaller models vs. one big model, and pick the best developed model to build up for this purpose

--model framework should be informed and shaped by questions/goals, but what questions or goals should be addressed? Perhaps LaMP's 12 big questions are best...

#### Who should be involved in the working group? What is its structure? Housed in LaMP?

--*considerations:* need an invested and knowledgeable coordinator to keep all of the people linked, and need a 'champion' to defend it (with authority, to keep it moving forward); expertise of specialists and generalists both have merits; need sustainability (agency buy-in, funding, staff commitment, etc. all need to be there long-term); need people to feel responsible for it

--structure: one person in charge, a small core group of people (meeting regularly long-term), further subject experts can be involved in short-term supplemental groups

--the one person in charge: (1) a fulltime person whose salary was split by parent agencies, OR (2) a person working between agencies (e.g., USGS person hanging out at EPA GLNPO)

--the small working group: (1) multidisciplinary, specialists in most pressing areas and generalists will both be good team members (but generalists who are knowledgeable about the problems and a range of approaches and who are open-minded seemed esp. good); OR (2) 'model czars' as one person from each parent agency (have them meet

once a week by phone/webinar, the czars should be senior enough and have enough staff commitment to get stuff done and keep exchanges between people going)  
--further experts: need specialists in the most important topics/ecosystem zones  
--need to be lake specific; most of our discussion supported housing it in LaMP with many of the same staff who already run that program being the same...even just designating one leader might be enough to use the existing structure there and just add to their agenda to become more fruitful  
--discussion focused around government agencies. Beyond that, there was some talk of making sure researchers involved (GLRRIN mentioned for how to do that); private sector and NGOs not mentioned at all; binational mentioned briefly. (We did not discuss roles and contributions of these groups explicitly.)

How can we link science and management, or developers and end-users? How can we best make products available for end-users?

--*considerations/solutions*: need all data and model products to be unified so 'customer' knows where to go and what they can get there (e.g., one website--talked about different platforms/people already doing this); need data on same scale/standards for better organization and synthesis; need both short-term and long-term products so that everyone is satisfied; might help for the researchers to be using the same models for research that produce the forecasts for other end-users (see next question)

How can we link agencies and people developing these models? How should models be structured to facilitate this?

--*considerations*: unified effort, community ownership (need everyone to feel they played a part and to see payoff for themselves), adaptability, long-term maintenance, model performance (some problems are just too hard, emerging problems that we're going to be starting from scratch to tackle right now)  
--*solutions*: discussed having a few well supported, big computer models that everyone uses (housed in one place, start from a model that's already far along in development, keep it well maintained, potentially can swap chunks of it in and out like the engine of a car while keeping the bigger frame constant, but the links between the pieces hardwired into the system so that the different disciplinary experts have to synchronize; the con is that everyone will be somewhat forced to use this smaller set of options, it's not impossible but harder to be adding in new ones...)  
--also discussed having several smaller models that each address a few of the goals/questions...

What are the biggest challenges in making a community modeling framework happen?

--*considerations*: funding data management; funding model support/maintenance; coordinating efforts binationally; promoting agency support; time and energy (roadblocks happen, things get slowed down, and people move on into a different program direction); satisfying contrasting goals (e.g., between short-term policymakers and long-term researchers, different goals within research community)  
--*solutions*: to streamline model support: we talked about pros and cons of having one big model; for continued agency support: we talked about formalizing a mandate, or something

that the agencies can point to in order to defend and direct themselves, and we talked about maybe embedding the model framework development process in current agency structure/activities as much as possible (e.g., LaMP); for contrasting goals: we thought it was important to choose a model framework that satisfies multiple needs concurrently

\*\*Note from presentation 12/10/10

--My group members added "gap analysis" as a major idea from our discussion too: that they hoped the RFP procedure would be used to identify gaps in our knowledge through these efforts, and that proposal requests could be put out to fill those gaps in.

Breakout Group #4

12/9/2010 : Group 4 Notes

Felix Martinez (Facilitator); Sara Katich (Note Taking)

**Community Modeling and Forecasting Framework for Lakewide Management in the Great Lakes: A Lake Michigan Working Group**

Q. 1 What are the appropriate and necessary scope of activities for the working group?

- Fulfilling/identifying gaps for future projects and budgeting
- Brokers
  - Demonstrate need for RFPs and incorporate input from stakeholders driving models
  - Define problem by putting decision-makers and modelers in the same room. Unless modelers are skilled at explaining concepts to managers about relative expectations, the project is doomed to fail. Managers can take an approach where modelers help support purpose and explain time, resources and data in addressing question. Working Group needs both managers and modelers.
- If every issue is part of the Working Group, it will be too large. The Working Group should take a broker role that connects people. Meeting with managers, modelers separately and then bringing those folks together around topics.
- Act as a source for people doing projects – bring information together
- Bring in experts to work through details
- What model could help decision making issues? Group would decide what to work on first, gather experts in the area and Working Group would decide what to do best.
- Peer-review process – finding holes/gaps in what we need
- What has been done, what is available, slippery slope to endorsing things?
- Endorse a problem area that provides a source of RFPs for agency. Could help identify holes, and help agencies justify RFPs.
- Establishing model criteria needed for a useful regulatory or management model. What skill assessment exists?
- Models should be evaluated against independent data set – How much uncertainty exists in the model? Managers should be able to say what tolerance can be lived with.

- TMDL – what is margin of safety for max? load for a given system? Example. Working group needs to be involved in that discussion. Risk analysis – where do we draw line w/ daily limit and acceptable levels of risk. Ex: Fish consumption advisories.
- What type of models will group help facilitate – short-term predictive or long-term scenario – probably both. Going to be really broad.

Should the working group be implemented as a standalone entity or should it be housed under the structure of an existing regional entity such as the LaMP? Is LaMP an appropriate place?

- How does Regional Collaboration fit in? Possible option. In general, level too high. Some representatives may serve well, others may not.
- Managers, modelers, scientists want to discuss issues that have regional or site specific orientation. All models are specific to a question or locality. Can't have everyone represented.
- How many people can you have and still be effective? All doing it in 'spare time.' Need few dedicated people. Must be sustainable and have resources. Needs to be sustainable for over a year. If we want on the ground end-users, we need a solution for maintaining continuity and funding.
- Regular committee and steering committee needed.
- How does working group fit into existing policy? What is the thought process with collaborating with working groups put together with policy? Dedicated people needed
- Lake Mich. Watershed issues need to know things at national level and global and know how it impacts. Membership. Don't want to duplicate efforts.
- GL fisheries commission fulfills the broker role and includes managers and modelers.
- Does it invite organizational structure with director, etc? Balance between enough rep. but not too much. Need rules and structure. Fed. State. , Sea Grant Director, private sector but there needs to be something in it. Water resource centers, others like Sea Grant?
- Fed. Agencies, USGS, USDA, etc. that are involved in work or not?
- Each group that is agency makes decision on who is appropriate. Needs to be defined by what the working group does. That's them committing and making it a priority.

What would be the appropriate operational principles to ensure linkage between science and management communities and facilitate coordination/collaboration in the development, improvement and implementation of ecosystem models and forecasts?

- Need observations and process science for models
- Collaboration with observation commitment. Interact with GLOS. We need to do a better job of integrating new observing technologies and networks into modeling, especially if looking for operational forecasting model.
- GLOS is still an experiment. Lake Erie Millennium Network? EPA, Ohio Sea Grant, EnviroCanada and Ontario Admin of Environment could all have representation on

steering committee. Understand both science and management is important. GLERN for Lake Michigan. Four people on steering committee?

- GLERN had modeling meeting 2 years ago. Right now, this is just for Lake Michigan. We could have working group for each lake.
- CSMI – 6-7 different GL monitoring programs. Cooperative science and monitoring initiative – EPA & enviro-canada. Monitor great lakes every 5 years. Intensive monitoring. Timeline long, but at least long-term database exists. Modeling working group aligned with this process is a possibility.
- We know what needs to be done. We need money to get it done and where to do it at. What practices are most effective? What are these questions that need to be answered and how to bring scientists together to get those answers? Bringing ends together.
- Use history to establish justification for long-term working groups. Need to be proactive instead of responsive – not only making changes once bad things happen.
- Systems are changing rapidly, need continual process, not one that pulses.
- Need to know how much reduction is needed and how to do it. Working group would help formulate entire questions.
- Don't think this work group needs to be identifying a single model needed.
- We don't just need a model of aquatics, we need many models.
- What are bounds of being considered? Economics, fishes, activities outside watershed?
- At some point this is too broad and the Working Group needs bounds. Do bounds come before or after – could this be problem specific?

#### What are roles and contributions of outside groups?

- Partnerships needed to help identify gaps. It is surprising how little lakewide information there is available. At least use baseline data as starting point for user specific goals.
- Political support – NGOs could play a big role. TNC, Ducks unlimited – maybe not member but involved in outreach to help make informed decisions. The Working Group needs representation with people who do engagement.
- There needs to be emphasis on getting information out to people.
- Educators – how to present to the public.
- Conflict of interest among agencies and outside partners. No way to get around it.
- Working Group organization that has agency rep. that are money givers/managers and responsible for managing the system. They would organize and advertise and carry out workshop which other sectors would be invited to and give opinions to help address program. Managers go away and develop a plan and RFPs can be used to carry out the plan.

#### Organizational Structure: Resources and Challenges

- Many people are funded through soft funding and we need to keep activities moving forward if employee turnover is happening every few years.

- So many different agencies and organizations. How do you set up a long-term sustainable model? Any other examples of other activities that people could point to?
- Working group will not have funds but those in group may have funding. Endorsement of working group may make other sources of funding available.
- To some degree, upper management needs to have buy-in and advance the effort. Need influence to allocate resources. Higher up people could be influential and help set goals. Buy-in but not dictation. Getting resources to supply, maintain, revise and adapt in a framework is needed. Making a model on a routine basis for management needs long-term funding commitments. How much is this going to cost – life cycle cost of entire enterprise?
- Why do things fizzle out – identify what happens and how to prevent it. Agency willing to make long-term commitment. Often a front man needed for someone to push something through. Need Agency commitment, funds and champion.
- Need to avoid diffuse activity – need champion/bulldog. Need one person that spearheads activities.

#### Product Delivery

- What tools do we need to answer user needs?
- Do you turn model over or arrange support? Different ways for a model to provide information. Do we provide models that end-users can manipulate and specify? This places restrictions on the level of complexity that can be added.
- Part of the Great Lakes Tributary monitoring program is to turn model over to conservation district or someone who can manage the system. Resources or expertise are lacking to do this.
- Are end-users always going to be managers – public as well? We should not turn over models but provide them with results. Resources are needed to keep models in operational mode.
- Multiple end-users – model still has to be run. Once model passes criteria, it then can be transferred to a decision-support tool or the public.
- Need to develop models that are not only run by developers. Takes additional resources and cooperative agreements and developers are never asked to do this in their proposals. Beyond just getting model, focus on using of model. This is a big expense that needs to be considered.
- Instructions and videos are needed to understand how to use models.

#### Where the group should be housed?

- There is a risk in having the group sanction modeling efforts such as what has happened with GLOS. There needs to be a process that balances this group and setting standard criteria for modeling.
- Participation with the LaMP may be helpful because it has a broad spectrum.
- LaMP people may be looking at problems from the past. Need a group in touch with the problems of now – people who are on the ground and good at running models. There

needs to be interaction b/t observers, experimental lists and people on the ground seeing problems. Otherwise, we could have substantial lag time.

- LaMPs need to be in the issues, but additional stakeholders will become involved as other lakes involved.
- Need to work with LaMP, not create separate independent work
- Working group should be independent to start with and develop some identity. Let things develop organically to see where it fits best.
- If working group is under LaMP, it may be more difficult transferring working groups to other lakes. LaMPs are all very different from each other. If successful, people will want to transfer it.
- NWS – work within what is already going on, likelihood of success since resources are already happening. LaMP helps advance framework that is already there.
- If linked GLERN does not have agenda except getting people together to distribute information. To keep loose and open, makes most sense as parent organization unless worried about legacy.
- Like to start independent and see where it goes. CSMI process interaction.

## Appendix F. Friday Plenary Session Notes

Day 2: Large Group Discussion

Key Questions:

Who are the recommendations going to? Where should report go? Is there an agency that is the right place to host the working group?

Hosting agency or organization as well as other federal agencies need to have buy-in for this working group. Who might be the host – equally important is how. The process of partnership is important. How we do we implement partnership? What are principles of partnership that would create ‘safe place’ for working group participants?

### GLOS

- GLOS has buy-in to set up modeling committees – it is part of its mandate
- GLOS could host with endorsement from LaMP and GLFC. GLOS could host and receive funding from the two other groups.
- The GLOS template already exists and has resources to hire a staff person to help facilitate modeling in the Great Lakes.
- People agree this is a good idea. GLOS has funding for a support person. Now buy-in is for agency benefit for being at the table.
- GLOS had pragmatic consideration. This workshop came out with a preference for housing under GLOS but other housing options were considered.
- Wouldn't group under GLOS be expanded to identify missing gaps that inform an RFP for maybe next year?
- As models develop, GLOS can be a quasi-operational home.
- LimnoTech received contract from NOAA to develop design for enterprise architecture for GLOS. Part of enterprise says what technologies go out but also includes data management and communication and modeling/delivery to end users. LimnoTech is thinking of concept to develop architecture, observing instrumentation and looking for pilot projects (2-4 to design). This system would be more detailed more resolved spatially and a temporary system that would support model development or operation and delivery. It is possible for Lake Michigan to be one regional application to develop this concept. This is a design process and a thought process for what we could do. The contract is funded by NOAA with other partners such as GLOS and EPA who are partners in design development.
- Activities appropriate to this workgroup are appropriate in design study.
- Enterprise Architecture – working group could oversee all aspects of developing models, doing GAP analysis and working in framework. EPA science advisory panel wants three big outcomes; 1) policy decision-making aspect of overall problem 2) Modeling progression and 3) external peer review process. Those three things could be overseen and developed by working group.
- Planning coming out of Joe's project – not modeling. Things they have to do are within scope as things identified to do in Lake Mich.

## Alternatives

Judy needs to start factoring in another entity into a five year plan and the essence of LaMP involves academics, tribal members, industry, states, planning commissions, etc. As organization matures, more activities run competitively. CBOS – sub-regional observing system – much like GLOS described but at higher level and there are membership fees. Everyone can participate but decision makers pay fee

The Chesapeake Bay folds in CBOS, non-agency involved but not key. CBOS across all entities – federal, state academic and industry. Industry is big in CBOS, which develops intermediate productions and facilitates commercialization of products. GLOS is exploring this idea.

## Federal Agencies

- Comment on spending plan and funding must go through the RFP process.
- GLOS is funded by NOAA and set up as a multi-agency concept. Need to ensure the working group is not NOAA dominated. Non-profit – some GLRI grants fund GLOS.
- Make certain agency or entity does not dominate in terms of the mission. We want buy-in from so many others. All missions need to be accounted for.

## Role of GLOS:

Now evolving – standard criteria for observing systems 1) certification process – may be requirements at national level 2) Quality mgmt. plan – EPA grant – project level quality assurance.

GLOS does not dictate but participants who come together and coordinate. GLOS is looking at standardization of observing systems. Modeling could follow same criteria.

GLOS could play an integrative and facilitation role - from collecting to delivering products and services.

GLOS does have modeling sub-committee. GLOS is looked at as semi-interdependent. EPA funds indirectly. GLOS would have to remain independent as possible.

Within region, identify user needs. Outreach, data management/integration; Mission is what are needs of region and how to facilitate.

## How to do it:

No overwhelming agreement on how to do it:

- Multiple groups
- Individual/USGS with LaMP association
- Workshop – ad hoc independent nature

## Who Participates:

Academic community involved in working group, but ideas from community, not just agencies

GLOS

LaMP

GLFC

Discussed agencies – Corps of Engineers is not represented in workshop but have great interest in sediment transport in GL basin

Ground level people need to be put on working group

Fisheries and corps coordination needs to happen simultaneously

Meet with them in January

2 concerns: inclusion and non-inclusion of states. Fish commission stretching to state level?

States have interests, authorities, and capabilities. States need to be embedded to the process.

#### Lake Michigan:

Pursue working group under GIOS – how does that fit into GLRI process?

GLRI – operates 2 levels – transfer within agencies for restoration as well as general RFP.

Weather our lab could coordinate GLRI templates.

#### Next Steps:

Tentative guideline – walk through process with fisheries commission. Build support in effort b/ necessary. Fisheries commission is a challenge, they were not present at the workshop

Speak with Jim Diana

GLRI RFP – people asking for money to produce models – is this duplication?

States reached on fisheries side. Fishery commission could reach fish side of equation of state.

We are still missing environmental folks in states. Does LaMP connect there?

When reconvene, put together a report embedded in this group and other parties. Run it through agencies. Okay with wording and then start getting buy-in.

Report captures recommendations and how it should be implemented and operated?

Terms of reference, put it in the report – spell out it happened after the workshop and a draft terms of reference.

Ultimately, people have to pay for initiative, need to include strong and well thought out case for value of modeling. People don't understand value of models.

#### Distribution

- GLOS board
- LaMP
- Fisheries Commission
- Steering Committee
- Include for annual report for GLRI so it is part of reporting process. Other agencies may want to do that as well. This process makes it more likely to generate funds. This should be part of the overall report that goes back to the EPA.
- State and Federal agencies – paper needs to move up, not only laterally. Start with mid-level regional management.
- Great Lakes commission serves states – board of directors have DNRs – needs to go to Commission!

The following needs to be considered related to the report.

- 1) How to draft report to have buy-in
- 2) Report will charge someone to do something – develop plan for implementation
- 3) How to be distributed