

**GREAT LAKES OBSERVING SYSTEM (GLOS)
PROPOSAL COVER PAGE**

TITLE: Implementation of the Great Lakes Observing System, 2011-15

TOPIC AREA: Continued Development of Regional Coastal Ocean Observing Systems

PRINCIPAL INVESTIGATOR CONTACT:

Dr. Jennifer Read (p) 734-332-6101
229 Nickels Arcade (f) 734-332-6120
Ann Arbor, MI 48104 (e) jread@glos.us

DURATION: 2011-2015

FUNDING REQUEST:	\$ 3,906,482	Year One
	3,913,964	Year Two
	3,910,807	Year Three
	3,899,343	Year Four
	3,916,485	Year Five
	\$19,547,080	Total

AMOUNT TO BE TRANSFERRED TO NOAA (CILER and GLERL):

CILER		GLERL	
\$ 2,469,426	Year One	\$ 369,000	
2,531,864	Year Two	407,880	
2,533,752	Year Three	420,116	
2,506,579	Year Four	432,720	
2,578,404	Year Five	445,701	
\$12,620,025	TOTAL	\$2,102,418	

PROJECT SUMMARY

PROJECT TITLE: Implementation of the Great Lakes Observing System, 2011-15

PRIMARY CONTACT:

Dr. Jennifer Read, Executive Director (p) 734-332-6101
229 Nickels Arcade (f) 734-332-6120
Ann Arbor, MI 48104 (e) jread@glos.us

RECIPIENT INSTITUTION: The Great Lakes Observing System (GLOS)

OTHER INVESTIGATORS:

Dr. Thomas Johengen, Assoc. Dir., Cooperative Institute for Limnology and Ecosystems Research (CILER), UMICH
Dr. Jay Austin, Large Lakes Observatory, University of Minnesota-Duluth
Dr. Val Klump, Dir., WATER Institute, University of Wisconsin-Milwaukee
Dr. Guy Meadows, Dir., Marine Hydrodynamic Laboratory, University of Michigan
Dr. Robert Shuchman, co-Dir. Michigan Tech Research Institute
Dr. Charles Kerfoot, Michigan Technological University
Dr. Greg Boyer, Dir., Great Lakes Research Consortium, State University of New York, ESF
Ms. Christine Manninen and Mr. Stuart Eddy, Great Lakes Commission
Mr. Frank Lichtkoppler, Ohio Sea Grant, The Ohio State University
Ms. Elizabeth LaPorte and Mr. Steven Stewart, Michigan Sea Grant, U. of Michigan and Michigan State University
Mr. Steven Ruberg, NOAA Great Lakes Environmental Research Laboratory

BRIEF PROJECT SUMMARY:

The only freshwater region of IOOS, the Great Lakes is home to over 40 million US and Canadian citizens, many first nations, eight states and two provinces. The region's coastline totals nearly 11,000 miles and the Great Lakes and their connecting channels form the largest fresh surface water system on Earth, holding nine-tenths of the U.S. fresh surface water supply. The Great Lakes Observing System (GLOS) was formed to coordinate the regional observing network that plays a critical role in the management of these valuable resources. The Great Lakes provide unique technical and political challenges for managing observing systems, but these challenges highlight the significant need and numerous benefits for coordinating observing resources with the purpose of meeting the region's priorities within the IOOS framework. The Great Lakes-St. Lawrence system has benefitted over time from a multitude of programs supporting the collection, analysis and storage of physical, chemical, biological and cultural data. These programs have been managed by a complex array of public, nongovernmental and academic entities on both sides of the international border. While coordination among these entities has improved over time, interoperability of data has been quite limited and, in many cases, observation and data integration activities have lagged behind resource management and other decision making needs.

This proposal will achieve an overarching goal developed by the GLOS Board of Directors in consultation with its members, partners and stakeholders. Five objectives- all consistent with the IOOS Maturity Index for integrated observing system sub-systems- support this goal. These objectives will be addressed year-by-year through a distinct set of specific tasks that build to system maturity over the five year project period.

Overarching GOAL: A fully integrated Great Lakes 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 System.

Objective One: Program Planning and Management: Data and information needs of regional resource managers and policy makers are addressed through the coordination, management and governance of GLOS.

Objective Two: Data Management and Integration: GLOS users have ready access to high quality, interoperable data and associated products that meet IOOS criteria.

Objective Three: Observations: GLOS users benefit from timely, reliable and sustained observations that meet regional needs and priorities.

Objective Four: Model and Tool Development: GLOS provides its users with specific products and services that are efficient, accurate, cost effective and capable of future growth.

Objective Five: Outreach and Education: Input from identified major stakeholders – users, members and partners – is systematically and routinely integrated into program planning and evaluation.

In addition to addressing issues similar to other IOOS regions (e.g., spill response, search and rescue, beach quality, beach hazards such as rip and channel currents), GLOS is also positioned to address unique regional issues resulting from its freshwater composition and geography. These issues include source water protection; providing baseline data to managers of Great Lakes Areas of Concern (AOCs) and Lakewide Management Plans (LaMPs); identifying, collecting and integrating key fishery and associated environmental (physical, chemical and biological) observations to support state and provincial fishery managers; understanding the impacts of climate change upon net basin water supplies; assisting municipal/regional planners in adapting to climate change; and prioritizing maintenance funds for key port and harbor infrastructure.

Proposed GLOS activities feature the following benefits:

Improved source water protection for Great Lakes drinking water; Improved implementation and evaluation of water quality and ecosystem restoration activities under the U.S.-Canada Great Lakes Water Quality Agreement, the Great Lakes Restoration Initiative and binational fisheries management activities; Improved spill response planning and support for emergency response to spill events; State of the science support for planning and implementing climate adaptation strategies in vulnerable communities; More effective beach management, including data for beach quality forecasts and support for source contaminant identification; More efficient allocation of resources for port and harbor infrastructure maintenance; Improved data to support ecological forecasting models to address changes in water quality and food-webs in response to multiple stressors; Improved wind and wave observations and forecasts to promote safety among commercial shippers and recreational boaters; and Improved development of remote sensing products to provide synoptic (or regional scale) analysis of water quality and ecosystem health.

As requested, GLOS has provided a detailed work plan for all five years indicating baseline activities and system enhancements. In order to effectively and efficiently achieve all the priorities identified in the Strategic Plan, \$19.308 Million or approximately the full funding amount of \$4,000,000 per year is requested.

PARTNERS:

In addition to the investigators listed above, the following federal state/provincial and regional agencies and organizations are currently providing input to or engaged in GLOS projects and/or program planning: The International Joint Commission; Great Lakes Fishery Commission; Great Lakes Commission; Great Lakes-St. Lawrence Cities Initiative; Windsor Regional Environmental Emergencies Team; (U.S.) NOAA (Great Lakes Regional Collaboration Team, OAR, NOS, NWS, NDBC); U.S. EPA, Great Lakes National Program Office, Region 5 Emergency Response, Large Lakes Research Station; U.S. Geological Survey, Great Lakes Science Center, Water Resources Division, Great Lakes Coordinator; U.S. Army Corps of Engineers, Great Lakes and Ohio River Division (Buffalo District, Detroit District, Chicago District), Institute for Water Resources; Department of Homeland Security, Federal Emergency Management Agency, U.S. Coast Guard; (Canada) Environment Canada, Boundary Waters Unit, Great Lakes Management & Reporting, Great Lakes-St. Lawrence Regulation, Environmental Protection Operations Div.; Fisheries and Oceans Canada, Transport Canada, Canadian Coast Guard; State/Provincial/Local members and partners include: Michigan Dep. Natural Res. and Environment; New York Dep. of Environmental Conservation; Ohio Environmental Protection Agency; Wisconsin Dep. Natural Res.; Ontario Min. of the Environment; Ontario Min. of Natural Resources; Conservation Ontario; City of Cleveland; Macomb County, Michigan; Council of Great Lakes Industries, The Nature Conservancy, Lake Carriers Association, St. Clair Partnership (an association of municipal, township, county, state/provincial and federal agencies).

Implementation of the Great Lakes Observing System, 2011-15

a. Background

The Great Lakes-St. Lawrence River region is home to over 44 million US and Canadian citizens within eight U.S. states and two Canadian provinces. With a coastline totaling nearly 11,000 miles, the region encompasses the largest surface freshwater system on Earth, comprising nine-tenths of the U.S. surface freshwater supply and one fifth of the global supply. The resource is extensively- and intensively- used by a diverse group of stakeholders whose environmental health, economic well-being and quality of life is fundamentally dependent upon the informed use, protection and management of the region's water and related natural resources. The Great Lakes Observing System (GLOS) sees the region's uniqueness as an opportunity to showcase and demonstrate the interoperability of the Integrated Ocean Observing System (IOOS) while contributing to national and regional priorities that include supporting ecosystem restoration and protection; reducing public health risks; improving safety and efficiency of maritime operations; increasing effective mitigation of natural hazards; and improving understanding of climate change and supporting the development of adaptation strategies.

Significance of the Proposed Project. Activities proposed for FY2011-15 fill key gaps in regional activities, while contributing regional input to national priorities as summarized in Table 1 below.

Under base capacity, this project will sustain and enhance the system described below and, with enhanced funding, be able to address additional key regional priorities identified in the problem summary section below.

Problem Summary. The Great Lakes-St. Lawrence system has benefitted over time from a multitude of programs supporting the collection, analysis and storage of physical, chemical, biological and cultural data. These programs have been managed by a complex array of public, nongovernmental and academic entities on both sides of the international border. While coordination among these entities has improved over time, interoperability of data has been quite limited and, in many cases, observation and data integration activities have lagged behind resource management and other decision making needs.

In addition to addressing issues similar to other IOOS regions (e.g., spill response, search and rescue, beach quality, beach hazards such as rip and channel currents), GLOS is also positioned to address unique regional issues resulting from its freshwater composition and geography. These issues include source water protection; providing baseline data to managers of Great Lakes Areas of Concern (AOCs) and Lakewide Management Plans (LaMPs); identifying, collecting and integrating key fishery and associated environmental (physical, chemical and biological) observations to support state and provincial fishery managers; understanding the impacts of climate change upon net basin water supplies; assisting municipal/regional planners in adapting to climate change; and prioritizing maintenance funds for key port and harbor infrastructure.

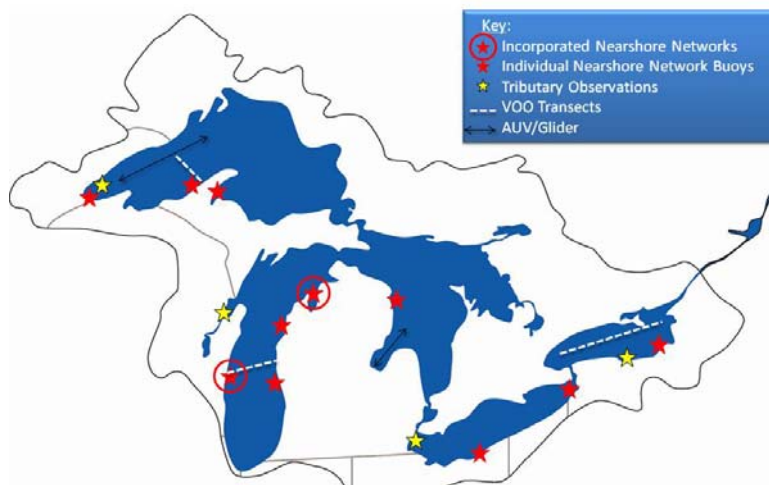
Status of ongoing efforts. Over the 2007-10 period, GLOS has worked with regional partners to identify needs, develop priorities and begin implementation of a regional observing system. During this period, approximately \$750,000 in total annual programmatic and administrative funding has been available. GLOS focused on the development of basic data management services, such as SOS and THREDDS servers; integration of the first generation of parameters identified by the IOOS data integration framework (DIF) team; prototype data visualization applications, and a first generation website. In partnership with NOAA's Great Lakes Environmental Research Laboratory (GLERL), GLOS supported the development of a 3D hydrodynamic model for the Lake Huron-Lake Erie corridor that addresses lake level and flow forecasting needs, and supports source water protection, spill response and search and rescue operations. GLOS worked with a regional partner, the Cooperative Institute for Limnology and Ecosystems Research (CILER), to leverage the efforts of four research universities and NOAA-GLERL to plan and implement a nearshore observing network. Deployed in the near shore zone (i.e., at 20-50 m contour lines) and near municipal water intakes, the network has improved 1) near shore

Table 1. Proposed GLOS Contributions to National and Regional Priorities for the Period, FY2011-15

Regional/ National Priority Document	Program Mgmt. and Planning	Data Mgmt. and Communications	Observations	Modeling and Tools	Outreach and Education
GL Restoration Initiative Action Plan & GL Water Quality Agreement	Coordinate with US EPA , other US and Canadian partners	Integrate priority metadata and links to data services – e.g., EPA GLENDa & Storet, USGS stream	Provide <i>In situ</i> and remotely sensed obs for 5 priority AOC watersheds, incl bio sensor	Implement models for Lower Fox/Green Bay, Saginaw Bay; state of lake visualization tool	Seek input from AOC/LaMP and fishery managers, public health
IOOS Development Plan	Coordinate all sub-systems with relevant IOOS leads	Provide NOAA-compliant data products; implement forecasting/decision support tools – HECWFS	Fill nearshore gaps, provide remotely sensed priority parameters	Integrate <i>in situ</i> and remotely sensed observations	Engage priority users associated with IOOS societal goals/ GLOS theme areas
IGOS Coastal Theme	Implement Upper GL climate risk assessment with priority groups	Ingest and redistribute nearshore network data	Provide obs for beach managers, land-use planners	Provide support for risk maps and hazard forecasts	Work with Land-use planners, emergency response
GOOS Coastal Module Implementation Report	Maintain membership in GEO; Register components and services	Maintain C-GOOS metadata and data discovery/transport standards for data services	Provide obs for GOOS variables as also meet regional needs	Implement flexible solutions for res. mngr decision making	Seek input from AOC/LaMP and fishery managers, public health
National Operational Wave Observation Plan	Coordinate with USACE and NDBC on GLOS Obs to support implementation	Deliver NOWOP data through server and map tools	Provide nearshore wave obs per NOWOP criteria	Support USACE infrastructure analysis	
National Surface Current Mapping Plan	Participate on freshwater Tiger Team	Integrate data products into GLOS dataservices and/or hosting of data	Leverage NOAA funded project, PI Dr. Chris Ruf		Seek input from Coast Guard and others re. GL applications
Net. Gap Analysis for Nat. Water Level Observation Net.	Coordinate with GEO Great Lakes Testbed	Integrate NWLON into GLOS data assembly for coordination and delivery	Support partner efforts to enhance/expand NWLON	Support US-Can hydrology interoperability	
Guidance for Implementation of the IOOS DMAC		Implement protocols and data services	Implement DMAC standards for new observation equipment	Comply with DMAC format for new model outputs	Support IOOS DMAC format outreach, including awareness building

ecological forecasting; 2) water quality monitoring for water intakes and public beaches; 3) wind/wave forecasting and circulation models in the near shore for maritime operations and beach safety (rip and channel currents); and 4) lake heat balance monitoring (i.e., climate change impacts). GLOS has also leveraged the outreach and education experience of the seven Great Lakes Sea Grant programs to undertake needs assessments with key target audiences, recognizing that their long-standing engagement and strong relationships provide a vehicle for efficient and effective outreach.

Figure 1: Near-shore Network & Tributary Observation Network



Over the same four-year period, GLOS governance has matured. In 2006, GLOS transitioned from its initial planning phase and, led by a regional steering committee, saw the appointment of its first Board of Directors and the subsequent adoption of bylaws. In 2008, the Internal Revenue Service recognized GLOS as a 501(c)(3) organization, and day-to-day operations transitioned to GLOS staff led by the first Board-appointed Executive Director, Dr. Jennifer Read. GLOS began developing a diverse membership with representation from state agencies, binational treaty organizations, industry associations, universities and research consortia, and individuals. In 2010, GLOS updated and expanded its strategic business plan, titled *A Blueprint for Great Lakes Decision-Making, 2011-15*. An adaptive, user-driven approach to program and project planning, referred to as the Management and Planning Process (MAPP), was designed and implemented with input from GLOS members, partners and other users. Significantly, this planning process embraced the regional priorities identified in the federally- led Great Lakes Restoration Initiative Action Plan (GLRI).

MAPP employs an iterative, four phase approach that supports adaptive management activities in the region. The phases include: 1) determining priorities; 2) developing strategies to address them; 3) implementing programs; and 4) evaluating those programs and adapting, as needed, on the basis of that evaluation. Over the 5-year project period MAPP will be used at two levels of program planning – in strategic planning to develop long-term programs and at the project level for individual projects.

In addition to initial planning, programming and governance development, GLOS has also engaged in key regional activities involving data coordination, management, integration and interoperability. Examples include the International Upper Great Lakes Study (IUGLS); Can-Am GEO Great Lakes Testbed; Great Lakes Modeling and Assessment Center (GLMAC); Integrated Water Resources Science and Services (IWRSS); EPA's Midwest Spatial Decision Support System Partnership and Exchange Network; and the binational Cooperative Science and Monitoring Initiative (CSMI).

Proposed Activities: (Detailed scopes of work for each subsystem are in the Appendix.) Over the next five years, under **baseline funding**, GLOS will:

- Operate and maintain GLOS data services, including access to historic, and near real-time observations, forecasts and associated data and information, and incremental improvements to data visualization tools.
- Sustain the established nearshore network, provide limited support of mobile assets (AUV/Glider) to the binational Coordinated Science and Monitoring Initiative (CSMI), and provide complementary, remotely sensed observations.

- Enhance and refine hydrodynamic models for Great Lakes connecting channels (e.g., Huron Erie Connecting Waterways Forecasting System, Upper St. Lawrence River, key embayments such as Green Bay and Saginaw Bay).
- Support development of integrated (hydrodynamic and ecosystem, and across agencies) modeling frameworks, lake-by-lake, that emphasize predictive forecasting and support for adaptive management in conjunction with the CSMI.
- Identify and assess baseline needs of resource managers and public health officials (e.g., Areas of Concern, Lakewide Management Plans, climate change adaptation), and promote the regional observing system as a planning and decision making tool among key regional partners.
- Manage and plan programs to monitor progress and refine goals and strategies, including managing contracts, developing annual work plans and semi-annual reports, and participating in IOOS and NFRA committees as well as other regional partner initiatives (e.g., GEO Great Lakes Testbed, Integrated Water Resources Science and Services, US EPA Exchange Network).

With enhanced funding, GLOS will be able to address a variety of high priority issues identified in *A Blueprint for Great Lakes Decision Making, 2011-15*. Under **enhanced funding**, GLOS will:

- Increase participation in partner initiatives, manage competitive requests for proposals identified in the work plan, and initiate new projects.
- Develop a suite of user informed decision support tools that integrate data already incorporated into the GLOS system as well as identified priority data.
- Enhance the near shore network with 1) the addition of observations in key tributaries (e.g., St. Louis River/Duluth Harbor- Lake Superior; Lower Fox/Green Bay- Lake Michigan; Saginaw River/Bay- Lake Huron; Maumee River- Lake Erie; Genesee River- Lake Ontario); 2) development of a Harbor Infrastructure Analysis System; 3) enhanced evaporation and biological sensors to support resource management needs including understanding climate change impacts; 4) increased support to CSMI; and 5) development of emergency spill response capacity.
- Provide implementation support for the lake-by-lake integrated modeling framework.
- Engage in additional targeted needs assessment activities and evaluation of tools/products; build GLOS membership and partner engagement; and enhance stakeholder understanding of the value of an integrated, regional observing system.

b. Goals/Objectives

This proposal will achieve an overarching goal developed by the GLOS Board of Directors in consultation with its members, partners and stakeholders. Five objectives- all consistent with the IOOS Maturity Index for integrated observing system sub-systems- support this goal. These objectives will be addressed year-by-year through a distinct set of specific tasks that build to system maturity over the five year project period.

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Objective Five: Outreach and Education: Input from identified major stakeholders – users, members and partners – is systematically and routinely integrated into program planning and evaluation.

c. Audience and Benefits

GLOS *Blueprint for Decision Making* outlines a program and project development approach that provides timely and relevant information and data integration services to target audiences of decision makers and resource managers working in the four GLOS theme areas identified below. Through MAPP, all projects and programs must be responsive to identified management and decision-making needs of target user groups. Examples of priority audiences associated with each of the four theme areas are as follows:

<p>Ecosystem Management</p> <ul style="list-style-type: none"> - LaMP and AOC managers - Fisheries managers including tribal fisheries - Coastal and protected natural area managers - Municipal/regional planners 	<p>Public Health and Water Security</p> <ul style="list-style-type: none"> - Drinking water managers, regulators, and water intake operators - Beach managers - Emergency response, Search and Rescue
<p>Maritime Operations</p> <ul style="list-style-type: none"> - Recreational boating and harbor communities - Commercial operations - Other vessels (e.g., workboats, emergency response, science vessels) 	<p>Climate and Natural Hazard Adaptation</p> <ul style="list-style-type: none"> - Climate change modelers and researchers - Infrastructure managers - Municipal/regional planners and consultants supporting these efforts

These audiences are comprised of public agencies, nongovernmental organizations and academic institutions that work within multiple disciplines and across multiple geographic locations. Among others, they include federal, state, provincial, local, regional, tribal and First Nations governments; citizen and user groups; academic institutions; private business/ industry and consultants. GLOS targets components of this community that have compatible goals and objectives, and are best suited to contribute to and/or benefit from GLOS products and services.

Proposed GLOS activities feature the following benefits:

- Improved source water protection for Great Lakes drinking water;
- Improved implementation and evaluation of water quality and ecosystem restoration activities under the U.S.-Canada Great Lakes Water Quality Agreement, the Great Lakes Restoration Initiative and binational fisheries management activities;
- Improved spill response planning and support for emergency response to spill events;
- State of the science support for planning and implementing climate adaptation strategies in vulnerable communities;
- More effective beach management, including data for beach quality forecasts and support for source contaminant identification;
- More efficient allocation of resources for port and harbor infrastructure maintenance;
- Improved data to support ecological forecasting models addressing the impact of multiple stressor on water quality and food-webs;
- Improved wind and wave observations and forecasts to promote safety among commercial shippers and recreational boaters and beach goers; and
- Improved development of remote sensing products to provide synoptic (or regional scale) analysis of water quality and ecosystem health.

d. Work Plan

GLOS requests **base capacity funding of \$11.52 million over a five year period as follows: Year One - \$2.26M; Year Two- \$2.25M; Year Three- \$2.29M; Year Four- \$2.36M; and Year Five- \$2.36M.** Presented below is a description of base capacity activities in Year One, followed by a prioritized system enhancements (and associated costs) should additional resources become available.

YEAR ONE TASKS

- 1) Maintain and support a Board of Directors that provides oversight, advice and direction on the implementation of *A Blueprint for Great Lakes Decision Making*.
- 2) Engage current and prospective members and partners through conferences, meetings, workshops and other regional activities (e.g., Can-Am GEO, International Upper Great Lakes Study, US EPA's Data Exchange Network, development of lake-by-lake integrated modeling framework.)
- 3) Support development of IOOS through multiple vehicles (e.g., National Federation of Regional Associations, Data Integration Framework, DMAC Biological Observations Task Team, National HF Radar Technical Steering Team Freshwater Applications Tiger Team, national modeling committee, NFRA Education and Outreach Committee.)
- 4) Monitor, evaluate and refine projects and services to ensure adherence to GLOS standard operating procedures, including the QMP and the MAPP outlined in the *A Blueprint for Great Lakes Decision Making*.
- 5) Engage the public through program communications (e.g., website, newsletter, webinar and in-person presentations .) in coordination with NFRA E&O, IOOS, or other regional communication priorities and needs.
- 6) Convene priority user groups (e.g., AOC/LaMP managers, fishery managers, public health officials) to provide input to DMAC, observations, tools and modeling sub-systems.
- 7) Integrate national (IOOS Framework) and regional datasets into the GLOS DMAC system.
- 8) Maintain and support mechanisms that provide output to the GLOS DMAC system (e.g., Observation Explorer, Data Catalog, Model Inventory Database, existing Harborview tool.)
- 9) Construct pilot state of the lakes application to meet fishery manager and potentially LaMP manager needs.
- 10) Maintain and operate the Nearshore Network of *in situ* observing platforms (buoys and fixed structures) and sensors.
- 11) Enhance remotely sensed algorithms for identified regional priority parameters.
- 12) Coordinate deployment of GLOS mobile assets (AUV and glider) with binational Coordinated Science and Monitoring Initiative (Lake Superior).
- 13) Refine and enhance hydrodynamic models initiated under FY2008-10 IOOS and US EPA funding including the Huron Erie Connecting Waterways Forecasting System (HECWFS) to address public health, source water and spill response needs; the Upper St. Lawrence River hydrodynamic model to address marine operation requirements; and the Lower Fox River/Green Bay and Saginaw River/Bay hydrodynamic models to address resource management requirements.
- 14) Engage K-12 teachers and students through enhanced curriculum, *Teaching with Great Lakes Data*, and associated implementation support.

Year One System Enhancements (in priority order with estimated costs). Tasks 7 and 9- Integrate additional parameters to increase GLOS ability to provide IOOS Framework parameters, and add at least one additional indicator to the pilot application (\$50,000); Task 9 Award competitive contract for development of new products/tools related to fishery management needs or climate adaptation needs (\$147,000); Task 10a- Award competitive four year contract(s) for new observation platforms and sensors with biological parameters that meet AOC/LaMP or Fishery Manager needs (\$1.13M total); or Task 10b- Award competitive contract(s) to add biological sensors to existing platforms with parameters that meet AOC/LaMP or fishery manager needs (\$180,000); Task 12- Provide travel and shiptime for additional AUV/glider missions in support of CSMI(\$28,353); Task 2- additional support for travel, conference and workshop registration to engage current/ prospective

members, partners and stakeholders and provide staff training (\$5,000); **Task 6a-** In-depth user needs assessment including focus groups and workshops (\$50,000); **Task 6b-** Award competitive contract for development of new products/tools related to fishery management needs (\$75,000); **Task 14-** Develop an additional teacher-verified lesson and enhance teacher training (\$25,000).

Obstacles: Year One tasks anticipate and address challenges associated with: 1) securing the full and timely cooperation of members and partners by reaching out to other agencies and organizations to introduce GLOS services and support; and 2) awarding competitive projects through timely issuance of RFPs and proposal evaluation.

YEAR TWO TASKS

- 1) Support and sustain the GLOS Board of Directors, including timely recruitment and transition of highly qualified members, and implement their direction relative to *A Blueprint for Great Lakes Decision Making*.
- 2) Employ conferences, meetings, workshops and other regional activities (e.g., Can-Am GEO, International Upper Great Lakes Study, US EPA's Data Exchange Network, development of lake-by-lake integrated modeling framework) to engage current and prospective members and partners.
- 3) Support implementation of a national Integrated Ocean Observing System through multiple vehicles (e.g., NFRA, Data Integration Framework, DMAC Biological Observations Task Team, National HF Radar Technical Steering Team Freshwater Applications Tiger Team, national modeling committee, NFRA Education and Outreach Committee.)
- 4) Monitor and refine projects and services to ensure adherence to GLOS standard operating procedures, including QMP and the MAPP outlined in *A Blueprint for Great Lakes Decision Making*.
- 5) Build public support for GLOS and IOOS through program communications (e.g., website, newsletter, webinar and in-person presentations) in coordination with NFRA E&O, IOOS, or other regional communication priorities and needs.
- 6) Convene priority user groups (e.g., municipal/regional planners, infrastructure planners) relative to climate change adaptation) to provide input to DMAC, observations, tools and modeling sub-systems.
- 7) Develop a strategy document that includes protocols and prerequisites for integrating climate change adaptation priority data into the DMAC system.
- 8) Maintain and enhance mechanisms providing output to the DMAC system (e.g., Observation Explorer, Data Catalog, Model Inventory Database, Harborview) including adoption of relevant new protocols and services.
- 9) Upgrade priority products, such as pilot state of lakes application with additional indicators, plan fishery management and climate adaptation products.
- 10) Maintain and operate the Nearshore Network of *in situ* observing platforms (buoys and fixed structures) and sensors.
- 11) Enhance and operationalize remotely sensed algorithms for identified regional priority parameters.
- 12) Coordinate deployment of GLOS mobile assets (AUV and glider) with binational Coordinated Science and Monitoring Initiative (Lake Huron).
- 13) Enhance hydrodynamic models including Huron Erie Connecting Waterways Forecasting System, Upper St. Lawrence River hydrodynamic model (addresses marine operation requirements), and Lower Fox River/Green Bay and Saginaw River/Bay hydrodynamic models (address resource management requirements).
- 14) Engage K-12 teachers and students through enhanced curriculum, *Teaching with Great Lakes Data*, and associated implementation support.

Year Two System Enhancements (in priority order with estimated costs). **Task 10a-** Operate and maintain the GLOS tributary monitoring network (\$560,000 year 2 with 3% increment in years 3-5); **Task 9-** Award competitive contract for development of new products/tools related to fishery management needs (if unrealized in Year One) or climate adaptation needs (\$90,000); **Task 10b-** Award competitive contract(s) to implement Harbor

Infrastructure Analysis System and over lake evaporation system to support climate change analysis (\$655,000 total to be awarded over years 2-5); Task 12- Provide travel and shiptime for additional AUV/glider missions in support of CSMI(\$29,203); Task 2- additional support for travel, conference and workshop registration to engage current/ prospective members, partners and stakeholders and provide staff training (\$5,000); Task 6- In-depth user needs assessment including focus groups and workshops (\$50,000); Task 14- Develop an additional teacher-verified lesson and enhance teacher training (\$25,000).

Obstacles: Year Two tasks anticipate and address challenges associated with: 1) engaging new user community (e.g., planners related to climate adaptation needs) by working through established Sea Grant networks; and 2) awarding competitive projects through timely issuance of RFPs and proposal evaluation.

YEAR THREE TASKS

- 1) Support the GLOS Board of Directors, including timely recruitment and transition of highly qualified members, and implement their direction relative to *A Blueprint for Great Lakes Decision Making*.
- 2) Employ conferences, meetings, workshops and other regional activities (e.g., Can-Am GEO, US EPA's Data Exchange Network, lake-by-lake integrated modeling framework, adaptive management follow on from Upper Great Lakes Study) to enhance member and partner participation.
- 3) Enhance IOOS implementation through various national efforts (e.g., NFMA, Data Integration Framework, DMAC Biological Observations Task Team, national modeling committee, other IOOS committees as they are identified.)
- 4) Ensure projects and services adhere to GLOS standard operating procedures, including QMP and the MAPP outlined in *A Blueprint for Great Lakes Decision Making*.
- 5) Enhance public support for GLOS and IOOS through program communications (e.g., website, newsletter, webinar and in-person presentations) in coordination with NFRA E&O, IOOS, or other regional communication priorities and needs.
- 6) Convene priority user groups (e.g., commercial, science vessel and recreational captains, other marine operations personnel) to provide input to DMAC, observations, tools and modeling sub-systems.
- 7) Integrate priority data related to climate change adaptation into the DMAC system.
- 8) Maintain and enhance mechanisms providing output to the DMAC system (e.g., Observation Explorer, Data Catalog, Model Inventory Database, Harborview) including adoption of relevant new protocols and services.
- 9) Maintain and operate the Nearshore Network of *in situ* observing platforms (buoys and fixed structures) and sensors.
- 10) Operationalize remotely sensed algorithms for identified regional priority parameters, begin algorithm development for new parameters.
- 11) Coordinate deployment of GLOS mobile assets (AUV and glider) with binational Coordinated Science and Monitoring Initiative (Lake Ontario).
- 12) Enhance hydrodynamic models including Upper St. Lawrence River hydrodynamic model to address marine operation requirements; and Lower Fox River/Green Bay and Saginaw River/Bay hydrodynamic models to address resource management requirements.
- 13) Engage K-12 teachers and students through enhanced curriculum, *Teaching with Great Lakes Data*, and associated implementation support.

Year Three System Enhancements (in priority order with estimated costs). *Task 9a- Operate and maintain the GLOS tributary monitoring network (\$613,400 for second year of operation); Task 9b- If unrealized in year two, award competitive contract(s) to implement Harbor Infrastructure Analysis System or direct measurement of evaporation from all five Great Lakes (\$695,000 total to be expended years 3-5); Task 7- Award competitive contract for development of new products/tools related to fishery management needs (if unrealized in Year One or Two) or climate adaptation needs (\$90,000); Task 11- Provide travel and shiptime for additional AUV/glider missions in support of CSMI (\$30,080); Task 2- additional support for travel, conference and workshop*

registration to engage current/ prospective members, partners and stakeholders and provide staff training (\$5,000); **Task 7-** Additional data integrated and/or development of a pilot tool for integrating and applying data related to climate adaptation planning (\$85,000). **Task 14 (New Task)** Develop a strategy document that includes protocols and prerequisites for integrating automatic identification system (AIS) data into the DMAC system (\$25,000). **Task 6-** In-depth user needs assessment including focus groups and workshops (\$35,500); **Task 13-** Update Teaching with Great Lakes Data website (\$12,500).

Obstacles: Year Three tasks anticipate and address challenges associated with 1) engaging the user community (e.g., commercial and science vessel captains) by working through established Sea Grant networks; and 2) awarding competitive projects by timely issuance of RFPs and proposal evaluation.

YEAR FOUR TASKS

- 1) Support the GLOS Board of Directors and plan for year five (FY2015) updates to *A Blueprint for Great Lakes Decision Making* and GLOS Business Plan.
- 2) Engage members and partners through conferences, meetings, workshops and other regional activities (e.g., Can-Am GEO, US EPA's Data Exchange Network, lake-by-lake integrated modeling framework, adaptive management follow on from Upper Great Lakes Study, other regional collaborations as they emerge).
- 3) Support and enhance IOOS implementation through various national efforts (e.g., National Federation of Regional Associations, Data Integration Framework, DMAC Biological Observations Task Team, national modeling committee, other IOOS committees as they are identified.)
- 4) Ensure projects and services adhere to GLOS standard operating procedures, including QMP and the MAPP outlined in *A Blueprint for Great Lakes Decision Making*.
- 5) Build public support for GLOS and IOOS through program communications (e.g., website, newsletter, webinar and in-person presentations) in coordination with NFRA E&O, IOOS, or other regional communication priorities and needs.
- 6) Convene priority user groups (e.g., AOC/LaMP and fishery managers, public health officials) to update input to DMAC, observations, tools and modeling sub-systems.
- 7) Develop a strategy document that includes protocols and prerequisites for integrating automatic identification system (AIS) data into the DMAC system.
- 8) Maintain and enhance mechanisms providing output to the DMAC system (e.g., Observation Explorer, Data Catalog, Model Inventory Database, Harborview) including adoption of relevant new protocols and services.
- 9) Maintain and operate the Nearshore Network of *in situ* observing platforms (buoys and fixed structures) and sensors.
- 10) Enhance remote sensing algorithms for identified priority parameters and products.
- 11) Coordinate deployment of GLOS mobile assets (AUV and glider) with binational CSML (Lake Erie).
- 12) Enhance hydrodynamic models including Lower Fox River/Green Bay and Saginaw River/Bay hydrodynamic models to address resource management requirements; and initiate St. Marys River hydrodynamic model to address marine operations and fishery management requirements.
- 13) Engage K-12 teachers and students through enhanced curriculum, *Teaching with Great Lakes Data*, and associated implementation support.

Year Four System Enhancements (in priority order with estimated costs). **Task 9a-** Operate and maintain the GLOS tributary monitoring network (\$ 631,800 year three of operation); **Task 9b-** If unrealized in previous years, award competitive contract(s) to pilot or implement: Harbor Infrastructure Analysis System, direct measurement of evaporation from all five Great Lakes, or observations supporting hazard warning related to wind set-up and wave actions(\$615,000 total years 4-5) ; **Task 8-** Award competitive contract for development of new products/tools (if unrealized in Year One, Two or Three) addressing most pressing need identified by priority users (\$95,000); **Task 11-** Provide travel and shiptime for additional AUV/glider missions in support of CSML (\$30,982); **Task 2-** additional support for travel, conference and workshop registration to engage current/ prospective

members, partners and stakeholders and provide staff training (\$5,000); **Task 6-** In-depth user needs assessment including focus groups and workshops (\$35,500); **Task 13-** Additional teacher training (\$12,500).

Obstacles: Year Four tasks anticipate and address challenges associated with awarding competitive projects by timely issuance of RFPs and proposal evaluation.

YEAR FIVE TASKS

- 1) Support GLOS Board of Directors for update of *A Blueprint for Great Lakes Decision Making* and Business Plan to inform the next five-year planning and proposal process.
- 2) Engage members and partners through a variety of regional activities participation and input to the GLOS planning process.
- 3) Support and enhance IOOS implementation through various national efforts (e.g., NDFRA, Data Integration Framework, other DMAC teams as identified, the national modeling committee, other NFRA and IOOS committees as they are identified.)
- 4) Ensure FY11-15 projects are adhering to GLOS standards, including QMP, completing successfully and remaining needs/gaps feed into the update of *A Blueprint for Great Lakes Decision Making*.
- 5) Sustain public support for GLOS and IOOS through program communications (e.g., website, newsletter, webinar and in-person presentations) in coordination with NFRA E&O, IOOS, or other regional communication priorities and needs.
- 6) Convene priority user groups (e.g., municipal/regional planners and infrastructure managers relative to climate change adaptation and marine operations) to update input to DMAC, observations, tools and modeling sub-systems.
- 7) Integrate identified priority data related to Task 6 in FY2014 and FY2015 into the GLOS DMAC system.
- 8) Maintain and enhance mechanisms providing output to the DMAC system (e.g., Observation Explorer, Data Catalog, Model Inventory Database, Harborview) including adoption of relevant new protocols and services.
- 9) Maintain and operate the Nearshore Network of *in situ* observing platforms (buoys and fixed structures) and sensors.
- 10) Enhance remote sensing algorithms as possible for identified priority parameters and products relative to Task 6 above, include gaps/unmet needs in FY2016-20 planning.
- 11) Coordinate deployment of GLOS mobile assets (AUV and glider) with binational CSMI (Lake Michigan).
- 12) Enhance hydrodynamic models including Lower Fox River/Green Bay and Saginaw River/Bay hydrodynamic models (address resource management requirements), St. Marys River (address marine operations and fishery management requirements).

Year Five System Enhancements (in priority order with estimated costs). **Task 9-** Operate and maintain the GLOS tributary monitoring network (\$ 650,750 year four of operation); **Task 8-** Award competitive contract for development of new products/tools (if unrealized in Year One, Two or Three) addressing most pressing need identified by priority users (\$90,000) **Task 11-** Provide travel and shiptime for additional AUV/glider missions in support of CSMI(\$31,911); **Task 2-** additional support for travel, conference and workshop registration to engage current/ prospective members, partners and stakeholders and provide staff training (\$5,000).

Obstacles: Year Five tasks anticipate and address challenges associated with engaging an expanded GLOS user community in updating *A Blueprint for Great Lakes Decision Making* which, over the course of the five-year project period, will greatly expand to include many additional groups. This will be addressed by reaching out to other agencies and organizations to summarize GLOS impact over 5-year period through the application of metrics identified in the 2011-15 edition of *A Blueprint for Great Lakes Decision Making*.

Technical Approach and Quality Assurance (QA): GLOS will design and implement a technical and QA approach that will be consistently applied across all five years of the project cycle. A GLOS Technical Advisory Panel, comprised of experts in multiple relevant disciplines, will provide technical advice on all tasks. The regional

competition(s) will follow NOAA procedures (including blind peer reviews) and include a review panel providing a slate of recommended projects for approval by the GLOS Board of Directors. GLOS has drafted an organizational Quality Management Plan (QMP) in line with EPA requirements and IOOS guidelines to develop a consistent operational system to ensure that procedures for the collection, management and application of data are scientifically sound, legally defensible, and of known and documented quality. The GLOS Quality Management Plan (QMP), currently under review by NOAA and US EPA, will apply to all tasks, as will supporting quality plans developed for the Observations and DMAC subsystems. GLOS consultants will be held to the same high quality assurance standards and plan preparation/ implementation requirements. Quantitative and qualitative metrics enumerated in *A Blueprint for Great Lakes Decision Making* will be used to benchmark performance on an annual basis.

Partner and Federal Agency Roles: GLOS members and partners will contribute to all tasks across all five years of this project via multiple feedback mechanisms (e.g., Annual Meeting, project workshops, individual meetings). The following federal state/provincial and regional agencies and organizations are currently providing input to or engaged in GLOS projects and/or program planning. This group will be expanded over the next five years. *International* partners include the International Joint Commission, Upper Great Lakes Study; Great Lakes Fishery Commission; Great Lakes Commission; Great Lakes-St. Lawrence Cities Initiative; Windsor Regional Environmental Emergencies Team (binational federal, state/provincial and local participation); *Federal* partners include: (U.S.) National Oceanic and Atmospheric Administration, Great Lakes Regional Collaboration Team, Oceanic and Atmospheric Research (Great Lakes Environmental Res. Lab., Great Lakes Sea Grant Network), National Ocean Service, National Weather Service, National Data Buoy Center; U.S. EPA, Great Lakes National Program Office, Region 5 Emergency Response, Large Lakes Research Station; U.S. Geological Survey, Great Lakes Science Center, Water Resources Division, Great Lakes Coordinator; U.S. Army Corps of Engineers, Great Lakes and Ohio River Division (Buffalo District, Detroit District, Chicago District), Institute for Water Resources; Department of Homeland Security, Federal Emergency Management Agency, U.S. Coast Guard; (Canada) Environment Canada, Boundary Waters Unit, Great Lakes Management & Reporting, Great Lakes-St. Lawrence Regulation, Environmental Protection Operations Div.; Fisheries and Oceans Canada, Transport Canada, Canadian Coast Guard; *State/Provincial/Local* members and partners include: Michigan Dep. Natural Res. and Environment; New York Dep. of Environmental Conservation; Ohio Environmental Protection Agency; Wisconsin Dep. Natural Res.; Ontario Min. of the Environment; Ontario Min. of Natural Resources; Conservation Ontario; City of Cleveland; Macomb County, Michigan; *Non-governmental Organization* members and partners include: Council of Great Lakes Industries, The Nature Conservancy, Lake Carriers Association, St. Clair Partnership (an association of municipal, township, county, state/provincial and federal agencies); *Academic* members and partners include: University of Minnesota-Duluth, Large Lakes Observatory; University of Wisconsin-Milwaukee WATER Institute; Michigan Technological University Research Institute; Cooperative Institute for Limnology and Ecosystem Research; University of Michigan Marine Hydrodynamic Laboratory, U Michigan Space Physics Research Laboratory; State University of New York Great Lakes Research Consortium.

Users: Input from GLOS users, identified above, is fundamentally important for the maturation of GLOS, particularly as it relates to model and tool development. Such input will be integrated into each task (including project design and implementation phases) via conventional and electronic means across all five years of this project.

e. Milestone Schedule

PROJECT SCHEDULE						
Milestones and <i>Deliverables</i> (<i>Deliverables in italics</i>)	Category (Baseline v. Enhancement)	2011	2012	2013	2014	2015
Program Management and Planning						
Contracts and sub-awards are in place	B	x				
<i>RFPs are drafted</i> for new contracts as needed	E		x	x	x	
Annual <i>work plans</i> are developed	B	x	x	x	x	x
Continued participation in partner initiatives	B/E	x	x	x	x	x
Project evaluation initiated	B				x	
Strategic Plan updated and <i>published to web</i>	B					x
Letters of Intent solicited and review for planning	B					x
Data Management and Integration						
Provide ongoing DMAC Subsystem development and coordination	B	x	x	x	x	x
Participation in IOOS planning activities	B	x	x	x	x	x
<i>Development of DMAC Implementation and Quality Systems Plans</i>	B		x	x		
Operations/ maintenance support for data solicitation and existing models/tools (e.g., Obs Explorer, Data Catalog, Model Inventory Database, HECWFS, Harborview)	B/E	x	x	x	x	x
DMAC services and support for emerging needs/tools in new programs such as customized state of lake application.	E	x	x	x	x	x
<i>New protocols, standards, and formats</i>	B		x	x	x	x
Inventory and <i>strategy document</i> for acquiring data identified in FY10-11 needs assessment	B			x	x	
<i>Inventory of observations and other data, databases and other material</i> useful to beach managers	B	x	x			
<i>Feasibility report on use of AIS to convey observations</i> and recommendations for next steps including inventory of potential vessels of opportunity.	E			x	x	x
Observations						
Observations Subsystem coordination and participation in IOOS planning activities	B	x	x	x	x	x
<i>Development of build-out, deployment plans and quality systems</i>	B/E	x	x	x		
Deploy and retrieve nearshore network instrumentation and AUV/gliders coordination with CSMI	B	x	x	x	x	x
Deploy and retrieve enhanced tributary monitoring instrumentation	E	x	x	x	x	x
Development and pilot testing of mobile emergency response system	E		x	x	x	x

PROJECT SCHEDULE						
Milestones and <i>Deliverables</i> (<i>Deliverables in italics</i>)	Category (Baseline v. Enhancement)	2011	2012	2013	2014	2015
Deploy and retrieve new observation platforms and sensors with biological parameters	E		X	X	X	X
Implement observing activities to address climate change adaptation strategies such as Harbor Infrastructure Analysis System and eddy covariant project	E		X	X	X	X
<u>Data contributed, evaluation and planning documents updated</u>	B				X	X
Models and Tools						
Participate in IOOS efforts	B	X	X	X	X	X
Organize "Modeling Framework" workshops, <u>develop and publish planning documents to web</u>	B	X	X	X	X	X
Identify Harborview expansion priorities and <u>implement as funding allows</u>	E	X	X	X	X	X
<u>Complete GLCFS enhancements in Green Bay and Saginaw Bay</u>	B/E		X	X	X	
<u>Initiate St. Marys hydrodynamic modeling</u>	E				X	X
Develop plans and implement <u>customized annual state of the lakes application</u> to meet fisheries and AOC/LaMP manager needs	B/E		X	X	X	
Develop priorities and <u>project plans</u> to address emerging model and tool needs	B				X	X
<u>Develop RFPs</u> , run competition and select awards to initiate tool/model development	E	X	X	X	X	
Outreach and Education						
Outreach & communications project management and support to raise awareness	B	X	X	X	X	X
<u>Quarterly newsletters – GLOS and Sea Grant Network</u>	B	X	X	X	X	X
Plan and implement data/membership solicitation	B/E		X	X	X	
Manage Sea Grant outreach and education activities	B/E	X	X	X	X	X
Participation in IOOS/NFRA committees and projects	B	X	X	X	X	X
Planning, <u>evaluation</u> , and training for existing programs/tools	B/E		X	X	X	X
Planning and <u>needs assessment</u> for new user groups	B/E		X	X	X	X
Enhanced communications, promotion and training including: <u>video, publications, presentations & webinars</u>	E		X	X	X	X

e. Cost Proposal

	Principal Investigator	Institution	2011	2012	2013	2014	2015
GLOS	Dr. Jennifer Read, Executive Director	Great Lakes Observing System	\$1.04M	\$974,219	\$956,939	\$960,043	\$892,379
Sub-	Mr. Tim Eder, Exec Dir.	Great Lakes Commission	\$300,000	\$317,500	\$328,680	\$323,540	\$345,177
contracts	Dr. James Diana, Dir.	Michigan Sea Grant	\$ 73,000	\$ 74,000	\$ 60,000	\$ 57,000	\$ 26,000
	Mr. Frank Lichtkoppler, Prog. Lead	Ohio Sea Grant	\$147,000	\$151,000	\$122,000	\$120,000	\$ 56,000
	Tool Development	Competitive Enhancements	\$147,000	\$ 90,000	\$ 90,000	\$ 95,000	\$ 90,000
CILER	Dr. Thomas Johengen, Assoc. Dir.	Cooperative Institute for Limnology and Ecosystem Research	\$2.469M	\$2.532M	\$2.534M	\$2.507M	\$2.578M
Sub-	Dr. Guy Meadows, Dir.	U Mich Marine Hydrodynamics Lab	\$132,000	\$193,519	\$199,326	\$205,306	\$211,465
contracts	Dr. Jay Austin	U Minnesota, Large Lakes Observatory	\$211,270	\$311,089	\$238,022	\$245,162	\$252,517
	Dr. Val Klump, Dir.	U Wisconsin-MIL, WATER Institute	\$132,000	\$226,514	\$233,409	\$240,615	\$247,992
	Dr. Robert Shuchman, co-Dir.	Mich. Tech Res. Institute	\$232,000	\$238,960	\$246,129	\$253,512	\$261,118
	Dr. Gregory Boyer, Dir.	Great Lakes Res. Consort.	\$264,000	\$351,807	\$352,061	\$362,623	\$373,502
		Competitive Enhancements	\$1.125M	\$655,000	\$695,000	\$615,000	\$630,000
NOAA	Mr. Steven Ruberg	NOAA- GLERL	\$396,000	\$407,880	\$420,116	\$432,720	\$445,701
Total			\$3.906M	\$3.914M	\$3.911M	\$3.899M	\$3.916M

Budget Narrative:

The total 5-year request is \$19,547,080 – Year One: \$3,906,482; Year Two: \$3,913,964; Year Three: \$3,910,807; Year Four: \$3,899,343; Year Five: \$3,916,485. Funds are requested to support operations of the GLOS Regional Association (Element 1, below), GLOS regional partner, the Cooperative Institute for Limnology and Ecosystem Research (Element 2, below) and NOAA's Great Lakes Environmental Research Laboratory (Element 3, below). Per FAQ post from IOOS office, this cost proposal and details in the appendix represent the "best case scenario" budget request, while the work plan above provides task detail on baseline and enhancement activities as well as enhancement costs per item.

1) GLOS: The total five year request is \$4,824,637, as follows: Year One: \$1,041,056; Year Two: \$974,219; Year Three: \$956,939; Year Four: \$960,043; Year Five: \$892,379. An overview of the funding break-out follows, with details available in the appendix to this proposal. Personnel: Salary is \$149,331 in Year One to support outreach specialist (1FTE) and technical specialist (1 FTE), noting that the Executive Director is under contract and the Business Manager salary is covered under IDC. A 5% cost of living and merit increase is factored for out years; Fringes: FICA (7.65 %) and Michigan State Unemployment Insurance (27% of first \$9K/employee) are \$11,910 in Year One and increase with salary in Years Two- Five. Travel: Years One –Three \$20,000, Year Four \$18,700 and Year 5 \$18,302. Equipment over \$5,000: None requested. Supplies: \$3,300 in Year One/\$3,368 in Year Three, including computer upgrades for Executive Director and Technical Specialist; \$2,000 in Year Two; \$1,000 in Year Three; \$ 502 in Year Five. Contractual: GLOS Executive Director \$90,090/year for five years; Great Lakes Commission DMAC support (Year One: \$300,000; Year Two: \$317,500; Year Three: \$330,000; Year Four: \$325,000; Year Five: \$325,500) including coordination of all DMAC activities (regional, national and international), operation and maintenance of all GLOS data services, development of new data services and backend support for new tool development. Ohio Sea Grant will coordinate Great Lakes Sea Grant Network outreach activities with targeted user communities (Year One: \$147,000; Year Two: \$151,000; Year Three: \$122,000; Year Four: \$120,000; Year Five: \$56,000). Michigan Sea Grant will coordinate Great Lakes Sea Grant Network education activities including further development of *Teaching with Great Lakes Data* and classroom implementation support (Year One: \$ 73,000; Year Two: \$74,000; Year Three: \$60,000; Year Four: \$57,000; Year Five: \$26,000). Tool development based on user needs will be undertaken in close consultation with a user-based advisory committee(s), contractors will be selected competitively per work plan above (Year One: \$150,000; Year Two: \$100,000; Year Three: \$100,000; Year Four: \$100,000; Year Five: 75,000). Other: \$4,500 is requested each year to cover costs associated with annual meeting facilities and refreshments. Indirect Cost Charges: These costs are calculated at 29.5%; note that GLOS is currently negotiating its indirect rate with the Department of Commerce; this is the estimated rate.

2) Cooperative Institute for Limnology and Ecosystem Research: The total five year request is \$12,620,025, as follows: Year One: \$2,469,426; Year Two: \$2,531,864; Year Three: \$2,533,752; Year Four: \$2,506,579; Year Five: \$2,578,404. An overview of the funding break-out follows with details available in the appendix to this proposal. Personnel: Salary is \$144,000 in Year One to support the Principal Investigator (Dr. Thomas Johengen) who will act as the program manager (2 months), an AUV/Glider technician (1 FTE), a modeler (Dr. Eric Anderson) (1 FTE) and support for student hourly support (~1,250 hours). A 3 % cost of living and merit increase is factored for out years; Fringes: Fringes are 25% for the PI; 35% for the technician and modeler, and 8% for student hourly and increase with salary in Years Two-Five. Travel: \$13,000 is requested in year one to support AUV/Glider missions and for PI and modeler to travel to GLOS annual meeting, year two \$23,390 request reflects additional AUV/Glider missions related to Tributary Observation with 3% annual increase for out years. Supplies: \$12,000 is requested in year one to cover replacement costs – electronics, hardware, laboratory supplies, year two \$17,360 request reflects additional expenses related to Tributary Observation with 3% annual increase for out years. Contractual: Subcontracts will be awarded to the following university partners who will provide implementation of the nearshore network and remote sensing (years 1-5), and Tributary Observation activities in years 2-5. University of Wisconsin-Milwaukee (Year One: \$132,000; Year Two: \$226,514; Year Three: \$233,409; Year Four: \$240,615; Year Five: \$247,992); University of Minnesota-Duluth observation activities and support for Lake Superior fishery managers (Years 1 and 2) (Year One: \$211,270; Year Two: \$311,089; Year Three: \$238,022; Year Four: \$245,162; Year Five: \$252,517); Great Lakes Research Consortium (State University of New York system) (Year One: \$264,000; Year Two: \$351,807; Year Three: \$352,061; Year Four: \$362,623; Year Five: \$373,502); Michigan Tech Research Institute support includes the nearshore network and remote sensing activities at a request of \$232,000 in year one and increasing at 3% annual increment; U Michigan Marine Hydrodynamic Laboratory Year One \$132,000, Year Two \$193,519, 3 % annual increment in years 3-5. Other: Ship costs are included to support deployment of AUV/Glider at \$9,000 in year one increasing at 3% annually. Indirect Costs: Indirect is charged at U. Michigan's 26% off-campus rate; CILER Program Development: CILER charges a 2% surcharge on total project costs for program development.

3) NOAA Great Lakes Environmental Research Laboratory: Funds will support deployment of buoys at Cleveland, OH and Alpena, MI under baseline funding and Muskegon, MI with enhanced funding. The total five year request is \$2,102,418, as follows: Year One: \$396,000 and increasing at a 3% increment in out years.