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Report to the NOAA Science Advisory Board

Joint Institute Review
Cooperative Institute for Limnology and Ecosystems Research (CILER)

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Executive Summary and Recommendations

The Cooperative Institute for Limnology and Ecosystems Research (CILER) is a productive and flourishing institution that serves science needs for the Great Lakes region. The Scientific Vision and Plan have close ties to NOAA's strategic mission. Projects underway at CILER have objectives and outcomes that address four NOAA Strategic Goals: (1) *Protect, Restore, and Manage the Use of Coastal and Ocean Resources Through an Ecosystem Approach to Management, (2) Understand Climate variability and Change to Enhance Society's Ability to Plan and Respond, (3) Serve Society's Needs for Weather and Water Information, and (4) Support the Nation's Commerce with Information for Safe, Efficient, and Environmentally-sound Transportation.* CILER uses the relationship between NOAA and the University of Michigan to foster relevant multi-investigator research involving scientists from NOAA and its laboratories, Universities, other federal agencies, and states. Numerous regional stakeholders commended CILER on successful research and management efforts and pointed to CILER's importance to resource management and science in the Great Lakes. CILER scientists and associates have authored numerous publications in a variety of regional, national, and international peer-reviewed journals. Education and outreach activities at CILER are significant, considering the small size of available staff assigned to theses activities.

The University of Michigan has managed CILER successfully over the last several years and has provided financial and "in-kind" support to maintain the Joint Institute. Leadership of the Institute has been solid and will need particular attention due to recent staffing changes. CILER performs several important missions for stakeholders in the Great Lakes and is effective in achieving their goals.

Numerous important suggestions are made throughout the full report. However, the panel makes the primary recommendations for improvements below.

1. Develop a new CILER Strategic Plan to define goals and objectives specific to CILER needs.

The committee feels that a unique CILER identity, inclusive of GLERL interactions but broader than GLERL, is a desirable goal for the University of Michigan and NOAA. Realization of this goal would benefit all concerned in terms of breath of science, funding opportunities, formation of widespread partnerships, development of large interdisciplinary research programs, and widespread recognition for the University of Michigan, GLERL, and other associated organizations. The Council of CILER Fellows should provide advice on future participants in this important activity.

2. Hire a new CILER Director with strong academic credentials and award the new Director a University of Michigan academic appointment at the level of "Full" or at least "Associate" Professor.

The new Director should be selected to command national and international respect within and outside of NOAA organizations and could play a strong role in developing a strategic plan and conceiving and developing large interdisciplinary projects involving NOAA, universities, and other governmental and environmental partnerships in the Great Lakes and marine coastal regions. Such leadership will increase the visibility and effectiveness of CILER at all levels.

3. Consolidate Great Lakes scientists and programs in a single building or complex at the University of Michigan as proposed.

The committee agrees with the proposed concept to consolidate research activities from a variety of organization under "one roof" to encourage open exchange of ideas and development of joint research projects, which will make "the whole bigger than the parts." Sharing of common facilities and activities such as libraries and seminar series among the different organization will be cost effective. Such partnerships are desirable from the standpoint of creating an environment for new ideas to thrive and should help produce more research, education, outreach, and management products or tools per unit cost.

4. Enhance CILER's visibility and effectiveness by increasing partnerships with other branches of NOAA and other universities in the Great Lakes region.

An expansion of CILER's role should result in increased research and funding possibilities for scientists in CILER, GLERL, and associated partners. For example, interactions with the NOAA National Weather Service could help provide information interfacing meteorological events with Great Lakes physical dynamics, which in turn relate to biological and biogeochemical processes. These activities would contribute to the goal of having CILER become an internationally-recognized organization for leading interdisciplinary and inter-institutional Great Lakes and marine-coastal research.

5. Set time limits with "sun rise" and sun set" periods for CILER sub-projects developed under the broad themes outlined in the new Strategic Plan.

The EEGLE program and other success stories mentioned in this report serve as effective examples of strong projects with specific goals, accomplishments, and beginning and ending times. Using this framework will have several advantages, including the focus on specific projects, timely production of publications and new products, and the timely development of new projects which address important problems.

6. Continue and increase CILER's research, education, and outreach efforts.
Education and outreach efforts (e.g. Partners for Excellence Program; National Ocean Sciences Bowl; Great Lakes Summer Student Fellowships, Thunder Bay National Marine Sanctuary and Underwater Preserve; and the proposed Great Lakes Center for Ocean Science Education Excellence (COSEE)), in addition to research contributions presented in scientific journals and at scientific meetings, can convince citizens and organizations that Great Lakes science provides a powerful tool to support good management decisions.

They demonstrate how CILER/GLERL science has had a positive effect on the well being of the Great Lakes and is valuable to stakeholders. CILER's role in such efforts should go beyond that of facilitation, administration, and some mentorship; it would be desirable for CILER to take on more programmatic planning and leadership, which may constitute one role for the new Assistant Director. Also, if data are available, the effectiveness of the education programs could be measured by how many students involved in them go on to study in CILER-related fields, have received advanced degrees, or have received employment in these fields. Other metrics are possible for the public outreach programs.

7. Encourage SNRE faculty members across a wide spectrum of disciplines to bring their talents and help CILER accomplish its goals.

The strengths and diversity of SNRE faculty members should be used by CILER to evaluate impacts of Great Lakes research activities and how they relate to the public and other stake holders.

8. Reinvigorate the Council of CILER Fellows and give them a stronger role in CILER Strategic Planning for research and other activities.

The Council contains a reservoir of senior research and management talent and experience that should be used effectively to help plan the future of CILER. Changing the membership of this group periodically will help invigorate interest and assure that new ideas are brought into consideration.

9. Improve the content and usefulness of annual reports.

CILER annual reports had limited utility for examining and reporting the breadth and quality of research accomplished by the institute. The new CILER director should examine annual report formats and recast them in a form that could be both a useful tool for reporting to NOAA on funded activities but also as an outreach tool for highlighting institute projects.

10. **Re-examine the issue of using CILER as a funding mechanism for Great Lakes research.**

The new Director and Council of CILER Fellows should re-examine mechanisms for funding non University of Michigan academic institutions for Great Lakes research. A fair system that is mutually beneficial to the University of Michigan, NOAA, CILER, and other institutions is clearly needed.

Review Process

The quality of the CILER scientific program was judged on the basis of discussions of issues involving the: (1) Science Plan, (2) Science Review, (3) Outreach and Education, and (4) Science Management Plan, which were presented in written format and oral presentations by Dr. Rosina Bierbaum, Dean, School of Natural Resources and the Environment (SNRE); Dr. Stephen Brandt, Director of GLERL; Dr. Donald Scavia, Interim Director, CILER; and four CILER scientists during the on-site review. Several posters were also presented by CILER students and scientists. Additional documentation, provided to the review committee before the site visit, included (1) previous annual reports (2001-2002, 2002-2003, and 2003-2004) and the CILER Proposal to NOAA to cover the period 2001-2006.

Section 1 Science Plan

Science Plan Strengths:

Scientific Vision. The review committee supports the scientific vision statement for the CILER Institute "to enhance collaborative research between GLERL and academic scientists throughout the Great Lakes Basin." The five research tasks defined for CILER in the proposal (Climate and Large Lake Dynamics; Coastal and Nearshore Processes; Large Lake Ecosystem Structure and Function; Remote Sensing of Large Lake and Coastal Ocean Dynamics; and Marine Environmental Engineering) detailing the fourth multi-year plan for July 1, 2001, to June 30, 2006, are commendable and fit well into the NOAA Strategic Plan as indicated below.

Relationship to NOAA Strategic Plan. Current CILER/GLERL research clearly supports the NOAA Strategic Plan formulated for the years 2005-2010 as indicated below:

NOAA Strategic Plan Goal #1: *Protect, Restore, and Manage the Use of Coastal and Ocean Resources Through an Ecosystem Approach to Management.* CILER research covers a wide variety of Great Lakes and coastal marine issues and includes important monitoring, research, and modeling efforts, which are needed to help assess the state of the ecosystems and provide information required to make informed predictions of the potential effects of different management strategies and scenarios.

NOAA Strategic Plan Goal # 2: *Understand Climate variability and Change to Enhance Society's Ability to Plan and Respond.* CILER research addresses climate-related research within the Great Lakes basin by developing models of ice thermodynamics in the Great Lakes and by tracking changes in the conditions in the Great Lakes via the Coast Watch and other long-term monitoring programs (e.g. monitoring changes in benthic populations and contaminant concentrations with depth of sediment cores).

NOAA Strategic Plan Goal # 3: *Serve Society's Needs for Weather and Water Information.* Coast Watch activities, along with the development of new observation technologies, provide information needed to develop predictions and warning about weather and water conditions.

NOAA Strategic Plan Goal # 4: *Support the Nation's Commerce with Information for Safe, Efficient, and Environmentally-sound Transportation.* CILER addresses this goal directly, and Goal 1 indirectly, by their projects related to overseas no ballast on board (NOBOB) vessels trading on the Great Lakes. The introduction of nonindigenous species, via release from NOBOBs, is a major problem facing the Great Lakes and coastal marine systems as world trade with other countries continues to increase. This project relates closely to Goal # 1 because the introduction and development of new species (e.g. zebra mussel) can affect the structure and function of food webs in the Great Lakes and other regions. The innovative NOBOB research being conducted by CILER/GLERL scientists is thus relevant to the future well being of these important ecosystems.

Publication Record. The collaborative science conducted by CILER, GLERL, and students and scientists from other institutions addresses important issues and is of high quality. The committee commends the scientists for obtaining research funding from national agencies and other sources, publishing research results in respected refereed journals, and making them available to a wide spectrum of stakeholders. In addition to a few reports and a book chapter, CILER authors have authored or co-authored papers published in a wide spectrum of quality aquatic science journals including: *Archives of Environmental Contamination and Toxicology, ASCE Journal of Waterway, Port, Coastal, and Ocean Engineering, Aquatic Ecology, Aquatic Toxicology, Boreal Environment Research, Canadian Journal of Fisheries and Aquatic Sciences, Ecological Modeling, Ecotoxicology and Environmental Safety, Environmental Science and Ecology, Environmental Toxicology and Chemistry, Freshwater Biology, Estuarine Coastal and Shelf Science, Hydrobiologia, Journal of Great Lakes Research, Journal of Geophysical Research, Journal of Physical Oceanography, Limnology and Oceanography, North American Journal of Fisheries Management, and Transactions of the American Fisheries Society.* The publication of CILER research results in respected journals helps assure that CILER research results will be used by a variety of stake holders including: the academic research and education community; scientists (field, experimental, and modeling emphasis) who conduct research to improve understanding of the Great Lakes and coastal marine systems; resource managers who are responsible for making policy decisions regarding the status of water quality and fisheries in these large ecosystems; private land owners; tourists and other users of Great Lakes resources, and other citizens interested in the well-being of the lakes and coastal resources

Interdisciplinary Accomplishments. Through participating in large interdisciplinary programs, CILER scientists have had a broader impact on improving our understanding of Great Lakes issues than would be feasible from individual scientific efforts standing alone. An excellent example of a successful interdisciplinary collaborative project to improve understanding of a Great Lakes system is the large EEGLE (Episodic Events

Great Lakes Experiment), which was conducted by CILER, GLERL, and other academic institutions. Results from this large research effort, co-sponsored by NOAA and the National Science Foundation (NSF), have been published in refereed journals covering a variety of related fields and resulted in conceptual and ecosystem models. These research findings have improved our understanding of physical processes and sediment transport and changed nutrient-cycling/energy-flow paradigms in Lake Michigan during winter/spring months. Insights gained from this study will be applicable to other temperate systems around the world.

Other examples of interdisciplinary studies which may affect management strategies and practices are interfacing physical transport models with yellow perch transport in Lake Michigan and phosphorus transport in Lake Erie.

The NOBOB effort is an example of research, which can be applied to engineering issues and management decisions regarding the handling of ballast water. In turn, these decisions will affect the future well-being of Great Lakes ecosystems, and the organizations and people who benefit from them. Coast Watch provides another example of a monitoring program that allows current and future scientists and mangers to recognize changes and make wise decisions regarding policies affecting the future well-being of water quality and fisheries resources in the lakes.

Examples of new scientific programs, which could have large impacts affecting our future understanding and predictive capabilities, are the International Field Years for Lake Erie (IFYLE) and the Great Lakes and Human Health Initiative, and the National Program for Research on Aquatic Invasive Species, described by Dr. Brandt, which are being developed as collaborations among GLERL, CILER, and other institutions.

Opportunities for improvement:

Need for CILER Identity. One consideration for future planning is whether a unique CILER identity, inclusive of GLERL interactions but broader than GLERL, is a desirable goal for the University of Michigan and NOAA, respectively. The quality of CILER research is considered to be high and CILER/GLERL research products are important to implementing wise practices for the management and use of the Great Lakes and other aquatic resources. However, based on the information provided, it was difficult for the committee to assess the relative roles of CILER and GLERL in the planning and implementation of joint research projects. At present, CILER appears to serve as an effective extension of GLERL's research capabilities. CILER scientists make important inputs and contributions to the efforts, but most current projects appear to have been conceived and led by GLERL scientists.

CILER provides an effective means to hire students and assistants on a temporary basis to work with GLERL scientists to accomplish short term projects. Career-track CILER scientists are successful and accomplished researchers, but they work at GLERL and use GLERL equipment and facilities and therefore do not have a strong identity with CILER

vs. GLERL. This current approach has produced strong scientific contributions, but it does not provide a template to build a multi-institutional CILER with a unique identity.

CILER Annual Reports. A lack of internal and year–to-year consistency among projects and between years was noted in the sub-theme project write-ups contained in the CILER Annual Reports. Reports for some projects were identical to the reports on the same projects from the year before, others had some identical sections with addendums indicating progress, and still others simply included only progress made over the year of the report. The committee suggests that Annual Progress Reports be made more consistent among projects and years with minimal redundancy among reports from the different years. A detailed background could be included for new projects, but inclusion of long sections of project descriptions, or accomplishments, which are repetitive from year to year, is not efficient. The Committee suggests that, after the first project year, a short abstract could be included for each project, followed by a progress summary that is limited to accomplishments made over that specific year.

CILER as a NOAA Funding Mechanism for Large Lakes Research. Questions arose about the benefits vs. disadvantages of using CILER as a general mechanism to fund Great Lakes Projects, which do not involve University of Michigan researchers. This issue should be re-examined to come up with a fair funding mechanism that is mutually beneficial to CILER, the University of Michigan, NOAA, and the other Universities that are involved.

Expand CILER Role at the University of Michigan. CILER scientists, in conjunction with GLERL and other scientists, are doing an effective job in meeting the administrative, educational, and research objectives of CILER. The committee believes that SNRE may now have a "window of opportunity" to expand these accomplishments even more in the future. The University of Michigan must make a strong commitment to supporting Great Lakes programs and NOAA must support CILER conceptually and financially for this goal to succeed. The joint creation of new positions by the University of Michigan, GLERL, and the Great Lakes USGS Laboratory is a positive indicator of potential commitments from the University of Michigan, NOAA and the USGS. The strengths and diversity of SNRE faculty members should be used by CILER to evaluate impacts of Great Lakes research activities and how they relate to the public and other stake holders. SNRE faculty members across a wide spectrum of disciplines should be encouraged to contribute their talents and help CILER accomplish its goals. The proposed new building to house marine scientists from various organizations and agencies at one site will promote the goal of a strong Great Lakes program and provide a strong "stepping stone" if realized.

Section 2 Science Review

The research conducted in CILER is organized around five tasks (summarized briefly below). An additional important task (Task I), to enhance and support research and scientific collaboration by the institute, is addressed elsewhere in our report.

The five research tasks are:

Climate and Large Lake Dynamics (Task II)

Deciphering the relationships between large lakes and regional climate presents a unique opportunity to improve the understanding of large-scale climate change, since changes to the hydrology, chemistry, and biology of large lakes provide signals of climate change that may be easier to interpret than in other environments (e.g., large marine ecosystems).

Coastal and Nearshore Processes (Task III)

Despite the intrinsic value of the nearshore zone and the large impact of anthropogenic activities, many of the key processes that shape the structure and function of the nearshore zone remain poorly understood, such as linkages between physical, chemical, and biological conditions in these dynamic environments. The research focus has been on advancing scientific understanding of sediment-water exchange and sediment transport in the Great Lakes and other ecosystems.

Large Lake Ecosystem Structure and Function (Task IV)

The Great Lakes are affected by numerous chemical and biological stressors, including chemical contamination, eutrophication, and non-indigenous species. The research uses ecosystem approaches to study various elements of Great Lakes ecology, including the cycling of critical materials, linkages between the physico-chemical environment and lake biota, and ecological consequences of establishment of nonindingenous species.

Remote Sensing of Large Lake and Coastal Ocean Dynamics (Task V)

In large lakes, remote sensing of the temperature field provides a direct measure of the density field. This one-to-one correspondence, which does not exist in marine environments, provides new and exciting clues to many physical, biological, chemical, and geological processes. The rapid formation and extensive existence of ice provides an opportunity to use the capabilities of remote sensing to foster and promote safe navigation. Research using remote sensing provides catalysts for the formation of the next generation numerical predictive models of Great Lakes and Coastal Ocean Dynamics

Marine Environmental Engineering (Task VI)

Aquatic ecosystems are impacted by multiple chemical and biological stressors that affect ecological function and structure and pose significant human health risks. The Great Lakes remain vulnerable to the impacts of invasive species. Scientific information related to the handling and disposal of contaminated sediments and dredge material, and more accurate and automated methods of providing safe navigation within waterways are needed. Research projects have addressed all of these issues.

2A. *Scientific Highlights and Accomplishments*

Summary

It was evident from the presentations and the poster session that the Institute's scientific productivity is strong, balanced among the tasks and of high quality. The underlying themes to the science are (1) model development for forecasting, (2) field research to support the models and (3) research to validate or improve model accuracy and precision, through studies of mechanisms and processes and cause and effect. Overall, research emphasis includes ecosystem impacts of climate change, impacts and control of non-indigenous species introductions, and incorporation of new technology into measurement systems and modeling approaches.

The Panel was impressed with the high quality of CILER research, the high quality of the new CILER staff, such as Drs. Tomas Hook and Larissa Sanos, and the implementation of outstanding science to address pressing management issues in the Great Lakes Basin. As an example of strong collaboration on a regionally important issue, CILER has had an important role in facilitating and implementing the International Field Year on Lake Erie (IFYLE). This project is a strong example of a cooperative, interdisciplinary, multi-partner project to address a key regional issue at the proper spatial and temporal scale to generate science useful to managers. The overall management questions are:"Why is there still a dead zone in Lake Erie following control of the factors thought responsible for eutrophication?," and "What are the direct and indirect effects of hypoxia on ecosystem components in the dead zone? The Panel found that building collaborative, multidisciplinary teams is a strong point for CILER. This approach has led to scientific findings that are cutting-edge and relevant to Great Lakes management.

Emerging Areas of Scientific Interest. Three main areas detailed for future research at CILER are:

1. Participation in a two-year field project to investigate the effect of hypoxia on the Lake Erie ecosystem. The project, International Field Year on Lake Erie (IFYLE), aims to identify the causes and ecological consequences of low oxygen events. This is a major multi-partner field program. The Panel supports the decision to have a year of sample analysis and assessment between the 2 years of field sampling. This plan will offer an important opportunity to make "mid-course" adjustments to the sampling design.

2. The development of an integrated coastal observing system for the Great Lakes. This approach will provide real-time observations of chemical, biological, and physical parameters. The system will allow data collection during extreme weather events, facilitate modification of sampling parameters in anticipation of episodic events, facilitate collection of biological and physical samples in response to episodic events, and support long term research and sensor and system development.
3. Identifying the influence of processes and condition of the Great Lakes on human health through NOAA's Oceans and Human Health Initiative. CILER is a partner to the NOAA Center of Excellence for Great Lakes and Human Health, which is based at GLERL. The goal of this center is to use ecosystem forecasting to help minimize risks to human health in coastal environments. Forcasts, based on a multidisciplinary approach will reduce the risk to human health in the Great Lakes in three main areas: water quality, beach closures and harmful algal blooms.

Synopsis of Scientific Accomplishments

The following examples are some of the most significant science findings from the last five years. They are illustrative rather then exhaustive, and highlight the scientific strengths of the Institute and its collaborators. The extensive research collaborations between CILER, and other entities made it difficult for panel members to identify where CILER staff ,versus associates, provided clear leadership. The panel supports of extensive collaborations, but encourages CILER leadership to identify succinctly the roles CILER staff play in specific research products.

Biological Monitoring – The sustained monitoring of benthic macroinvertebrates from the mid 60s to present provides an invaluable long term time series for evaluating the status and trends of Lake Michigan ecosystem. From this time series a correlation of benthic populations with the zebra mussel invasion and dramatic decline over 6 year period was evident. This finding established the basis for and led to the formulation of hypotheses on causes and ecosystem consequences of the decline in *Diporeia*. The Panel encourages the maintenance of this time series to indicate ecosystem status and trends. The value of such long term time series is crucial to NOAA's implementing an ecosystem approach to management in Great Lakes and marine environments.

NOBOB – The results from this investigation are timely, responsive, and relevant to ballast water management. Until very recently, no data existed on the biota occurring in the residual water and sediments of ballast tanks of ships transiting the Great Lakes that have declared "No Ballast on Board" (NOBOB). This effort is an excellent example of "end to end" science. Specifically, the research led to improved scientific understanding and knowledge, followed by the translation of the science to advice that resulted in management actions. The U.S. Coast Guard is using the results to develop a management plan for NOBOB.

Contaminants –This program is strong and will continue to be important because of existing legacy problems of persistent organic contaminants and the likelihood of increasing concerns from non-point source pollutants. One area of research concerns the concept of lethal body residues to improve understanding of species difference in toxicity. This "cutting-edge" research helps estimate the effects and ecological hazards from persistent environmental contaminants. Contaminants research also includes an effects-based approach to screen for the hazard potential of bioaccummulated compounds, and the use of an effects-based ecological model to assess direct and indirect effects of biocides being considered for use in treating ballast waters.

IFYLE – Through CILER the International Field Year for Lake Erie was initiated recently. CILER investigators were successful in a competitive Sea Grant process and received funding for two out of 13 successful research proposals out of a total of 41 submitted proposals. In addition, CILER helps facilitate regional planning, and will have a critical role in FY 06 for planning another year of sampling in FY 07. To date, CILER has contributed substantively to facilitation and implementation of the project. . This activity is an excellent example of a cooperative, interdisciplinary, multi partner project to address a key regional issue. It exemplifies an appropriate role for CILER in fostering multi-partner ecosystem-scale projects, while having individual investigators compete to be members of the science team. The Panel encourages CILER to participate actively in future projects similar to IFYLE. They will be critical to implementing an ecosystem approach to management for the Great Lakes, as called for the NOAA Strategic Plan.

Models – A long standing, continuous scientific strength of CILER is the development of physical models of Great Lakes processes. This research has improved understanding of Great Lakes dynamics and how they affect biotic and abiotic components. For example, the hydrodynamic and sediment transport models show that resuspended sediments are equal the amount of fine sediment transported to the Lake Michigan by rivers. This phenomenon is caused by large waves together with wind stress (northerly), and is therefore episodic in nature. A major advance was linking the circulation model to the sediment-transport model, and adding remote sensing data to the model to yield a simulation model. Results from this model indicated that a few episodic events may control long term sedimentation in the lake.

Additional examples of the use of models:

- Yellow perch represent an important fishery and populations are depleted. A 3D-particla trajectory model, to explore transport, growth, settlement and survival, is in development. This information would help explain interannual variation, which is important to improving fishery management schemes. It is the first such model for larval fish transport in the Great Lakes.

- A Lake Erie hydrodynamic model is being developed to assist assessment of water quality of the lake, which is linked to phosphorous loading. The model will allow development of scenarios for evaluating future management options.

- The "lessons learned" in Lake Michigan and Erie are being transported to Lake Champlain. Due to the physical characteristics of that lake, scientists had difficulty describing its circulation. Promising work is under way to adapt ocean drifters for use in lakesA hydrodynamic model of Lake Champlain using these data is planned. This research exemplifies how CILER can foster technology transfer to improve scientific understanding and management of other large lake ecosystems.

Section 3 Education/Outreach

CILER, in collaboration with GLERL, is involved in a number of commendable outreach and education programs (described briefly below) to increase student and public awareness about the science of the Great Lakes. The educational programs provide opportunities for Michigan high school students and college and university undergraduates in the U.S. and Canada. The level of participation in these programs by the recipient groups is outstanding and the programs appear to be well organized and conducted.

A. What types of educational activities/opportunities (K-12; undergraduate and graduate students) does the institute offer on an ongoing basis?

Educational Programs

Partners for Excellence Program

- Recipients – Ann Arbor Public Schools high school students (those who will be juniors)
- Lead organization – GLERL
- Source of funding/annual funding – GLERL/$1,500
- Length of program – 15 years
- Recipient experience – summer research opportunity under the tutelage of CILER or GLERL mentors, including the writing of an end of session essay
- Average number of students in program – about 2-3 per summer

National Ocean Science Bowl – Great Lakes Bowl

- Recipients – high school students in the Great Lakes region
- Lead organization – CILER
- Source of funding/annual funding – Consortium for Oceanographic Research and Education (CORE), Michigan Sea Grant, GLERL/$15,000
- Length of program – 8 years
- Recipient experience – Great Lakes Bowl is a regional competition of the NOSB that tests students' math and science skills as applied to topics on ocean and Great Lakes biology, chemistry, geology, physics, technology, history, and economics. Students involved with the NOSB are eligible for the Ocean Scholar Program and the Coastal and Ocean Science Training Internship Program. The NOSB also supports teachers, providing them with valuable resources and professional development opportunities.

- Average number of participants – in each of 2004 and 2005, there were 80 students comprising 16 teams, with 16 coaches and approximately 50 volunteers and staff

Great Lakes Summer Student Fellowships

- Recipients – undergraduate and graduate students from around the U.S. and Canada
- Lead organization – GLERL
- Sources of funding/annual funding – GLERL/$135,000
- Length of program – 8 years
- Recipient experience – summer research experience under the tutelage of "Great Lakes professionals," including CILER and GLERL mentors; program includes a final oral presentation and written report
- Average number of students in program – approximately 25-30 per summer

Public Outreach Programs

Thunder Bay National Marine Sanctuary and Underwater Preserve Programs

- Recipients – general public
- Lead organization – CILER
- Sources of funding/annual funding – Thunder Bay National Marine Sanctuary and Underwater Preserve, and the University of Michigan's Department of Naval Architecture and Marine Engineering/$50,000
- Recipient experience – improve public awareness of underwater research within the Great Lakes, with the use of a remotely operated vehicle (ROV); program related to shipwreck preservation and the study of recently discovered Lake Huron sinkholes
- Average number of visitors – during June 2004-May 2005, about 16,000 exhibit visitors; estimate for the new facility is about 70,000 visitors/year. There are also between 500-1000 recreational divers at the site per year.

NOAA CoastWatch Website

- Recipients – general public, including particularly mariners and fishermen
- Lead organization – NOAA
- Sources of funding/annual funding – NOAA/NESDIS, NOS Coastal Ocean Program (COP)/$ unknown
- Recipient experience – web tool (http://coastwatch.glerl.noaa.gov) to track changes in conditions in and above the Great Lakes, including ice cover levels and water surface temperatures; data also applicable to studies concerning climate change in the Great Lakes Basin. CILER research led to the creation of many of the research tools and products seen
- Average number of web hits – 17,570 visits/month; 73,540 views/month (a view represent the number of pages visited)

B. What are the current and planned outreach efforts?

Current Efforts

- Continuation of all efforts listed in A.

Planned Efforts

Great Lakes Center for Ocean Science Education Excellence (GL COSEE)

- One component of NSF's National COSEE Network – CILER is serving as the focal point for the Great Lakes Center proposal submission
- Five-year effort to connect formal and informal educators, students in grades 4-10, and the public with the science of the Great Lakes.

Effectiveness of CILER Outreach Efforts

The relative roles of CILER and GLERL in these efforts appear to be those of facilitator/administrator and programmatic leader, respectively. The panel would like to see CILER's role on the programmatic side of these programs increase. Also, it was not clear how the effectiveness of these programs has been assessed. Thus, CILER's role in such efforts should go beyond that of facilitation, administration, and some mentorship; it would be desirable for CILER to take on more programmatic planning and leadership, which may constitute one role for the new Assistant Director. Also, if data are available, the effectiveness of the education programs could be measured by how many students involved in them go on to study in CILER-related fields, have received advanced degrees, or have received employment in these fields. Other metrics are possible for the public outreach programs.

Section 4 Science Management Plan

A. How does the Institute identify new intellectual opportunities?

New intellectual opportunities are identified by individual PIs, rather than linked to a CILER strategic plan. Research themes and new starts are developed according to previous NOAA strategic plan and the research interests and priorities of GLERL. CILER should re-evaluate its own intellectual opportunities, priorities, and themes based on the new NOAA strategic plan for 2005-10.

B. What are some recent examples of intellectual opportunities?

CILER ran a competition (Science Enhancement Program) targeted to UM faculty to develop cooperative research with NOAA scientists, which was funded thru OAR. A more recent example is the announcement of seven new joint appointments co-sponsored by CILER and GLERL.

C. What is the strategy for new starts (projects, techniques, campaigns, etc.).

The current strategy for new starts is largely PI driven. More recently, CILER has developed a joint appointments program with GLERL that could lead to seven new research faculty positions and new areas of research within CILER. We encourage CILER to build relationships with other NOAA line offices besides OAR (e.g., NOS). In addition, CILER should re-invigorate the Council of Fellows, since it has met only once in the last several years. Council membership should be re-evaluated to account for strategic research areas and expertise. As part of its mandate, the Council should assess and develop high priority areas for new research.

D. How much of the Institute resources are reserved for new opportunities or bright ideas?

Other than the science enhancement funds ($104K), there are limited opportunities to allocate resources for new and potentially, high risk/high reward projects. This limitation is exacerbated by the fact that most of the science budget comes from GLERL and OAR.

E. What is the demographic structure of the Institute employees?

CILER appears well balanced in terms of gender. However, there are no women and appear to be no minority members on the Council. The appointment of new Fellows should address this issue. In addition, the joint appointment program offers an important opportunity to enhance the diversity of CILER staff. The CILER strategic plan should address diversity in a manner similar to the NOAA strategic plan (i.e., the recruitment of "a highly-skilled, motivated, and effective workforce that reflects the communities we serve.")

F. What is provided for human resources development? (Recruitment, Rewards, Training)

In addition to tuition support for students, CILER provides training for its employees largely through GLERL in areas such as laboratory and fire safety. For senior level CILER scientists, there is limited room for advancement within NOAA and UM. Both entities should identify ways to remove the "ceiling" in scientific advancement relative to being a government scientist or a tenured faculty member.

G. What is the state of the financial health of the Institute? (Provide a budget summary and identify imbalances or needed adjustments.)

As with other cooperative institutes the core budget ($170 K) has remained flat for the last few years. Grant funding is the primary source of additional funding for the institute. It was clear to the panel that the institute is very dependent on funding from GLERL. The panel recommends CILER broaden its grant support from NOAA and other line offices, and enhance University support from federal and state entities. The proposed building of a new facility on Michigan's North Campus will result in the co-location of a broad range of Great Lakes science interests. This will increase opportunities for funding from a broader range of sources because of increased interactions with agencies other then GLERL. The Council of Fellows should help provide direction for the development of new intellectual and financial opportunities for CILER.

The cost of contract management has created conflicts between GLERL and CILER. The panel recommends an increase in CILER core budgets that will cover all indirect costs to the University, thus eliminating this conflict.

H. How does the Institute intend to work towards accomplishing its financial goals?

The institute is committed to hiring a Director and the panel strongly agrees that the new Director should be a tenure track professor appointment at the full or associate level.

I. Are their any issues in interacting with NOAA that require attention?

CILER's interactions with GLERL have been productive, and have resulted in high quality science. However, the Joint Institute should develop a higher degree of independence, based on a strategic plan and broader connections with NOAA and other government agencies and universities. This action will allow CILER to meet its commitment to be a regional entity for fostering interactions between NOAA and other federal, international, state, and local agencies and the GL academic research community.

J. Are their any issues in interacting with the University that require attention?

From the perspective of the University, the recent development of a NOAA policy that all institutes will be awarded competitively injects a level of uncertainty for the UM to move forward aggressively in making changes. NOAA needs to help ensure that there are clear

benefits to UM to take the leadership role for a regional ecosystem-based approach to research in the Great Lakes basin. This effort will require fostering collaborations with the Great Lakes academic research community and NOAA, as well as state and other federal agencies.

Review Panel

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Carl Richards was Director of the Minnesota Sea Grant College Program at the University of Minnesota and Professor of Biology at the University of Minnesota Duluth. Very recently he became Division Director of the US E.P.A. Mid-Continent Ecology Research Laboratory in Duluth. Dr. Richards has a Ph.D. in Ecology from Idaho State University, a M.S. in Biology from California State University at Los Angeles, and a B.S. in Biology from the Univ. of Southern Mississippi. He has worked as an administrator and researcher in a variety of settings including, university, private, and governmental organizations. He has over 25 years of experience conducting research on the influence of land and water management activities on aquatic ecosystems. This work has included the restoration of streams and watersheds, the development of biotic indicators for aquatic ecosystems, and the identification of linkages in landscape patterns on stream, watershed, lake, and coastal processes. He is currently conducting research funded by the U.S. EPA and National Science Foundation examining the influence of various chemical and physical stressors on Great Lakes nearshore environments, the integration of spatial data for watershed assessment in the Upper Midwest, and the physical and biological factors regulating fish distributions in arctic Alaska. In addition, Dr. Richards is particularly interested in the application of web-based computer technologies in the dissemination and instruction of water science educational materials. He has numerous publications in the area of environmental assessment and is a frequent member of NSF, EPA, NOAA, and USDA review panels.

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Dr. Budd received a Bachelors degree in Natural Resources in 1985 and a Masters degree in Water Resources Science in 1998 from the University of Michigan and a Ph.D. in Biology in 1995 from Michigan Tech. She served as a Committee Staffer for the House Merchant Marine and Fisheries Committee in 1989-1991. Dr. Budd currently holds a research faculty position at Michigan Tech where she conducts research on limnological

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Dr. Gardner received a Bachelors degree (1963) in Chemistry from the University of Wisconsin, Stevens Point, and M.S. (1964) and Ph.D. (1971) degrees in Water Chemistry at the University of Wisconsin, Madison. He worked as a Research Associate (1971-1974) and Assistant Professor (1974-1977) at the Skidaway Institute of Oceanography. He was Lead Chemist for the Field Research Unit of the Columbia National Fisheries Research Laboratory (1977-1979). He served as Physical Scientist (1979-1981), Head, Ecosystem and Nutrient Dynamics Group (1981-1989), and Senior Physical Scientist (1989-1996) at the NOAA Great Lakes Environmental Research Laboratory. He moved to The University of Texas in 1996 where he serves as Professor. He was also Chair, Department of Marine Science, and Director, Marine Science Institute (1996-2004). Dr. Gardner research specialties include nitrogen dynamics as related to biogeochemistry and food webs in diverse aquatic ecosystems, including Texas estuaries, Florida Bay, the Great Lakes, and Lake Taihu (China). Dr. Gardner has published more than 100 refereed papers or book chapters on these subjects and served on state, national, and international scientific advisory committees.

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John E. Stein is currently the Acting Deputy Director for the National Marine Fisheries Service (NOAA Fisheries) Northwest Fisheries Science Center (NWFSC). In this position, he oversees the science of five research divisions that range in studies from environmental toxicology to salmon genetics to marine mammals. Since 1987, he has held several management positions at the Center, including serving as the Center's Salmon Science Coordinator, Director of the Environmental Conservation Division, Manager of the Physiological Toxicology program, and Project Manager of a marine mammal biomonitoring project that is part of what is now NOAA Fisheries' Marine Mammal Health and Stranding Response Program. Dr. Stein's scientific expertise includes the development and application of biological markers of genetic damage, reproductive processes, and immunocompetence in fishes, and the application of these techniques in delineating relationships between chemical contaminant exposure and effects in fishes and marine mammals. Dr. Stein is currently the Chair of the Marine Environmental Quality Committee of the North Pacific Marine Sciences Organization (PICES), and Vice-Chair of the PICES Science Board, and has been invited to present at several international conferences over the years. He also serves on numerous committees in the Pacific Northwest that address the recovery of listed Pacific Salmon. Dr. Stein is

the author or coauthor of over 120 research papers and received his Ph.D. in organic chemistry from the University of Washington.

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Mr. Peppler received Bachelors and Masters degrees in Atmospheric Science from Purdue University in 1980 and 1982, respectively. He also received a Masters Degree in Industrial Engineering from the University of Illinois at Urbana-Champaign in 1991. He worked at the Illinois State Water Survey from 1982-1995 on climate diagnostics research ranging from North American growing season rainfall to the North Atlantic Oscillation to tropical Atlantic sea surface temperatures. He also helped manage and maintain several meteorological observing networks in Illinois. From 1995 to present he has served as Associate Director of the Cooperative Institute for Mesoscale Meteorological Studies (CIMMS) at the University of Oklahoma. While at CIMMS he has been both a site scientist for the Southern Great Plains portion of the Atmospheric Radiation Measurement (ARM) Program and manager of ARM's Data Quality Office. Mr. Peppler is currently spending a year at the National Severe Storms Laboratory as Assistant Director for NOAA Relations.