Before the House Subcommittee on Environment, Technology, and Standards

Hearing on *Great Lakes Restoration: How? How Soon?*

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Mr. Chairman, Members of the Subcommittee, I thank you for this opportunity to testify before you today on this issue of critical national importance. My name is Don Scavia, and I come here in several capacities: I am Professor of Natural Resources and Environment and Associate Dean at the University of Michigan, and Director of Michigan Sea Grant.

I also represent the Healing Our Waters Great Lakes Coalition. The coalition is dedicated to the protection and restoration of the Great Lakes, and represents 85 national, regional, state, and local organizations, including Great Lakes conservation organizations such as the Alliance for the Great Lakes, Great Lakes United, and the Ohio Environmental Council; national conservation organizations like Ducks Unlimited, Trout Unlimited, the Sierra Club, and the Audubon Society; and educational institutions such as Shedd Aquarium and the Brookfield Zoo. I serve as science advisor to the Coalition's steering committee.

Before joining the faculty at UM, I served in NOAA as a research scientist and research manager for 29 years, providing me with a national perspective on the significance of the Great Lakes, the need for the restoration strategy, and the role science can play in that restoration.

My testimony today focuses on four areas: 1) the need to act now to protect these national treasures; 2) a set of priorities identified by scientific community in their white paper: "A Prescription for Great Lakes Ecosystem Protection and Restoration", 3) the need for a strong science base for restoration, and 4) the critical role for an independent voice that Great Lakes universities can provide.

It is critical to act now

The view from the majority of the science community is that we know enough now to take action. There are indeed important science needs, but they should not create a rationale for inaction. Making a substantial investment in the Great Lakes restoration and protection now will ensure that the economic and ecological health of the Great Lakes region is strong and healthy. This is not only of great importance to the region, but also to the nation. Delaying that investment will make future actions far more costly and could result in irreversible damage to this national and global treasure.

A significant portion of my testimony draws directly from the white paper: *Prescription for Great Lakes Ecosystem Protection and Restoration: Avoiding the Tipping Point of Irreversible Changes*[1], which I include as part of my testimony. The paper was written by 8 scientists and endorsed by over 60 other leading scientists from every state in the Great Lakes basin.

The authors and endorsers of the white paper point out that Great Lakes ecosystems may be nearing a tipping point – beyond which the lake ecosystems would move to a new state, one that is less desirable from a recreational, commercial, and aesthetic perspective and, more importantly, one from which it will be very difficult, if not impossible, to recover. The problem with ecological tipping points, though, is that you cannot be sure you have reached it until it is too late. Thus, we urge a precautionary approach to avoid passing that critical point.

In another consensus report (*Scientific Consensus on Marine Ecosystem-Based Management*)[2] over 200 scientists cautioned against reaching thresholds beyond which altered marine ecosystems may not return to their previous states. In that report, they also state that because the tipping point for these irreversible changes may be impossible to predict, increased levels of precaution are prudent. While the same ecological principles cited for the world's oceans apply to the Great Lakes, the lakes may be even less able to cope with stress than typical coastal marine environments because the Lakes are relatively closed and evolutionarily younger systems ill-adapted to large fluctuations.

Symptoms of stress

There is widespread agreement among scientists that the Great Lakes are exhibiting symptoms of stress from toxic chemicals, invasive species, excess nutrients, shoreline modifications, change in land use, hydrologic alterations, and climate change. While most of these stresses are not new, more than ever we are seeing symptoms of ecosystem breakdown -- in other words an ecosystem nearing its "tipping point" - caused by the combinations of these stresses that overwhelm natural buffering capacities that enable ecosystems to be resilient. Large areas in the lakes are undergoing rapid changes where these combinations of persistent and new stresses are interacting to trigger synergistic ecosystem degradation. Rapid ecological responses to new stresses that may interact with each other and with remnant features of past responses to older stresses, have exhibited sudden and unpredicted changes in the past 5 to 10 years, to an extent that is unique in Great Lakes' recorded history. The new stresses have complicated past and current efforts to remediate earlier harmful phenomena, such as:

- Extirpation or major declines in important native species (such as lake trout and deepwater ciscoes) due to over fishing and invasive species (such as sea lamprey predation on lake trout, and competition with deepwater ciscoes by invasive alewives and rainbow smelt);
- Declines in other valued and important native aquatic species (including certain plankton, unionid clams, and certain native fish species) caused by altered food webs and introductions of aquatic invasive species (e.g., zebra and quagga mussels, round gobies

[1] http://www.restorethelakes.org/PrescriptionforGreatLakes.pdf
[2] http://compassonline.org/files/inline/EBM%20Consensus%20Statement_FINAL_July%2012_v12.pdf

and predatory zooplankton such as *Bythotrephes cederstroemi* and *Cercopagis pengoi* (two species of water fleas);

- Widespread reproductive failures of keystone, heritage, and other (both native and introduced) fish species, including lake trout, sturgeon, lake herring, coaster brook trout, and Atlantic and Pacific salmon caused by toxic contamination and loss of habitat, including loss of over 90% of wetlands along the Huron/Erie corridor;
- Approximately 50% of the threatened and endangered birds are wetland dependent species, and no wonder given the estimated 60% loss of wetlands in the Great Lakes watershed.
- Toxic contamination of fish threatens not only the species themselves, but also other wildlife and people, resulting in fish consumption advisories throughout the Great Lakes and inland lakes and rivers;
- General reduction in water quality, increased toxic algal blooms, Type E botulism in fish and waterfowl, and contamination of drinking water.
- Fouling of coastlines and near-shore areas from sewage overflows and contaminated runoff, resulting in beach closings, and loss of habitat for fish and waterfowl;
- Elimination of the rooted plant community and disruption of food webs in Sandusky Bay and Cootes Paradise in Hamilton Harbour, due to sediment and other pollutant loads.

Critical food-web disruptions are a particular case in point with regard to the tipping point. These disruptions date back to at least the invasion of the sea lamprey and the cascade of loss of native fishes and invasions of alewife, rainbow smelt, and a host of others.

However, more recent dramatic disruptions include the now well-documented rapid disappearance of the once abundant benthic invertebrate, *Diporeia,* from large areas of all the lakes except Superior. These dramatic declines are likely linked quite closely with the zebra and quagga mussel invasion, and may be one of the clearest warning signs of a tipping point where the Lakes may be moving into a new regime where these mussels maintain high populations, and prevent any substantial recovery of *Diporeia*, the once primary diet of important fish. In fact, Dave Jude - my colleague at the University of Michigan told me just this week that for the first time he has found enormous numbers of quagga mussels in Lake Michigan at depths where only few or none were found before. At a 100-meter depth, he pulled up between 600 and 700 pounds of quagga mussels in just a 10 minute bottom trawl tow. So many members of the fish community have historically depended on *Diporeia* that lacking this critical food source is another clear indicator of the ecosystem reaching a tipping point.

Restoration Priorities

The Great Lakes Regional Collaboration ("GLRC") has done an outstanding job of identifying the major stresses, and their recommendations for addressing them come just in time. The Collaboration is truly an historic event in two important respects. First, it is the first time that all levels of government and virtually all private stakeholders have come together to draft and support a single Great Lakes restoration plan, the "Great Lakes Regional Collaboration

Strategy." Over 1,500 people participated in the drafting of the final plan, including representatives from cities, counties, state agencies, tribal representatives, federal agencies, Congressional staff, businesses, conservation organizations, university scientists, and concerned citizens. Many of the scientists who drafted the "Prescription paper" as well as members of the Great Lakes Healing Our Waters Coalition actively participated in the Collaboration.

The GLRC Strategy sets a second precedent: it is the most comprehensive Great Lakes restoration and protection plan in history. It documents virtually all of the problems besetting the Great Lakes; it recommends concrete solutions; it identifies programs to implement those solutions; and it recommends the funding needed for those programs to succeed. This level of consensus is unprecedented. And unlike so many other plans that have come before it, this isn't just the plan for any one stakeholder or any one lake. It has received input and endorsement from the scientific community, agencies, public interest organizations, businesses, and recreationists. And, it comes as a result of the president's May 2004 Executive Order. Importantly, many of the GLRC recommendations build upon and strengthen successful existing efforts.

The GLRC is a critical first step in forming a permanent institutional mechanism to guide restoration efforts and to facilitate coordination among public agencies, research institutions, and stakeholder organizations to reach consensus on specific priority actions and integrated measures of progress. It is important to also recognize, however, that these international waters require strong coordination and cooperation with Canada. So, the next step in planning should integrate GLRC efforts with those of the Great Lakes Fishery Commission, International Joint Commission, and environmental and resource programs of Great Lakes states and provinces.

The GLRC recommendations are important because the aim to reduce ecosystem stresses. However, it will never be possible to eliminate them completely, and even then it will likely take decades to achieve. So we must, at the same time, and perhaps with more urgency work to restore the Lakes' natural buffering capacity by increasing its resiliency – or ability to cope with stress. ***The consensus of the authors and endorsers of the "Prescription paper" is that the most important way to increase that resiliency is to restore the terrestrial and aquatic environments of the nearshore regions and connecting rivers and straights.***

One key priority, however, that cannot be addressed through a primary focus on restoring this near shore resiliency is the effort to stop invasive species from entering the Lakes. This can only be done through comprehensive, basin scale efforts. In this case, prevention is far more effective than restoration because removal of established invasive species, or restoration from their impacts are almost impossible.

A focus on the nearshore region -- Over time, the combined effects of the suite of stresses have overwhelmed the ecosystem's self-regulating mechanisms. In the past, healthy nearshore communities and tributaries helped reduce the impact of many stresses on or entering the lakes. We now recognize that these nearshore and tributary areas constitute a buffer zone and add to the lakes' ability to rebound from stress, and without healthy buffers, the lakes' health is much more vulnerable. For this reason, it is of critical importance to ensure that the nearshore and tributary areas receive the most significant and urgent restoration attention.

Specific geographic areas where stresses have contributed or are likely to contribute to the degradation of the nearshore/tributary areas should be targeted first. These areas may well include those locations already identified as Areas of Concern by the International Joint Commission (expanded geographically to ensure they include all the major sources of stress) as well as nearshore/tributary areas that are now showing symptoms or vulnerability to multiple sources of stress. And this may require increased institutional focus (including increased emphasis within LaMP efforts) on these nearshore areas. This also has the added advantage of restoring urban coastlines, which in many instances have the most potential for restoration and is consistent with the Great Lakes Cities-St. Lawrence Cities Initiative "urban revitalization" agenda. The goal should be to reestablish the natural states critical to nearshore and tributary communities so they can once again perform their stabilizing function, or, if that is not feasible, enhance critical elements that play a role in stabilizing the communities. Many of the GLRC recommendations, if implemented properly, will provide this needed emphasis on near-shore (e.g., recommendations related to the AOCs, wetlands, coastal health, nonpoint source pollution).

With this focus on the nearshore and connecting rivers and straights, the Prescription paper proposes the following four major components that must be combined to develop a successful ecosystem restoration effort:

- *Restore* - Restore critical elements of the *ecosystem's self-regulating mechanisms*. To the extent possible, reestablish natural attributes of critical nearshore and tributary communities so they can once again perform their stabilizing function. Where full restoration of natural attributes is not possible, improve desirable aspects through *enhancement* of important functions.

- *Remediate* – As outlined in the GLRC report, remediate abusive practices that create *sources of stress.* Reduce or eliminate physical habitat alterations, pollution loadings, pathways for invasive species, and other stressors or their vectors into the lakes.

- *Protect* - Protect the functioning portions of the ecosystem from *impairment*. Preserve those portions of the ecosystems that now are healthy, and those that can be restored or enhanced, through sustainable development practices within the Great Lakes basin.

- *Measure* - Building on existing efforts, measure ecosystem health through a set of agreed-upon integrative indicators that can serve to assess current conditions and monitor the progress of restoring the lakes. This final component is also key element of the three-pronged approach to the recommended plan for science in support of restoration outlined below.

Science Priorities

While investments in long-range, basic research is important, and such investments in the Great Lakes lag significantly behind those of coastal and marine environments, these investments in the future need to be complemented with science that directly supports the urgent needs for restoration. I should note, however, that thoughtful research can be both basic and useful as

Donald Stokes outlined clearly in his book, *Pasteur's Quadrant*[3]. I recommend a science plan with three broad components: Integrated Assessment, Monitoring, and Restoration Innovation.

Integrated Assessment – Decades of research and monitoring have produced vast quantities of data and information on Great Lakes conditions, processes, and functioning. However, much of this information is inaccessible or not organized and synthesized in ways most useful to local, state, and Federal decision makers. Providing this information, along with its level of certainty, in credible and timely ways on issues identified by decision makers is an essential element of science support for restoration and protection.

Integrated Assessment (IA) is a formal approach to synthesizing and delivering relevant, independent scientific input to decision making through a comprehensive analysis of *existing* natural and social scientific information in the context of a policy or management questions. These assessments not only draw on the talents of subject matter experts, but also engage the broader stakeholder community in defining boundaries, integrating traditional knowledge, and identifying socially-acceptable solution options. The IA results are peer reviewed and subject to public comment, and the process should be supported by funds independent of those with vested interests in any particular solution option. IA takes the following structured approach:

1. Define the policy relevant question around which the assessment is to be performed. This is done in conjunction with managers and policy makers such that the analysis is directed toward solving specific policy or management needs.

2. Document the status and trends of appropriate environmental, social, and economic conditions related to the issue. This is a value-independent description of current conditions and, to the extent possible, the historical trends in those properties.

3. Describe the environmental, social, and economic causes and consequences of those trends. This often includes simulation, statistical, and other explanatory models and analyses. Again, these descriptions are fact-based although subject to analysis and interpretation.

4. Provide forecasts of likely future conditions under a range of policy and/or management actions. This can be quantitative forecasts from models or other trend analysis tools. These are subject to considerable scientific evaluation and interpretation.

5. Provide technical guidance for the most cost effective means of implementing each of those management options. These efforts are designed to provide those who are responsible for implementation the menu of approaches available to them, along with some evaluation of their potential for success and cost-effectiveness

6. Provide an assessment of the uncertainties associated with the information generated for the above steps and outline key monitoring, research, and modeling needs to improve

[3] Stokes, D.E. 1997. Pasteur's Quadrant. Basic Science and Technological Innovation. Brookings. Washington, DC. 180 Pg.

future assessments in this area. This assessment of uncertainties is often a guide to future research needs.

Such approaches have been very useful, for example, in assessments of the impacts of climate variability[4] and the causes and consequences of hypoxia in the Gulf of Mexico[5] (called for in the Harmful Algal Bloom and Hypoxia Research and Control Act), as well as a key element of the new science program for Michigan Sea Grant[6]. The Gulf of Mexico Hypoxia IA, for example, led to a Federal-state-tribal Action Plan for reducing nutrient loads to the Gulf, the primary anthropogenic driver of hypoxia.

Monitoring **-** Monitoring of agreed-upon integrative indicators is extremely important. This effort should build on ongoing efforts such as the development and application of State of the Lakes Ecosystem Conference (SOLEC) indicators. However, major negative changes in the ecosystem are occurring while many of the indicators that governments have traditionally used to measure Great Lakes health (water clarity, ambient water pollution levels, and certain contaminant levels in wildlife) actually show improvement. Because nonlinear changes may confound expected relationships between sources of stress and the lakes' response, traditional indicators alone may not be adequate descriptors of ecosystem health and may not be useful in predicting future conditions. While some type of consensus on indicators is desirable, given the dynamic nature of the system and our understanding of it, flexibility must also be included in their development and use.

Monitoring is essential to not only identify emerging issues, but importantly in the context of restoration, to track progress. Most managers and scientists now embrace the notion of adaptive management where adjustments in strategies are made as restoration proceeds. But, without effective monitoring systems, geared toward tracking progress at the right scales, adaptive management is not possible. A key issue for an effective monitoring network in this context is the ability for rapid detection of change on scales relevant to local and state decision makers, as well as Federal policy makers. Therefore, a priority should be placed on the nearshore terrestrial and aquatic ecosystem in concert with the geographic focuses of restoration. This requires close coordination of state and tribal agencies and the academic community to add higher spatial resolution to the Lake- and region-scale efforts of the Federal agencies.

Restoration Innovation – While we have enough information to proceed now with restoration, the task is long term and we need investments in new ways to deal with existing and emerging threats, as well as to find the most cost-effective technologies for identifying threats and restoration approaches. Such innovations could include: new ways to detect and monitor threats to ecosystem structure and functioning; improved methods for synthesizing and integrating information to provide useful forecasts of the impacts of management action or inaction; technologies for restoring wetlands, coastal habitats, and contaminated sites; methods to value ecosystem goods and services; assessments of the social causes and impacts of ecosystem change; and means to reduce uncertainties in Integrated Assessments.

[4] http://www.usgcrp.gov/usgcrp/nacc/default.htm
[5] http://www.nos.noaa.gov/Products/pubs_hypox.html
[6] http://www.miseagrant.umich.edu/ia/index.html

While the needs for such innovations can be identified, their solutions are hard to predict, and are best sought through investing in, and nurturing, the skills and talents of Great Lakes scientists, including through academic programs.

The Role of Universities

A strong and effective science program supporting restoration and protection of the Great Lakes needs the innovation, expertise, and independent voice of the academic community. During the 1960s, 70s, and 80s, the Great Lakes academic community was well-supported and provided an important complement to the science conducted in the Federal and state labs. I know this first hand because I worked in a Great Lakes Federal lab from 1975-1990. Working together, and with state agencies and environmental NGOs, these communities identified and analyzed the most important issues of the time – fisheries decline, eutrophication, and chemical contamination. Academic institutions contributed expertise in fisheries biology, food-web structure, ecosystem dynamics, biogeochemistry, ecosystem modeling, and engineering to these successes through cooperation and participation in activities and programs under the auspices of the bi-national Great Lakes Water Quality Agreement and Great Lakes Fisheries Convention, for example.

Through both applied research and research that improved our fundamental understanding of the Lakes' physical and ecological dynamics, academic research and modeling played historically important roles in critical resource management and policy decisions:

- Reducing phosphorus inputs to reduce algal growth and improve water clarity;
- Sea lamprey control;
- Reductions in industrial pollution;
- Reduction in contaminants such as DDT and PCBs;
- Reduced occurrences and magnitude of chemical spills and discharge of objectionable and nuisance materials that form scums, sludge, and odors;
- Confinement and removal of contaminated sediment;
- Growing recoveries of some native species, such as the lake trout in Lake Superior and the bald eagle throughout the Great Lakes

And these efforts have had significant impacts. In many places, nutrient control reduced algal overgrowth and increased water clarity, sea lamprey control allowed a rebound in fish populations, reduced industrial pollution resulted in declines of DDT and PCBs in fish and wildlife by as much as 90%, confinement and removal of contaminated sediment are progressing, and populations of native species, such as the lake trout in Lake Superior and the bald eagle throughout the Great Lakes are making substantial recoveries.

In spite of this progress, and as outlined above and in the GLRC report and the "Prescription paper", the Great Lakes are exhibiting a multiplicity of nagging and emerging issues that are impeding further ecological and economic recovery. Just when we need more research and monitoring to assist sound, science-based management and policy decisions, the Great Lakes research community is in decline. An aging work force will soon retire taking with it historical knowledge and perspective because of limited ability to hire young scientific replacements. Old and outdated scientific tools, facilities, and vessels are not being upgraded to address the

complex problems of today. Funding for both Federal and state science agencies are not keeping up with inflation and funding to the Great Lakes academic community is scarce, resulting in a significant loss of Great Lakes researchers from Great Lakes academic institutions.

Academics can and should play strong, even dominant, roles in Integrated Assessment, in assisting in and interpreting results from monitoring programs, in identifying and clarifying emerging issues, and in providing innovative solutions to both long-standing and new issues. Academics can be viewed as knowledgeable and interested parties in this management, but not constrained by the mission and viewpoints of their home organization. To be most effective, their work needs to be independent, based on competition and peer review, and well-funded. There are existing models for Federal programs that can provide that support in ways that are connected to and integrated with Federal and state science, but not handmaiden to it. These include EPA's Science to Achieve Results (STAR) program, NOAA's Center for Sponsored Coastal Ocean Research (CSCOR), and the Great Lakes Sea Grant programs. Each of these programs has a distinct mission that complements the others, as well as those of the Federal labs. They have established processes for interacting with the academic community and administering effective extramural grant programs. They require increased funding and encouragement to continue to expand their programs in the Great Lakes, focused on supporting restoration and protection needs.

It is important to build upon proven models of academic-governmental partnerships like Sea Grant and NOAA's CSCOR with well-funded, objective, and independent academic research that has strong linkages to resource management and policy needs. These programs can supply the people and new technologies for problem-solving, technology transfer, and the communication of science to policymakers and the public.

Summary and Conclusion

I would like to recap some of the key concepts from the above as responses to specific questions provided for this Hearing:

1. *What are the top three recommendations in the GLRC Strategy that you believe could be implemented with existing funding? What scientific research, scientific information, or science-based products are required to support the implementation of these three recommendations? Would your answers be different if funding could be increased?*

The top three recommendations, as outlined above, are 1) focus on restoring the near shore ecosystems -- including watersheds and tributaries and the connecting rivers and straights -- to increase the ability of the Great Lakes ecosystems to mitigate stress, 2) stop introductions of new invasive species, and 3) reduce the loads of non-point source pollution. These are priorities for both existing and increased funding; however, little more can be done at existing funding levels.

The key science priorities are 1) support for Integrated Assessments that harvest the decades of monitoring data and research output, integrate that information with stakeholder perspectives and considerations, and synthesize and deliver the results in ways that are accessible to decisions makers as they consider the key management and policy actions underpinning restoration; 2) support for increased monitoring near shore regions by states and Universities at the higher

spatial and temporal resolution needed to track progress and support adaptive management at relevant restoration scales; and 3) support for "restoration innovation" – creation of new technologies, methodologies, and processes for cost-effective restoration over the next decade.

2. *Has the GLRC led to more informed resource management planning decisions? What kinds of scientific information are now being taken into account in those decisions because of the GLRC? To what extent has the GLRC helped foster new or stronger collaboration between scientists and policy makers? What is your role in strengthening the relationship between scientists and policy makers?*

The simple answer to the first part of this question is "no". The GLRC focused on developing a Strategy for the future, and not on informing today's specific resource management planning decisions. While the GLRC has fostered new and stronger collaborations among decision makers and opinion leaders from a wide array of sectors, including some from the science community, it is too soon to know if these new collaborations will make a difference. The stage has been set by the Collaboration, though, and I am hopeful.

My role in strengthening the relationships between scientists and policy makers, as Michigan Sea Grant Director, has been to work with decision makers in Michigan's Departments of Natural Resources and Environmental Quality to identify key Great Lakes restoration issues that need science support, and solicit proposals from the academic community to conduct Integrated Assessments for them. Sea Grant and key partners will fund several IA projects this next funding cycle, both to address those needs and to serve as a model for other funding programs interested in strengthening the relationship between scientists and policy makers. We would like to see Federal grant programs focused in the same way.

3. *Are there additional actions EPA and other Federal agencies should be taking to help implement the GLRC?*

As mentioned above, the GLRC was an important first step in forming permanent institutional mechanisms to guide restoration and to facilitate coordination among public agencies, research institutions, and stakeholder organizations. It is important for EPA and the other U.S. Federal agencies to also recognize that Great Lakes protection and restoration require strong coordination and cooperation with Canada. I am sure the U.S. agencies recognize this. So, the next step in planning and implementation would be to integrate GLRC efforts with those of the Great Lakes Fishery Commission, International Joint Commission, and environmental and resource programs of Great Lakes states and provinces.

4. *What are the biggest challenges you see in implementing the Strategy, particularly in terms of meeting science and information needs?*

The biggest challenges for implementation are 1) ensuring adequate funding for implementing the GLRC Strategy recommendations, and 2) identifying appropriate leadership and coordination among Federal agencies, and allowing for honest engagement of the full stakeholder community.

I understand the overall estimates for funding are quite significant, but it is time for Great Lakes restoration to receive support commensurate with its national importance and at least comparable

to other large-scale regional restoration efforts. This is particularly true when one compares, not only the range of stresses that impact the Great Lakes, but their enormous size compared to other regional restoration initiatives. It is also important to ensure appropriate funding for the science priorities outlined above for supporting the restoration effort. A rule of thumb that can make sense is to provide 10% of restoration costs for science support.

The overall restoration task is daunting and requires effective leadership from the Federal government (preferably one agency); however, top-down approaches (whether for implementing restoration or for conducting supporting science) will not work. Setting specific goals, priorities, and responding to science needs requires full participation of Federal, state, and local governments; NGOs; Universities; and the private sector. It is not yet clear, that the GLRC has mechanisms in place to do that.

5. *What outcomes do you expect to see one year from now as a result of implementing the GLRC Strategy?*

Frankly, I do not expect too much in one year. It is very early in the process and developing the Strategy was a major undertaking that engaged the broadest spectrum of US participants. However, I fear that the lack of any significant new funding in the President's budget may set the stage that prevents holding the Collaboration together. Everyone participated in good faith, and many compromises were made to form solidarity behind the Strategy. Without significant movement and funding toward implementation, I am not sure much will be accomplished.

Closing

In closing, Mr. Chairman, I would like to thank you and the Subcommittee for your leadership in scheduling this hearing and maintain the momentum for Great Lakes restoration. I particularly would like to thank you for keeping science on the table. Without a strong science base, restoration will be less effective and more costly to the taxpayers.

I would also like to thank you for inviting me to participate in this hearing. The Great Lakes science academic community looks forward to working with you and all of our Collaboration partners to continue this important work, because it is only through concerted, coordinated action that we will realize our mutually-held goal of a cleaner, healthier Great Lakes.

I would be happy to answer any questions that you may have.

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As the Chief Scientist of NOAA's National Ocean Service between 2002 and 2005, Dr. Scavia was responsible for the quality, integrity, and responsiveness of NOS's science programs, and for ensuring that NOS's operations and resource management are based on solid science and technology. Before becoming the NOS Chief Scientist, Dr. Scavia was Director of the National Centers for Coastal Ocean Science and Director of NOAA's Coastal Ocean Program, where he managed coastal and Great Lakes research programs in NOS laboratories, monitoring and assessment offices, and extramural research.

Between 1975 and 1990, Dr. Scavia was a research scientist with NOAA's Great Lakes Environmental Research Laboratory in Ann Arbor, Michigan, focusing on modeling and empirical studies on nutrient cycling, bacteria and phytoplankton production, food-web dynamics, and biological-physical coupling at all scales.

Dr. Scavia holds Bachelors, Masters, and Doctorate degrees in Environmental Engineering from Rensselaer Polytechnic Institute and the University of Michigan. He has published over 60 articles in the primary literature and led development of dozens of interagency scientific assessments and program development plans.