COASTAL HEALTH APPENDICES

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APPENDIX A
SOURCES OF COASTAL HEALTH THREATS

1. Direct Pollution Sources

- Wet weather overflows (e.g., due to aging or overburdened infrastructure) that result in the release of raw sewage to source waters in urban areas through:
  - Sanitary sewer overflows (SSOs)
  - Combined sewage overflows (CSOs) in municipalities where storm and sanitary systems remain co-mingled
- Bacterial and chemical pollution from illegal and malfunctioning private sewage treatment systems:
  - Septic systems
  - Aerobic systems
  - Diffuse inputs such as run-off from animal feed lots and agrarian sources
- Storm water discharge, which can contribute to the fecal burden on bathing waters via storm drains because it may contain fecal contamination from humans (from illegal connections/leaks) or animals.
- Direct sewage inputs due to improper disposal of untreated fecal material originating from boats; coastal communities containing large marinas or harbors, and lacking sufficient pumping facilities, are particularly at risk.
- Aging and overloaded wastewater treatment and collection infrastructure.

2. Indirect Pollution Sources

- Storm water runoff, carrying bacterial and chemical pollution as a result of traveling over agricultural, industrial, and/or urban areas[a]
- Avian/animal deposition
- Shedding from bathers
- Discharge of untreated onboard boater waste
- Industrial discharge/legacy[b]
- Contaminated sediments (foreshore beach sand and submerged sediments) that release of bacterial (e.g., fecal indicator organisms) and chemical pollutants; especially prevalent in Areas of Concern[c]
- Groundwater discharge
- Algal blooms (can appear during dry weather, but are caused by nutrient loading during wet weather and aquatic invasive species)
- Ecosystem/food web changes caused by aquatic invasive species' impact on water quality[d]
- Air deposition[e]

3. Beach and Coastal Assessment Methods

- Microbial assessment
- Physical assessment

4. Threats to Drinking Water Quality

- Lack of source water protection criteria for pathogens and disinfectant by-products
- Outdated drinking water distribution systems
- Inconsistent compliance with sewage treatment and control
- Weak storm and wastewater enforcement

[a] The Nonpoint Source Strategy Team will address rural storm water.
[b] Elevated pH levels from industrial legacies are closing beaches.
[c] The Areas Of Concern (AOC) Team will address contaminated sediments in greater detail.
[d] The Aquatic Invasive Species Team will addresses AIS issues. With particular regard to their impact on near shore water quality, zebra and quagga mussels reduce a lake's ability to assimilate phosphorus and increase the likelihood that harmful algal blooms will occur. Furthermore, because zebra mussels select against Microcystis, they remove its competitors and allow it to bloom.
[e] The Persistent Bio-accumulative Toxics (PBT) Team will address air deposition of pollutants in greater detail.

- Sprawling land use with inadequate storm water runoff controls
- Incomplete filtration/removal of contaminants during the drinking water treatment process

APPENDIX B
CONDITIONS GOVERNING RECOMMENDED ACTION 1

- **U.S. EPA and the States should fully implement, enforce, and report on their wet weather control programs to identify and correct deficiencies, including adequate staffing and funding, to ensure the requirements of the CWA are achieved in a timely manner.**
- **Congress should support state and local resources by appropriating $7.535 billion in federal grants over five years as part of a 55/45 percent federal/local cost share to raise $13.70 billion to fund wastewater treatment improvements.** Rules governing the disbursement of funds will include but not be limited to the following:
  - Grants will only be awarded to communities with approved programs addressing wet weather controls of CSOs, SSOs, storm water runoff, and wastewater treatment plant bypasses.
  - Priority funding will go to communities who can demonstrate that non-structural controls, such as local land use regulations and best management practices that reduce or eliminate storm water flows into the system, are employed to the greatest extent possible.[f]
  - Plans must include provisions for review and updating industrial pretreatment programs to reduce the discharge of toxics to sewage treatment systems. (See PBT section for further detail.)
  - A discretionary provision for reimbursing communities that implement overflow controls as part of comprehensive programs, consistent with grant criteria, before October 1, 2008.
  - A discretionary provision for rewarding those communities that fully implement and achieve their comprehensive wet weather control plan before 2012.
- **Congress should appropriate $10 million over five years to the three U.S. EPA regions to review and upgrade their Great Lakes wet weather programs – including the CSO Control Policy, NPDES permit issuance and enforcement, storm water management – to insure that issues are addressed comprehensively.**
  - The 1994 national CSO Control Policy, for example, established no deadline for final compliance with overflow reduction targets by all municipalities.
  - The "anti-degradation" mandate of the CWA needs federal guidance to allow States to implement rules prohibiting new hook-ups to wastewater systems that do not control wet weather overflows.
- **Congress should appropriate $40 million over five years to the Great Lakes States to administer a new grants program, review and upgrade all of their wet weather programs (including NPDES permits and enforcement), and implement anti-degradation rules in relation to sewage system expansions.**
  - The focus of this approach is on comprehensive solutions involving construction items, storm water controls, policy revision, strict monitoring and enforceable schedules.
  - Funding and permits for future sewer district expansions will be tied to having a comprehensive plan and ongoing compliance with timelines set out in NPDES permits or other enforceable documents.
  - Educate owners about regular maintenance of on-site sewage disposal systems (OSDS)[g] to prevent health and environmental hazards associated with failures. Local[h] regulations should require regular maintenance and inspection, by private evaluators, at the time of residential property sale.

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[f] See, for example, Center for Watershed Protection, "Model Land Development Principles," www.cwp.org, also quoted in full in the International Joint Commission's *2001-2003 Priorities Report.*

[g] On-site sewage disposal systems (OSDS), commonly known as septic systems, are wastewater treatment systems that use septic tanks and drainfields to dispose of sewage below the ground surface. Time and neglect will result in a failure of an OSDS that can cause serious public health and water quality problems in waterways.

[h] Whether to conduct feasibility evaluations of central sewers in areas with high concentrations of OSDSs should be a local decision based upon health and related considerations by the local community. The decision should be left to locals to adopt regulations that address the problem.

APPENDIX C
DETAILED DESCRIPTION AND EVALUATION OF ALTERNATIVE APPROACHES TO ACHIEVING GOALS

1. Alternative Approaches to Controlling Direct Pollution Sources (Wet Weather Events)

Federal and state statutory or regulatory requirements currently exist to address and control the adverse impacts of wet weather overflows including CSOs, SSOs, storm water, beach closings, etc. For several reasons, administration of these programs at the federal and state levels has not resulted in the full achievement of the goals and requirements of the Clean Water Act. For example, as of February 2005, of the 147 CSO communities in the Great Lakes basin only 77 have completed or are in the process of implementing Long Term Control Plans (LTCPs)[i] to achieve the requirements of controlling CSOs. SSOs are prohibited under the Clean Water Act, yet many communities still have chronic SSOs. Excessive storm water is entering the sewerage systems using needed capacity to convey sewage; sewerage systems are overloaded such that communities need to bypass part of their flows around portions of their wastewater treatment plants.[j] A major impediment to progress on reducing inputs of untreated waste to Great Lakes waters has been lack of funding for the high infrastructure costs typically involved. For example, U.S. EPA and States estimate costs for addressing the remaining CSOs in the Great Lakes basin at $8.6 billion, and total costs for minimizing discharges of untreated human waste from CSOs, SSOs[k] and treatment plants at $13.75 billion.[l]

The Coastal Health Strategy Team evaluated three alternatives for abating wet weather overflows.

Alternative 1 is to continue the present approach for eliminating CSOs through community-developed long-term control plans (LTCPs) in compliance with the national CSO Policy and Clean Water Act. Apart from municipal bonds and user fees, the State Revolving Fund (SRF) is the primary source of funding.

Cost/Feasibility Considerations:

- The SRF is significantly under-funded. For example, for the eight Great Lakes States, total SRF funding in 2005 was $393 million, with $260 million budgeted for 2006. Less than half of these amounts will be directed to communities within the basin without funding assistance, even municipalities that have LTCPs may not be able to implement them, and state and federal regulatory agencies cannot hire the personnel to monitor and enforce NPDES permits.

Advantages/Disadvantages:

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[i] According to the Water Divisions in EPA Regions V and II, there are 129 Great Lakes CSO communities in Region V, 1 in Region III, and 27 in Region II. Sixty of these in Region V, 1 in Region III, and 16 in Region II have completed or are implementing LTCPs.

[j] Not all wet weather overflows are from CSOs and SSOs. Numerous wastewater treatment plants experience excessive wastewater flows that result in the bypassing of untreated or partially treated wastewater. Such problems contribute excessive pollutants to the Great Lakes Basin and should be controlled by improvements in the sewerage collection system or treatment plant expansion.

[k] Many Great Lakes communities also have SSOs. Properly designed, operated, and maintained sanitary sewer systems are meant to collect and transport all of the sewage that flows into them to a publicly owned treatment works for proper treatment. SSOs mainly occur because of unwanted water infiltration into the system during wet weather, or inadequate system operation and maintenance. Untreated sewage from these overflows can cause serious water quality problems and also back-up into basements causing property damage and threatening public health. SSOs are prohibited under the CWA other than in unique circumstances that are approved by the regulatory agency.

[l] It should be noted that these costs are based upon the installation of "hard" controls, i.e. construction projects, and do not reflect cost savings that could be realized through the use of "soft" controls, i.e. use of best management practices, etc, to reduce the amount of storm water entering the sewerage system.

- Time schedules and funding sources to achieve full compliance are undefined. For almost half of the basin's CSO communities that have not yet developed LTCPs, control of CSOs is years away.
- Focus is on CSOs, not a system-wide or comprehensive approach to wet weather overflows. A piecemeal approach may lead to overflows elsewhere in the system (e.g., Milwaukee case).
- Focus is on percent reductions in discharge volumes, not on monitoring impacts on receiving waters. This may not accomplish the overarching goal or adequately protect sensitive or recreational areas.

Alternative 2 looks for major federal investment in construction projects such as additional treatment facilities, storm and sanitary sewer separation, deep tunnel construction, controls to eliminate infiltration and inflow of storm and ground water, and related physical facilities.

Cost/Feasibility Considerations:

- Costs will be excessive in large metropolitan areas as the focus is mainly "end of the pipe," i.e., not based on minimizing flows into the system, although new storm sewers would be subject to U.S. EPA storm water permit requirements.

Advantages/Disadvantages:

- In some cases, this approach may totally eliminate wet weather overflows.
- This approach does not address the underlying problem of increasing demand and increasing impermeable surface areas in sewersheds.
- Deep tunnel storage may negatively impact groundwater.
- Projects may involve extensive disruption to travel/access as roads are torn up for construction activities.
- Long time periods may be needed to complete the projects.

Alternative 3, as outlined in the main document, is the preferred alternative as it is the most cost-effective with the most advantages. Comprehensive solutions may include:

– Structural controls such as separating storm and sanitary sewers, constructing storage capacity, or controlling infiltration/inflow (I/I);
– Non-structural controls such as land use planning and aggressive use of best management practices to minimize impervious surfaces and prohibit increases in storm water run-off; and
– Regulatory controls such as updating and enforcing NPDES permits, and implementing more rigorous antidegradation guidance.

Cost/Feasibility Considerations:

- *Refer to the main document for a discussion of cost and feasibility considerations.*

Advantages/Disadvantages:

- *Refer to the main document for a discussion of advantages and disadvantages.*

2. Alternative Approaches to Controlling Indirect Pollution Sources (Dry Weather Impacts)

A holistic watershed approach to beach management will improve the identification of contamination sources at the local level, encourage remediation of those sources, ensure the protection of public health through a risk-based approach, decrease economic loss, and increase commercial benefits. To attract tourism and improve the economy of municipalities, investments in the development and maintenance of healthy and attractive beach recreational opportunities need to be a part of regional planning. The economic loss to a community from a swim closure day has been estimated to range from $1,274 to $37,030/day.[m] Commercial benefits for an individual Great Lake beach projected over the swimming

[m] Rabinovici S.J.M., R.L. Bernknopf, D.L, Coursey, A.M. Wein, and R. L. Whitman. *et al.* 2004. Economic and health risk trade-offs of swim closures at a Lake Michigan beach. Environ. Sci. Technol. 38 (10):2737-2745.

season would range from a low of $100,000 to over $3,000,000. For major municipalities, the economic value of beach recreational opportunities is estimated to exceed $100,000,000 per beach per season. With more than 800 beaches in the Great Lakes basin, healthy beaches can be a major driver of the economy of the Great Lakes.

The Coastal Health Strategy Team evaluated two alternatives for abating dry weather impacts.

Alternative 1 is to develop beach management practices designed to reduce bacterial or chemical contamination originating from beach sands. Beach sands have been proven to harbor bacterial indicators of bathing water quality (with the possibility of replication) and, potentially, human pathogens. When beach sands are located in the vicinity of storm drains or receive large amounts of water from other sources, such as run-off, there is also the potential for chemical contaminants to be deposited. Components of this approach include the following:

– Alter mechanical beach grooming practices to reduce bacterial concentration in beach sands.
– Change the grade/slope of the beach to promote adequate infiltration of surface runoff.
– Construct bio-retention basins or wetland areas to improve storm water management.
– Modify habitat to reduce the attraction of nuisance wildlife.
– Construct berms or grassy buffers to reduce the impacts of surface runoff.

Cost/Feasibility Considerations:

- Conducting feasibility studies on a large scale may be costly, however, representative beaches depicting a variety of conditions could be chosen as surrogates rather than conducting a study at each Great Lakes beach.
- Alternatively, prior studies could be validated at additional sites.
- Baseline levels would need to be determined in order to calculate reductions.

Advantages/Disadvantages:

- A comprehensive study of the behavior of bacterial indicators and pathogens in beach sands would allow for best management practices to be developed.
- Comprehensive studies regarding the relative contribution of chemical contaminants would aid in the fine-tuning of existing storm water management plans.
- Using bio-retention basins and wetlands to filter bacterial and chemical contaminants from storm water and surface run-off would have the added benefit of restoring habitat.
- Extrapolating the results of focused studies to non-participant beaches would not take into account local variability.
- The cost of reproducing sediment studies may be prohibitive for some municipalities without an external source of funding.

Alternative 2 is to develop and implement best management practices resulting in habitat modification. Specifically, this approach would implement management practices that reduce the burden of non-human fecal contamination through the modification of habitats that promote the development of sustainable populations of nuisance waterfowl.

Cost/Feasibility Considerations:

- With regard to resident or roosting waterfowl, rookeries may need to be identified and multiple deterrent techniques may need to be tested in order to assess their efficacy. This would require funding for controlled studies.
- Significant costs could be incurred to make some beach sites less attractive to wildlife.
- Pet owners may express significant concern; alternatives may need to be identified, i.e., dog parks.

Advantages/Disadvantages:

- Not all techniques may be feasible in all locations.

- Any management practices developed would need to conform to existing U.S. EPA, DNR, or other agency guidelines regarding the handling of domestic, resident or migratory wildfowl/animals.
- The relative contribution from wild vs. domestic inputs may need to be determined prior to implementing any management practices. This may prove difficult.

3. Alternative Approaches to Improving Beach and Coastal Assessment Methods

The Coastal Health Strategy Team evaluated five alternatives for reducing bathing water quality failures. Two are described below; the other three are included in the Coastal Health chapter recommendation.

Alternative 1 is to implement pilot projects to identify pollution sources at Great Lakes beaches which will allow managers to develop remedial action plans for the reduction or elimination of these sources of contamination. Components of this approach include the following:

– Develop pilot projects, based on microbial source tracking and/or spatial distribution studies, which will identify pollution sources at Great Lakes beaches.
– Based on the sources of contamination identified, develop remedial action plans which reduce the impacts from these sources.

Cost/Feasibility Considerations:

- Source identification pilot projects must be funded.
- Remediation projects must be funded.
- Costs are required to train staff to conduct source identification and remediation projects.

Advantages/Disadvantages:

- Projects will provide information on pollution sources that are contributing to water quality standards exceedances at beaches and steps needed to provide better protection of public health.
- Findings/solutions may be applicable at other Great Lakes beaches.
- Several source identification projects are going on along the Great Lakes; project managers can collaborate with other beach managers for ideas on what works.
- Workshops are available to train staff on identifying beach contamination sources.
- Resulting information can be used to develop a predictive model for high bacteria counts at beaches.
- Funding sources must be secured to implement source identification and remediation projects as well as to train staff.
- Contributing sources are difficult to pin-point.
- Pilot projects are resource-intensive.

Alternative 2 is to adopt the use of a beach classification scheme. In 1999, the U.S. EPA and WHO jointly hosted a meeting in Annapolis, Maryland to develop a health-risk-based approach to monitoring recreational waters. This approach includes employment of a beach classification scheme (based on the results of sanitary surveys), in addition to compliance monitoring based on bacterial indicators to assess health risk. The regulation of recreational waters in this manner would better reflect health risk and provide enhanced scope for effective management intervention. Enabling beach managers to respond to sporadic or limited areas of pollution, and to upgrade a beach's classification, provides a significant incentive to local management actions as well as to pollution abatement. A large number of factors can influence the condition of a given beach. A classification system reflects this, and allows regulators to invoke mitigating approaches for beach management. Specifically, this approach calls for the development of a health-risk based beach classification system for the Great Lakes based on bacterial indicator levels (microbial assessment) derived from routine monitoring and the results of standardized sanitary surveys.

Cost/Feasibility Considerations:

- Costs to study the relationships between factors that affect beach water quality and the ability of monitoring schemes to detect these changes.
- Funding pilot studies to evaluate the approach.

Advantages/Disadvantages:

- The approach requires substantial testing.
- Field testing would need to be amended to take into account local circumstances.
- Information concerning the existence of sources of contamination and their likely influence upon recreational water quality could provide a robust and rapid means to increase the reliability of the overall assessment.

4. Alternative Approaches to Protecting Drinking Water Quality

The Coastal Health Strategy Team evaluated two alternative approaches for maintaining safe drinking water.

Alternative 1 is a comprehensive approach to source water supply protection based on integrating the national policies contained in the Safe Drinking Water Act for source assessment and water quality standards with the Patriot Act for Homeland Security requirements of critical infrastructure plans for designated public drinking water supply systems. The Safe Drinking Water Act (SDWA) was originally passed by Congress in 1974 to protect public health by regulating the nation's public drinking water supply. The law was amended in 1986 and 1996 and requires many actions to protect drinking water and its sources: rivers, lakes, reservoirs, springs, and ground water wells. (SDWA does not regulate private wells which serve fewer than 25 individuals.) SDWA authorizes the U.S. EPA to set national health-based standards for drinking water to protect against both naturally-occurring and man-made contaminants that may be found in drinking water. U.S. EPA, States, and public water systems are currently working together to make sure that these standards are met through various levels of water treatment.

Originally, SDWA focused primarily on treatment as the means of providing safe drinking water at the tap. The 1996 amendments greatly enhanced the existing law by recognizing source water protection, operator training, funding for water system improvements, and public information as important components of safe drinking water. This approach ensures the quality of drinking water by protecting it from source to tap. The 1996 amendments also provided $120 million nationally for States to conduct source water assessments for every public water supply. The source water assessments found that many public water systems are moderately to highly susceptible to contamination, both nationally and within the Great Lakes basin, although intakes in the Great Lakes themselves tended to be less susceptible.

In response, the States have been given some flexibility to use their Drinking Water State Revolving Funds (SRF) for source water protection activities, but no program requirements, other than drinking water quality standards, nor dedicated and sustainable source of funding is available for source water protection implementation. The 1999 U.S. EPA Drinking Water Needs Survey found the need for $102 billion in immediate infrastructure improvements for the nation's drinking water treatment and distribution system and $150 billion over the next 20 years. In the Great Lakes basin, the eight States identified the need for over $44.5 billion. However, Congress has only authorized $9.6 billion in initial SRF funding and only $843 million was appropriated nationally in FFY 2005. Approximately $224 million of the FY 05 appropriation went to the Great Lakes States.

The U.S. Patriot Act of 2004 includes public drinking water intake, treatment, transmission and storage facilities as “critical infrastructure” because the incapacity or destruction of these systems and assets

would have a debilitating impact on the security, national economic security, national public health or safety, or any combination of these. With assistance of federal agencies, municipalities are required to have developed critical infrastructure protection plans and to implement protective measures accordingly.

This approach would go further than these existing authorities by authorizing the development and implementation of a source water protection program that includes a sustainable and fully-funded Safe Drinking Water Revolving Fund (SDWRF) and allows the States and local municipalities greater flexibility in how the funds may be used. This approach builds upon the existing national policies contained in the Safe Drinking Water Act and Patriot Act by developing and implementing a source water protection program that provides a sustainable funding mechanism for States and municipalities. It also includes integrating the Homeland Security requirements of critical infrastructure plans for public drinking water supply systems.

Cost/Feasibility Considerations:

- More funds should be made available to implement source water protection best management practices at the local level by increasing funds allocated to the SRF and increasing the States' flexibility to program those funds for source water protection.
- The financial benefit of preventative protection is the avoidance of costs incurred if protection is not achieved: treatment, remediation, finding and establishing new water supplies; providing bottled water, consulting services and staff time; legal costs of litigating against responsible parties; and conducting public information campaigns to satisfy public and media interest in incidents of source water contamination.
- Source water protection provides beneficial savings by reducing the cost of complying with regulations such as the Safe Drinking Water Act, reducing water treatment (i.e., filtration, disinfection, and removing disinfection byproducts), and earning monitoring requirement waivers thereby reducing monitoring costs.

Advantages/Disadvantages:

- No time is lost developing new public policies.
- Great Lakes basin policies are consistent with national priorities.
- The emphasis is on implementation actions at the state/local municipal level that integrate both capital improvement and best management practices.
- An existing Safe Drinking Water Revolving Fund exists to provide a sustainable funding mechanism.
- Estimated $44.5 billion needed by Great Lakes States for drinking water infrastructure improvements, including source water protection implementation.

Alternative 2 is a focused approach primarily addressing the immediate needs of aged and deteriorating public drinking water systems in major Great Lakes municipalities by establishing a new critical infrastructure construction grant program that complements the current SDWRF. The primary emphasis of this approach is on the immediate and significant investment needed to upgrade aged and deteriorating public drinking water systems through a critical infrastructure construction grant program. This approach integrates national authorities under the SDWA and Patriot Act, but requires a new funding mechanism in addition to the SDWRF.

Cost /Feasibility Considerations:

- Costs for implementing construction projects, especially in major Great Lakes cities, will be excessive but critical.
- States and local municipalities have limited capacity for matching funds.

Advantages/Disadvantages:

- Would require legislation to establish new construction grant program.
- By focusing on aged infrastructure alone, would not address source water protection.

APPENDIX D
ON-GOING EFFORTS IN GREAT LAKES RESEARCH

Human well-being and progress toward sustainable development are vitally dependent upon improving the management of Earth's ecosystems to ensure their conservation and sustainable use; without this, preservation services will be diminished, including those nonmaterial benefits, such as recreation and ecotourism, obtained from these ecosystems (Millennium Ecosystem Assessment – http://www.milleniumassessment.org/en/index.asp, last accessed 16th January 2005). The loss of recreational use can have an economic impact as well as create public dissatisfaction through loss of utility and, therefore, must be addressed through the formation of sound public policy. In his April 2000 Millennium Report to the United Nations (UN) General Assembly, UN Secretary-General Kofi Annan stated that it was "impossible to devise effective environmental policy unless it is based on sound scientific information." The studies presented below represent a sampling of the intensive scientific studies necessary to detect direct and indirect contamination sources, improve beach and coastal assessment methods, and ensure the quality of drinking water originating from the Great Lakes.

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Direct Pollution Sources (CSO, SSO, septic systems, storm water discharge, rivers and streams)

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http://oh.water.usgs.gov/beaches/

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State of Michigan

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http://www.epa.gov/OST/beaches/

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http://www.epa.gov/ost/beaches/

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U.S. EPA's "Beach Standards, Monitoring, & Notification" website (including links related to the Clean Beaches Plan and the Beaches Environmental Assessment and Coastal Health Act of 2000)
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http://www.great-lakes.net/glba/

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Center for Disease Control; Healthy Swimming
http://www.cdc.gov/healthyswimming/beaches_rivers.htm
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Great Lakes BeachCast---many links from this site
http://www.great-lakes.net/beachcast/nr_moreinfo.html

Great Lakes Research Consortium (Dr. Jack Manno)
http://www.esf.edu/glrc/

Great Lakes Research Consortium publications
http://www.esf.edu/glrc/pubs.htm

Great Lakes Fishery Commission
http://www.glfc.org/

Great Lakes Environmental Research Laboratory/NOAA
http://www.glerl.noaa.gov/

NOAA Great Lakes Environmental Research Laboratory (GLERL)
Center of Excellence for Great Lakes and Human Health
http://www.glerl.noaa.gov/res/Centers/HumanHealth/

USGS Great Lakes Science Center
http://www.glsc.usgs.gov/

Great Lakes Commission
http://www.glc.org/

International Joint Commission
http://www.ijc.org/

International Joint Commission Research Inventory (queriable)
http://ri.ijc.org

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University Centers

Great Lakes at Buffalo State College
Great Lakes Environmental Education at Buffalo State College
The Great Lakes Program at the University at Buffalo
Great Lakes Aquatic Ecosystem Research Consortium, Ohio State University
Institute of the Environment, University of Ottawa
Environmental Modeling Centre, Trent University
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