

Subgoal 6

Are land use, recreation, and economic activities sustainable and supportive of a healthy ecosystem?

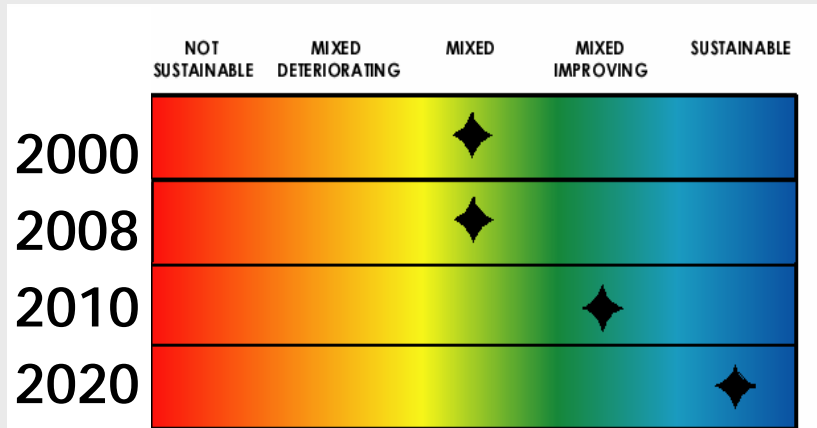
What is our target for sustainability?

A healthy ecosystem that benefits and supports a strong economy valued, enjoyed, and maintained by society.

Why is this important?

Land use, recreation, and economic activities are more sustainable, healthy, and supportive of a healthy ecosystem, but there is significant work that needs to be done. There is more information available on critical ecosystems, significant activity in better managing water resources, and more interest in determining the true value of a healthy ecosystem. There is danger, however, that the ecosystem could deteriorate if the knowledge is not shared widely and translated into actions especially in light of climate change.

Lake Michigan Target Dates for Sustainability



What is the current status?

The status remains mixed due to both positive and negative changes outlined in the LaMP.

What are the major challenges?

- Climate Change: national goal of 18% reduction of greenhouse gases by 2012
- Aging infrastructure and diminishing replacement resources
- Lack of confidence in green infrastructure as replacement foraging infrastructure
- Defining the climate change stressors likely to occur in the basin
- Educating people on the watershed approach to ensure more effective environmental management
- Conservation land being converted back to crops for biofuel

What are the next steps?

- Assist development of Green: Marina, Highway, and Golf Course programs for the basin to reduce inputs of nutrients, pesticides, and other pollutants into basin waters
- Promote studies that investigate the status of groundwater resources and their impact on water quality, aquatic habitat, and levels of Lake Michigan
- Support studies to determine sustainable yields for Great Lakes water resources
- Continue to promote studies that investigate the economic value of remediating contaminated sites as reported in LaMP 2006
- Promote a basin-wide opportunities for green areas that sequester carbon



What are some tools for addressing the challenges?

- Smart Growth Information Sources
- Milwaukee Metropolitan Sewerage District Protects Land to Store Stormwater
- Green Infrastructure Overview Resources
- Wisconsin Sea Grant Online Planning Guide for Coastal Communities
- Index of Sustainability Web Pages
- Managing Stormwater for Sustainability
- LEED Certification of Green Buildings
- Chicago Climate Exchange Trading System
- The Sustainable Sites Initiative

What are the State of the Lakes Ecosystem (SOLEC) indicators used to help assess the status of the subgoal?

For more information on status of indicators, see <http://www.epa.gov/solec/sogl2007/>

[Indicator # 4862 - Coastal Wetland Plant Community Health](#)

Status: Mixed; Trend: Undetermined

[Indicator # 4863 - Land Cover Adjacent to Coastal Wetlands](#)

Status: Not Fully Assessed; Trend: Undetermined

[Indicator # 7000 - Urban Density](#)

Status: Mixed; Trend: Undetermined

[Indicator # 7002 - Land Cover/Land Conversion](#)

Lake Michigan Status: Mixed; Trend: Undetermined

[Indicator # 7006 - Brownfields Redevelopment](#)

Status: Mixed; Trend: Improving

[Indicator # 7028 - Sustainable Agriculture Practices](#)

Status: Not Assessed; Trend: Not Assessed

[Indicator # 7043 - Economic Prosperity](#)

Status: Mixed; Trend: Not Assessed

[Indicator # 7054 - Ground Surface Hardening](#)

Status: Not Assessed; Trend: Not Assessed

[Indicator # 7056 - Water Withdrawals](#)

Status: Mixed; Trend: Unchanging

[Indicator # 7057 - Energy Consumption](#)

Status: Mixed; Trend: Not Assessed

[Indicator # 7060 - Solid Waste Disposal](#)

Status: Not Assessed; Trend: Undetermined

[Indicator # 7061 - Nutrient Management Plans](#)

Status: Not Assessed; Trend: Not Assessed

[Indicator # 7062 - Integrated Pest Management](#)

Status: Not Assessed; Trend: Not Assessed

[Indicator # 7064 - Vehicle Use](#)

Status: Poor; Trend: Deteriorating

[Indicator # 7065 - Wastewater Treatment and Pollution](#)

Status: Not Assessed; Trend: Undetermined

[Indicator # 7100 - Natural Groundwater Quality and Human-Induced Changes](#)

Status: Not Assessed; Trend: Not Assessed

[Indicator # 7101 - Groundwater and Land: Use and Intensity](#)

Status: Not Assessed; Trend: Not Assessed

[Indicator # 7102 - Base Flow Due to G groundwater Discharge](#)

Status: Mixed; Trend: Deteriorating

[Indicator # 7103 - Groundwater Dependent Plant and Animal Communities](#)

Status: Not Assessed; Trend: Not Assessed

[Indicator # 8129 - Area, Quality and Protection of Special Lakeshore Communities - Alvers](#)

Status: Mixed; Trend: Not Assessed

[Indicator # 8129 - Area, Quality and Protection of Special Lakeshore Communities - Cobble Beaches](#)

Status: Mixed; Trend: Deteriorating

[Indicator # 8129 - Area, Quality and Protection of Special Lakeshore Communities - Islands](#)

Status: Mixed; Trend: Undetermined

[Indicator # 8129 - Area, Quality and Protection of Special Lakeshore Communities - Sand Dunes](#)

Status: Not Assessed; Trend: Not Assessed

[Indicator # 8131 - Extent of Hardened Shoreline](#)

Status: Mixed; Trend: Deteriorating

[Indicator # 8135 - Contaminants Affecting Productivity of Bald Eagles](#)

Status: Mixed; Trend: Improving

[Indicator # 8147 - Population Monitoring and Contamination Affecting the American Otter](#)

Status: Mixed; Trend: Not Assessed

[Indicator # 8164 - Biodiversity Conservation Sites](#)

Status: Not Assessed; Trend: Undetermined

[Indicator # 8500 - Forest Lands - Conservation of Biological Diversity](#)

Status: Mixed; Trend: Undetermined

[Indicator # 8501 - Forest Lands - Maintenance of Productive Capacity of Forest Ecosystems](#)

Status: Not Assessed; Trend: Undetermined

[Indicator # 8503 - Forest Lands - Conservation and Maintenance of Soil and Water Resources](#)

Lake Michigan Status: Mixed; Trend: Undetermined

Great Lakes Regional Collaboration Sustainability Vision Statement

The Great Lakes Regional Collaboration states that:

Sustainability is not one government program or a spectator activity, it is a balancing act that requires full involvement of all Lake Michigan basin citizens. Until recently there were many published materials on "what is" sustainability and "how to" but we have now reached the point where we can begin to measure our progress or lack thereof. It is essential we track the use of our resources: climate, water, energy, land, industrial and municipal waste, water run off, and flora and fauna.

GLRC's vision is:

A sustainable Great Lakes ecosystem that ensures environmental integrity and that supports, and is supported by, economically viable, healthy communities.

This is built upon the United Nations' 1987 Brundtland Commission report that defined sustainability as: development that meets the needs of the present without compromising the ability of future generations to meet their own needs. In alignment with this sentiment is the Anishinaabeg Seventh Generation Principle that each generation considers the impact of its decisions on the next seven generations.

Ecosystem Sustainability

The interdependencies inherent in the ecosystem perspective require a balance between three fundamental elements: environmental integrity, economic vitality, and sociocultural well-being. The ability of these elements to function in balance over time is a measure of sustainability. The ecosystem perspective requires a shift of focus from resource programs to resource systems and in some cases their interaction. It places human activities and communities within an ecosystem and consequently, within ecosystem management.

The LaMP helps to identify the activities, partnerships, and locations where ecosystem management needs adjustment in order to attain a sustainable Lake

International Upper Great Lakes Study Releases Progress Report on St. Clair River

The International Upper Great Lakes Study (IUGLS) released its semiannual Progress Report. The main objectives of this study are to review the regulations related to Lake Superior outflows and to examine the physical processes and possible ongoing St Clair River changes and their impacts on the water levels of Lake Michigan and Huron. The International Joint Commission (IJC) directed the Study Board to complete the St Clair River portion of the Study by early 2010.

As part of this effort, a binational team of researchers has been investigating why water levels in the Upper Great Lakes are so low and whether possible physical changes in the St. Clair River might be responsible. The goal of the study is to determine whether altering regulations dealing with outflows from Lake Superior to take into account changing interests and climate would positively impact other connected waterways.

A recent estimate by the Georgian Bay Association (GBA) indicated that the volume of the river outflow may have increased by as much as 2.5 billion gallons per day, or about 2 percent of the flow of the St Clair River, as a result of dredging. These impacts are greater than those previously reported by the IJC. The GBA is requesting that action be taken immediately to address this issue. IUGLS will be assessing all the potential contributing factors to the changes in water level in order to ensure that informed decisions can be made. Studies have been initiated, hydrographic surveys are being conducted, and hydrometric stations are currently being installed in order to provide the information needed to address this issue.

Included in the report were initial results of a video analysis of more than 50 kilometers (30 miles) of the St. Clair river bed on videotape. The preliminary analysis noted that the river bed in the upper reach of the river is fully armored and that the armor layer is made up of coarse gravels, pebbles, and cobbles with sediment size ranging from about 4 mm to 250 mm (1/6 inch to nearly 10 inches). Based on the capacity of the flow to transport sediment, the armor layer in the upper part of the St. Clair River is considered to be stable and is not eroding.

More work involving sediment transport measurements and sediment models are planned to test this hypothesis. Additional video observations in the river are planned.

The next semiannual IUGLS Progress Report is scheduled to be released in April of 2008. More information is available at www.iugls.org.

Michigan basin. Sustainable landscapes are local ecosystems that are healthy enough to provide a range of valuable benefits and services, both now and in the future. Such benefits and services to humans include the following:

- Moderating natural events and human activities. Healthy landscapes can make communities safer and more livable by tempering the effects of natural events and human activities. For example, wetland systems can absorb and store storm waters, thereby aiding in flood control and ensuring more predictable stream flows and water levels as well as often providing for recharging local ground water.
- Enhancing social well-being. Healthy landscapes provide services that make communities more enjoyable and rewarding. For example, they provide opportunities for outdoor recreation, while also providing habitat for diverse plant and animal species. Plantings along stream banks can also provide buffers to filter pollutant runoff.
- Supporting local economies through tourism and sustainable natural resource use

United Nations 2007 Reports

Sustainability Report. In 2007, 20 years after the Brundtland Report, the United Nations weighed in on both climate change and sustainability in different reports. In its fourth Global Environment Outlook report published in October, 2007 the UN reported that in the two decades since the 1987 Brundtland Commission findings on Sustainability that warned the survival of humanity was at stake from unsustainable development, not much has changed for the better. The fourth report cites climate change, the rate of extinction of species, and the challenge of feeding a growing population among the threats putting humanity at risk.

Climate Change Report. The United Nations in 2007 released the Intergovernmental Panel on Climate Change (IPCC) *Fourth Assessment Report Climate Change 2007*. The Synthesis Report summarizes the most important findings, some of which are:

1. Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level.

2. Observational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, particularly temperature increases.

In terrestrial ecosystems, earlier timing of spring events and poleward and upward shifts in plant and animal ranges are with *very high confidence* linked to recent warming. In some marine and freshwater systems, shifts in ranges and changes in algal, plankton and fish abundance are with *high confidence* associated with rising water temperatures, as well as related changes in ice cover, salinity, oxygen levels and circulation.

3. Global greenhouse gas (GHG) emissions due to human activities have grown since pre-industrial times, with an increase of 70 percent between 1970 and 2004.

Changes in atmospheric concentrations of GHGs and aerosols, land-cover and solar radiation alter the energy balance of the climate system.

4. Global atmospheric concentrations of CO₂, methane (CH₄) and nitrous oxide (N₂O) have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values determined from ice cores spanning many thousands of years.

5. Most of the observed increase in globally-averaged temperatures since the mid-20th century is *very likely* due to the observed increase in anthropogenic GHG concentrations. It is *likely* there has been significant anthropogenic warming over the past 50 years averaged over each continent (except Antarctica).

In North America, one projected regional impact is that coastal communities and habitats will be increasingly stressed by climate change impacts interacting with development and pollution. The report also discussed adaptation and mitigation options, albeit not from a regional perspective.

Observed And Anticipated Effects On The Great Lakes Basin Ecosystem

In 2003, the International Joint Commission's (IJC) Water Quality Board issued a report to the IJC on the projected effects of climate change on the Great Lakes Basin and recommended management strategies. Climate Change and Water Quality in the Great Lakes Basin; Report of the Water Quality Board



The Lake Michigan Toolbox
Milwaukee Metropolitan Sewerage District Protects
Land to Store Stormwater
Climate Change Mitigation

The Milwaukee Metropolitan Sewerage District is purchasing and protecting land to reduce the impact of development on stormwater overflows. The program, Greenseams, formerly known as the Conservation Plan, is a flood management program that permanently protects key lands containing water absorbing soils. The program also aims to preserve land along stream corridors that connects the region's supply of public properties. Greenseams provides added support and protection for MMSD's structural flood management projects - infrastructure investments worth hundreds of millions of dollars. Greenseams identifies and purchases undeveloped, privately owned properties in areas that are expected to have major growth in the next 20 years and parcels of open space along streams, shorelines and wetlands. Sales are completely voluntary.

MMSD hired The Conservation Fund (TCF) to run Greenseams. TCF is a national non-profit conservation organization that forges partnerships to protect America's legacy of land and water resources. TCF performs high volume real estate transactions for local land trusts and government agencies throughout the country. All land acquired will remain as open space, protecting water and providing the ability to naturally store rain and melting snow in critical areas. Wetlands maintenance and restoration at these sites will provide further water storage.

In addition, preserving the properties also saves wildlife habitat and creates recreational opportunities for people living in the region. Where applicable, the properties can be used by the public for hiking trails, bird watching, and other passive recreation.

More information is available at: www.mmsd.com/floodmanagement/greenseams.cfm.



The Lake Michigan Toolbox
Smart Growth Information Sources
Climate Change Mitigation

Smart growth is development that serves the economy, the community, and the environment. It changes the terms of the development debate away from the traditional growth/no growth question to "how and where new development should be accommodated."

Smart Growth answers these questions by simultaneously achieving:

- Healthy communities -- that provide families with a clean environment. Smart growth balances development and environmental protection -- accommodating growth while preserving open space and critical habitat, reusing land, and protecting water supplies and air quality.
- Economic development and jobs -- that create business opportunities and improve local tax base; that provide neighborhood services and amenities; and that create economically competitive communities.
- Strong neighborhoods -- which provide a range of housing options giving people the opportunity to choose housing that best suits them. It maintains and enhances the value of existing neighborhoods and creates a sense of community. Transportation choices -- that give people the option to walk, ride a bike, take transit, or drive.
- A sample of smart growth information sources include:
 - www.epa.gov/smartgrowth/
 - www.cwp.org/index.html
 - www.lowimpactdevelopment.org/

to the Great Lakes International Joint Commission, ISBN 1-894280-42-3. 2003. It is available at <http://www.ijc.org/php/publications/html/climate/index.html>. The report said, "A change in climate could lead to alterations and impacts on environmental quality. The climate changes for a number of reasons- natural and anthropogenic- and studies are being carried out to detect changes in climate and identify associated impacts. Natural climate variability is influenced by changes in solar radiation, wobbles in the earth's orbit, and volcanic activity. Humans influence the climate by urban development, changes in land use patterns and practices and increased emissions of greenhouse gases.

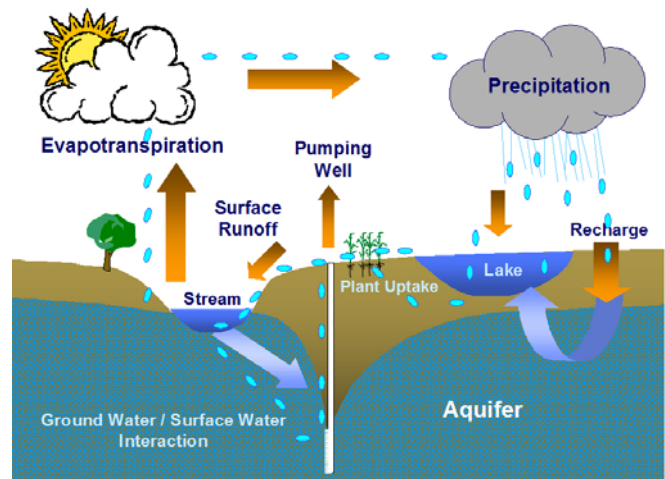
Both mitigation and adaptation actions are required as a balanced response to climate change. Mitigation measures are geared to reduce emissions and increase sinks of greenhouse gases, while adaptation actions seek to increase resilience by reducing risks and taking advantage of opportunities due to a changing climate."

The effects of a changing climate will be experienced in the Great Lakes and the Lake Michigan basin over the next century. The Union of Concerned Scientists Executive Summary Report, *Confronting Climate Change in the Great Lakes Region: Impacts on Our Communities and Ecosystems*, has documented the following expected changes:

- Winters are getting shorter;
- Annual average temperatures(air and water) are growing warmer;
- Extreme heat events are occurring more frequently;
- The duration of lake ice cover is decreasing as air and water temperatures rise; and
- Heavy precipitation events, both rain and snow, are becoming more common.

In addition, anticipated changes might include the following:

- Future lake levels are expected to decline as winter ice coverage decreases;
- Declines in the duration of winter ice are expected to continue;
- The distributions of fish and other organisms in lakes and streams will change. Coldwater species such as lake trout, brook trout, and white



The Water Cycle
Source: USEPA

- fish are likely to decline in the southern parts of the Great Lakes region, while warm water species are likely to expand northward;
- Invasions by non-native species will likely be more common, increasing the stress on native plant and animal populations;
- Lower water levels coupled with warmer water temperatures may accelerate the accumulation of mercury in the aquatic food chain as it is more likely to convert into a more bio-available form;
- Earlier ice breakup and earlier peaks in spring runoff will change the timing of stream flows, and increases in heavy rainstorms may cause more frequent flooding;
- More forest fires due to hotter and drier conditions;
- Increased incidence of extreme events such as severe storms and floods carrying sediment, nutrients and other contaminants into tributaries and the lake; and
- Increases in the number and severity of summertime pollution episodes.

In the Lake Michigan watershed, a number of mitigation measures are already underway. The Chicago Climate Exchange and the LEED guidelines for buildings are two examples of these measures. As climate change adds stress to many of the current Lake Michigan problems, green infrastructure tools become a high priority that must move from "examples" to the way to sustain communities.

As an example of moving from planning to reality, Wisconsin Governor Jim Doyle signed Executive Order



The Lake Michigan Toolbox Green Infrastructure Overview Resources (Climate Change Adaptation)

Green infrastructure is an interconnected network of green space that conserves natural ecosystem values and functions and provides associated benefits to human populations. The following are a series of resources for further protecting and developing green infrastructure.

- USEPA Low Impact Development page: www.epa.gov/owow/nps/lid
- Low Impact Development Center: www.lowimpactdevelopment.org
- Conservation Design Resource Manual: Language and Guidelines for Updating Local Ordinances, www.chicagowilderness.org/pubprod/miscpdf/CD_Resource_Manual.pdf
- Nonpoint Education for Municipal Organizations Network, <http://nemo.uconn.edu/>
- Center for Watershed Protection, An Introduction to Better Site Design www.cwp.org/better_site_design.htm
- Town of Franklin, Massachusetts, The Franklin Best Development Practices Guidebook www.franklin.ma.us/town/planning/HANDBOOK.PDF
- U.S. Department of Housing and Urban Development, The Practice of Low Impact Development, www.huduser.org/Publications/PDF/practLowImpctDevel.pdf.
- Prince George's County Low Impact Design Strategies, www.epa.gov/owow/nps/lid/lidnatl.pdf
- Planning with Power, Purdue University, www.planningwithpower.org
 - The Relationship Between Land Use Decisions and the Impacts on Our Water and Natural Resources, www.planningwithpower.org/pubs/id_260.pdf
 - Impacts of Development on Waterways, www.planningwithpower.org/pubs/id-257.htm



The Lake Michigan Toolbox Wisconsin Sea Grant Develops Online Planning Guide for Coastal Communities (Climate Change Adaptation)

The University of Wisconsin Sea Grant program developed an online planning guide for communities located on the Great Lakes. Communities situated on the Great Lakes in Wisconsin face a variety of challenges in developing comprehensive plans to guide future growth and development. In addition to all the elements of a comprehensive plan that inland communities must address (e.g., housing, transportation, infrastructure, land use, etc.), coastal communities also must tackle the preservation and sustainable use of coastal amenities, and the reduction of coastal hazards.

The Great Lakes Coastal Communities section of the Community Planning Resource Website provides a toolkit to support comprehensive planning and sustainable development along the Lake Michigan and Lake Superior coasts of Wisconsin. The website includes:

- A Planning Guide
- Information on Hazards Planning
- Plan Examples
- Laws and Regulations
- Training Materials
- Additional Links
- Maps and Data
- News and Events

More information is available at: <http://www.aqua.wisc.edu/cpr/>



The Lake Michigan Toolbox Index of Sustainability Web Pages

The USEPA Sustainability web site examines sustainability and provides links to USEPA programs and tools in four key areas: the Built or Human-created Environment; Water, Ecosystems and Agriculture; Energy and the Environment; and Materials and Toxics. Links to the programs and tools are organized in three categories: Policies and Programs; Research, Tools and Technologies; and Assessments and Performance Measures.

More information is available at: www.epa.gov/sustainability/index.htm and www.epa.gov/sustainability/links.htm



The Lake Michigan Toolbox Chicago Climate Exchange Trading System for Climate Change Mitigation

The Chicago Climate Exchange (CCX) has developed an integrated greenhouse gas (GHG) reduction and trading system includes a full portfolio of offset projects. CCX issues tradable Carbon Financial Instrument® (CFI™) contracts to owners or aggregators of eligible projects on the basis of sequestration, destruction or reduction of GHG emissions.

All CCX offsets are issued on a retrospective basis, with the CFI vintage applying to the program year in which the GHG reduction took place. Projects must undergo third party verification by a CCX approved verifier. All verification reports are then inspected for completeness by the Financial Industry Regulatory Authority (FINRA, formerly NASD).

Offset projects can be registered by Members, Offset Providers and Offset Aggregators. Offset Providers and Offset Aggregators do not have significant GHG emissions. Entities that have significant GHG emissions are eligible to submit offset project proposals only if they have committed to commit their own emissions to the CCX Emission Reduction Schedule as Members. Offset projects involving less than 10,000 metric of CO₂ equivalent per year should be registered and sold through an Offset Aggregator. The terms of the business and legal relationships between aggregators and offset project owners are left to the discretion of those parties.

CCX has developed standardized rules for issuing CFI contracts for the following types of projects:

- Agricultural methane
- Coal mine methane
- Landfill methane
- Agricultural soil carbon
- Rangeland soil carbon management
- Forestry
- Renewable energy

Traders moved 100,496 carbon contracts in February 2008 which equaled half of the total 2007 volume of 224,375.

More information is available at:
www.chicagoclimateexchange.com.

145 that requires that new state buildings be constructed with "green" design".

The following are activities related to climate change that support mitigation and adaptation in the basin.

- The *National Summit on Coping with Climate Change* took place on May 8-10, 2007, in Ann Arbor, Michigan. The summit brought together leading scientists and scholars with key decision makers in a structured discussion that addressed the options available to institutions, firms, and societies in the U.S. for adapting and responding to climate change. The summit focused on four specific sectors that represent illustrative examples of the social, economic, environmental, and natural resource issues that need to be addressed. The chosen areas of focus were Public Health, the Energy Industry, Water Quality, and Fisheries. The summit then turned its attention to general models for how different kinds of organizations, within these sectors and more generally, can put into place structures or processes that help them to anticipate and adapt to near- and long-term change. Background papers and other information about the summit are available on the internet at http://www.snre.umich.edu/climate_change/sector_papers.
- US EPA Region 5 recently released its climate change strategy, entitled *USEPA Region 5 Framework for Addressing Climate Change and Clean Energy*. (available at <http://www.epa.gov/region5/aboutr5/climatechange.htm>). The framework focuses on:
 - Changing how our energy is produced;
 - Changing how our energy is used;
 - Changing how materials, products, and waste are managed; and
 - Integrating climate change considerations into US EPA operations and core programs.
- The Pileus Project is coordinated by Michigan State University (MSU) and US EPA's Office of Research and Development. This project provides useful climate information to assist decision makers. The current focus is on two leading industries in the Great Lakes region: agriculture and tourism. Through the use of climate models and participatory workshops, Pileus seeks to: provide a better understanding of historical climate trends, variability, and their past impacts on people and industry; evaluate how future climate trends and variability may impact people and industry, using newly developed,

Green Infrastructure Policy

Ben Grumbles, USEPA Assistant Administrator for Water outlined a Green Infrastructure policy in 2007 that is not just for USEPA but is a shared effort with states, tribes, local governments and watershed groups.

Green infrastructure can be both a cost effective and an environmentally preferable approach to reduce stormwater and other excess flows entering combined or separate sewer systems in combination with, or in lieu of, centralized hard infrastructure solutions. EPA Water Programs are in a pivotal position to exert leadership in the consistent and reliable implementation of green infrastructure approaches.

Several cities, searching for alternatives to traditional hardscape solutions to wet weather discharge problems, have initiated some green infrastructure approaches. The Natural Resources Defense Council (NRDC) has recently published a document with information and case studies on these efforts. EPA urges the use of green infrastructure approaches described in the NRDC report. *Rooftops to Rivers: Green strategies for controlling stormwater and combined sewer overflows* (NRDC, June 2006) is available at: www.nrdc.org/water/pollution/rooftops/contents.asp

Green infrastructure approaches essentially infiltrate, evapotranspire or reuse stormwater, with significant utilization of soils and vegetation rather than traditional hardscape collection, conveyance and storage structures. Common green infrastructure approaches include green roofs, trees and tree boxes, rain gardens, vegetated swales, pocket wetlands, infiltration planters, vegetated median strips, reforestation, and protection and enhancement of riparian buffers and floodplains. Green infrastructure can be used where soil and vegetation can be worked into the landscape. It is most effective when supplemented with other decentralized storage and infiltration approaches, such as the use of permeable pavement, and rain barrels and cisterns to capture and re-use rainfall for watering plants or flushing toilets. These approaches can be used to keep rainwater out of the sewer system to reduce sewer overflows and to reduce the amount of untreated stormwater discharging to surface waters.

Green infrastructure facilitates or mimics natural processes that also recharge groundwater, preserve base flows, moderate temperature impacts, and protect hydrologic and hydraulic stability.

Green infrastructure has a number of benefits:

- Cleaner Water -Vegetation and green space reduce the amount of stormwater runoff and, in combined systems, the volume of combined sewer overflows.
- Enhanced Water Supplies -Most green infiltration approaches result in stormwater percolation through the soil to recharge the groundwater and the base flow for streams.
- Cleaner Air-Trees and vegetation improve air quality by filtering many airborne pollutants and can help reduce the amount of respiratory illness.
- Reduced Urban Temperatures -Summer city temperatures can average 10°F higher than nearby suburban temperatures. High temperatures are linked to higher ground level ozone concentrations. Vegetation creates shade, reduces the amount of heat absorbing materials and emits water vapor -all of which cool hot air.
- " Increased Energy Efficiency -Greenspace helps lower ambient temperatures and helps shade and insulate buildings, decreasing energy needed for heating and cooling.
- Community Benefits -Trees and plants improve urban aesthetics and community livability by providing recreational and wildlife areas and can raise property values.
- Cost Savings -Green infrastructure may save capital costs on digging big tunnels and stormwater ponds, operations and maintenance expenses for treatment plants, pipes, and other hard infrastructure; energy costs for pumping water; and costs of wet weather treatment and of repairing stormwater and sewage pollution impacts, such as streambank restoration.

The Office of Water is working with a coalition of organizations, including the Natural Resources Defense Council, the National Association of Clean Water Agencies, and the Low Impact Development Center, to develop additional strategies for green infrastructure approaches to water quality challenges.

More information is available at: <http://www.epa.gov/npdes/greeninfrastructure>.



The Lake Michigan Toolbox LEED Certification of Green Buildings Mitigating Climate Change

The Leadership in Energy and Environmental Design (LEED) Green Building Rating System® is a voluntary, consensus-based national standard for developing high-performance, sustainable buildings. LEED standards include:

- New commercial construction and major renovations
- Existing building operations
- Commercial interiors projects
- Core and shell projects
- Homes
- Neighborhood development

LEED was created to:

- define "green building" by establishing a common standard of measurement
- promote integrated, whole-building design practices
- recognize environmental leadership in the building industry
- stimulate green competition
- raise consumer awareness of green building benefits
- transform the building market

LEED provides a complete framework for assessing building performance and meeting sustainability goals. LEED emphasizes state of the art strategies for sustainable site development, water savings, energy efficiency, materials selection and indoor environmental quality.

The U.S. Green Building Council is currently working with the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE); and the Illuminating Engineering Society of North America (IESNA) to develop proposed Standard 189, Standard for the Design of High-Performance Green commercial Buildings.

The proposed standard will apply to new commercial buildings and major renovation projects, addressing sustainable sites, water use efficiency, energy efficiency, a building's impact on the atmosphere, materials and resources, and indoor environmental quality.

Standard 189P will be an ANSI-accredited standard that can be incorporated into a building code. It is intended that the standard will eventually become a prerequisite under LEED.

More information is available at: www.usgbc.org/

climate-related models; and create an economic framework which explicitly incorporates climate into the decision-making process. Stakeholders and researchers from the Pileus Project are building on each other's experiences, pooling expertise, and expanding knowledge about climate impacts on industry. The core research team is located at MSU and consists of scientists from diverse disciplines. For more information about the Pileus Project, see <http://pileus.msu.edu>.

- Teaming-up to create a resource on adaptive management are King County, Washington, the University of Washington, and ICLEI - Local Governments for Sustainability, who have recently produced *Preparing for Climate Change: a Guidebook for Local, Regional and State Governments*. The guidebook is one of the first major local government resources on planning for the impacts of climate change. It is available online and can be downloaded for free. <http://cses.washington.edu/db/pdf/snoveretalgb574.pdf>.
- The Midwest Governors signed an agreement leading the way toward increasing energy efficiency, expanding community-based energy development, and establishing a statewide goal to reduce GHG emissions.
- The National Governor's Association (NGA), chaired by Governor Tim Pawlenty of Minnesota, has developed a publication entitled *Securing a Clean Energy Future: A Call to Action*, which outlines a strategy for reducing dependence on oil and reducing emissions of GHGs. *Securing a Clean Energy Future: A Call to Action*. 2008. Available at <http://www.subnet.nga.org/ci/scef/>.

Water-Resources Issues

The Great Lakes basin contains 95 percent of the fresh surface water in North America and 18 percent of the fresh surface water in the world. Ground water underlying the basin constitutes another large volume of freshwater. Humans, animals, and plants have adapted to this abundance in water resources. Yet, even in this water-rich area, water withdrawals, diversions, and use sometimes conflict with the needs of other users and ecosystems in the basin. For example, pumping of large water-supply wells in Wisconsin and Illinois has lowered ground-water levels in the area, increasing pumping costs and levels of such contaminants as radium. Because the Great



The Lake Michigan Toolbox

Managing Stormwater for Sustainability

Climate Change Adaptation

Overviews

- Catching the Rain: a Great Lakes Resource Guide for Natural Stormwater Management, American Rivers www.americanrivers.org/site/PageServer?pagename=AR7_CatchingtheRain.
- An Eight-Step Approach to Stormwater Retrofitting: How to Get Them Implemented, Center for Watershed Protection, www.cwp.org/retrofit_article.htm.
- Watershed-Based National Pollutant Discharge Elimination System Permitting Implementation Guidance, USEPA www.epa.gov/npdes/pubs/watershedpermitting_finalguidance.pdf.
- Stormwater BMP Design Supplement for Cold Climates, Center for Watershed Protection, www.cwp.org/cold-climates.htm.
- Lake County Stormwater Management Commission Technical Reference Manual, Lake County, Illinois, www.co.lake.il.us/smc/regulatory/tac/refmanual.asp.

Example Stormwater Ordinances

- Stormwater Ordinances, www.stormwatercenter.net.
- Stormwater Manual Builder, www.stormwatercenter.net.
- Watershed Development Ordinance, Lake County Illinois, www.co.lake.il.us/smc/regulatory/wdo/default.asp
- Post-Construction Stormwater Management Ordinances, USEPA www.epa.gov/owow/nps/ordinance/postcons.htm.
- Post-Construction Stormwater Management Ordinances, Stormwater Center, www.stormwatercenter.net/Model%20Ordinances/Post%20Construction%20Stormwater%20Management/post_construction_runoff_control.htm.
- Operation and Maintenance Criteria for Stormwater Practices, www.stormwatercenter.net/Model%20Ordinances/Operation%20&%20Maintenance.htm.
- Grand Traverse County, Michigan Soil Erosion and Stormwater Runoff Control Ordinance, including construction and post-construction runoff control. www.stormwatercenter.net/Model%20Ordinances/Post%20Construction%20Stormwater%20Management/grand_traverse_county_soil_erosi.htm.

Lakes basin contains so many communities, industries, and ecosystems that depend on quantities of water and because competition for available water is intensifying, there is a need to quantify the region's water resources and the trends affecting them so that the potential for possible future water-use conflicts can be reduced or avoided.

In recent years, numerous government agencies, commerce, industry, and the general public all have expressed concern about potential large withdrawals of water within the Great Lakes basin. In response, the Great Lakes States and Canadian Provinces signed the Great Lakes Charter Annex Implementing Agreements in December 2005. Illinois, Indiana, Minnesota, and New York have approved the agreement. These multi-state and binational agreements commit the States and Provinces to more effective water-resources management. This commitment requires a more detailed understanding

of the region's water resources and a synthesis of available data and information.

Great Lakes Water Availability and Use

At the request of Congress, the U.S. Geological Survey (USGS) is assessing the availability and use of the Nation's water resources to gain a clearer understanding of the status of our water resources and the land-use, water-use, and natural climatic trends that affect them. The goal of the National Assessment of Water Availability and Use Program is to improve our ability to forecast water availability for future economic and environmental uses. Simply put, the assessment will help characterize how much water we have now, how water availability is changing, and how much water we can expect to have in the future.

Currently, the assessment is focused on the Great Lakes basin (See Figure 6-1) to determine the best methods to evaluate water resources, both surface and ground water and to develop strategies for delivering information about water availability and use. Planned activities for the pilot study include estimation of: (1) recent monthly streamflows; (2) spatial and temporal trends in streamflow characteristics, ground-water recharge, groundwater flow, and ground-water storage; (3) basin ground-water divides; and (4) consumptive water use. Other water-resources regions will be added to the assessment as evaluation methods improve and as funding permits. More information is available at: http://water.usgs.gov/ogw/gwrp/activities/wateravail_pilot.html.

Ground-Water-Flow Models in the Lake Michigan Basin

Application of ground-water-flow models is one of the most comprehensive ways to synthesize ground-water data and to analyze the response of a ground-

water system to changes in the system, such as increased pumping rates, changes in pumping locations, changes in recharge, and climate variations. Regional models that simulate ground-water flow will greatly improve the overall understanding of ground-water conditions in the Great Lakes basin and provide a quantitative framework to help manage water resources in ways consistent with the Great Lakes Charter Annex agreements. Comprehensive ground-water-flow models are complex and time consuming to develop; therefore, the entire Great Lakes basin could not be modeled for this study. Instead, a ground-water-flow model of the Lake Michigan subbasin is being developed because (1) the entire watershed is in the United States, and many datasets already are available within the USGS; (2) ground water is withdrawn from bedrock and glacial-deposit aquifers, both of which are important aquifer systems throughout the Great Lakes basin; (3) important issues related to ground-water and surface-water interaction can be simulated with the model; (4) ground-water withdrawals in the Lake Michigan subbasin may affect the locations of ground-water

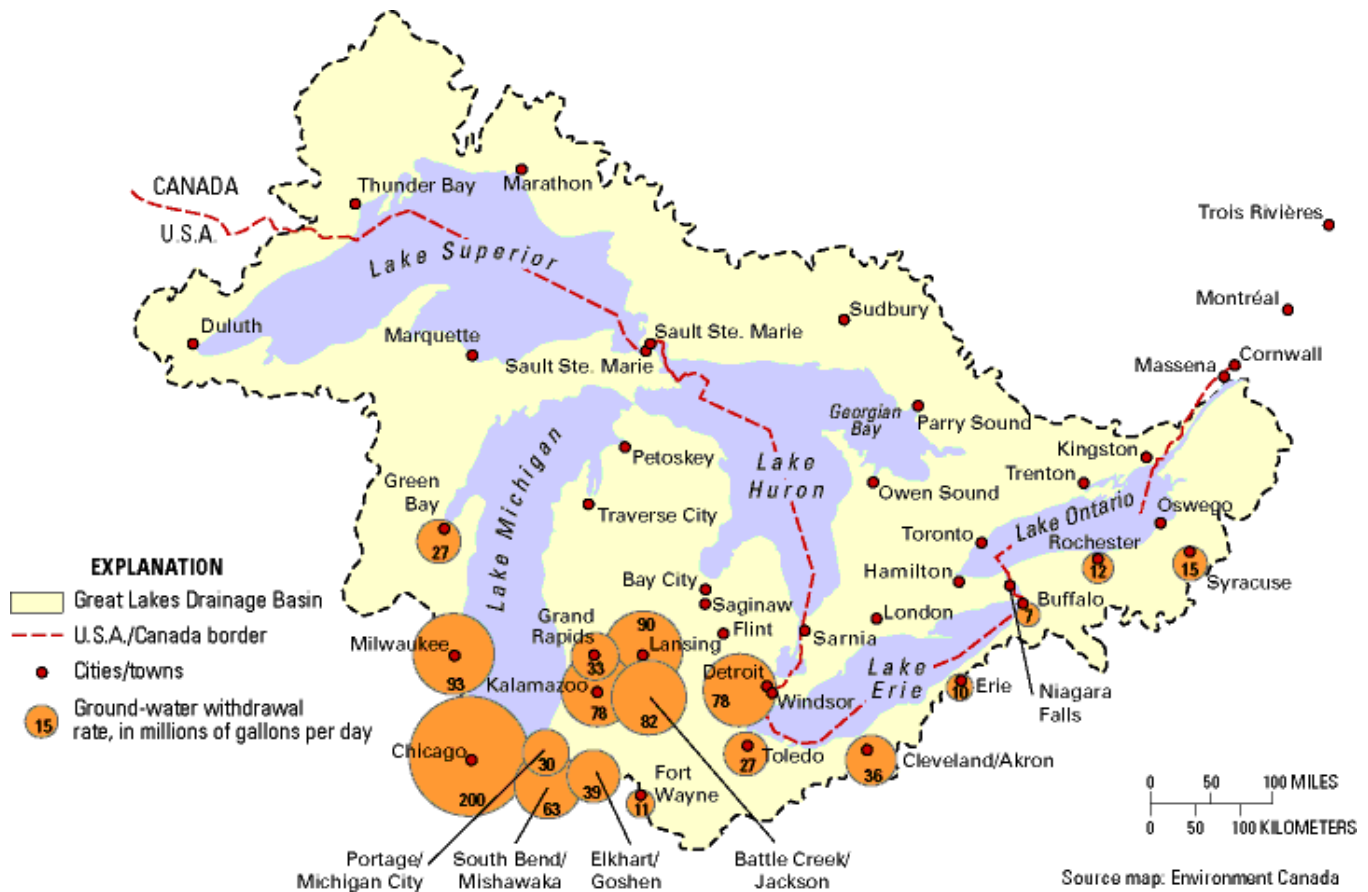


Figure 6-1 Groundwater Withdrawals in the Great Lakes Region

divides with Lakes Superior, Huron, and Erie; and (5) problems caused by large-scale ground-water withdrawals have been documented in the subbasin. In addition, one or more separate models within the Lake Michigan subbasin will be developed specifically to simulate ground-water and surface-water interaction in smaller watersheds because this is an important component of the water balance not only here but elsewhere in the Great Lakes basin. These models will be used to test new techniques for simulating the interactions of ground water and surface water at the appropriate scale. More information is available at <http://pubs.usgs.gov/fs/2005/3113>.

Lake Levels

The water-level elevations of Lakes Michigan, Huron, Erie, and Ontario have varied about 6 feet since 1860, when accurate records of lake levels were first recorded. Water levels in Lake Superior varied about 3 feet during the same interval. Prehistoric variations were much greater and were strongly correlated with climate change. Changes in water levels of the Great Lakes constitute the largest changes in the amount of water in the region. The Great Lakes basin study will summarize what is known about lake levels over the past 4,700 years. This analysis of lake levels will help put recent low lake levels into perspective, especially given the prospect of future global warming.

Lake Michigan was measured at 2 feet below the long-term average in 2001, having dropped more than 40 inches since 1997 when it was at near record highs. Levels increased for the 2002, but were still below average. The decrease in precipitation over the last five years resulted in Lake Michigan hitting its lowest point since 1966. Lake levels rose between the mid 1960s and the late 1990s.

The lower lake levels cause problems for the shipping and boating industry. Cargo ships are forced to lighten their loads, and many boat ramps become inaccessible. According to the U.S. Great Lakes Shipping Association, for every inch of water that Lake Michigan loses, a cargo ship must reduce its load by 90 to 115 metric tons, leading to losses of between \$22,000 and \$28,000 per trip.

Early reports for 2008 indicate that the lake remains below average even after a cold, wet winter. The fluctuation may be part of a 30 year cycle but

Climate Change Mitigation Strategies

Illinois Green Neighborhood Award Act

The Illinois Green Neighborhood Award Act is intended to provide support for sustainably designed neighborhoods which are known to reduce energy consumption, encourage strong local economies, and improve public health. The Act provides incentives for development projects in Illinois that are consistent with LEED_ND standards of the U.S. Green Building Council, Congress for the New Urbanism, and Natural Resources Defense Council. Leadership in Energy and Environmental Design for Neighborhood Development (LEED-ND) is an extension of LEED certification, the nationally accepted benchmark for the design, construction and operation of high-performance green buildings. Grants are available for up to 1.5% of the total project development costs through the department of Commerce and Economic Opportunity. the result will reduce energy consumption equal to \$554 per household annually and reduce dependence on cars and gasoline that leads to \$2,594 annual savings per household.

Chicago Climate Change Comprehensive Strategy

Chicago, under the direction of Mayor Richard M. Daley, is developing a comprehensive strategy to address climate change. Work began in December 2006 and the full research findings, strategy and a measureable plan will be released in 2008. Key to the extensive nature of the research and detailed plans was a base of foundation support (The Joyce, Grand Victoria, Lloyd A. Fry, and William J. Clinton Foundations). A large group of stakeholders make up a task force, advisory and communication committees to help guide the work.

deserves closer monitoring. Levels have remained lower for longer than they have in recorded history. The 1964 low level was 576.1 feet.

There are other potential factors affecting the levels. The International Joint Commission has proposed a study to investigate possible physical changes in the upper St. Clair River that may be causing water level changes in Lakes Michigan and Huron. this work would revise its upper Great Lakes Plan of study.

Lake Level Monitoring

Current Lake Michigan levels can be monitored online through a new National Oceanographic and Atmospheric Administration website, <http://glakesonline.nos.noaa.gov>. The site provides

Long-term Average and Current Lake Michigan-Huron Water Levels

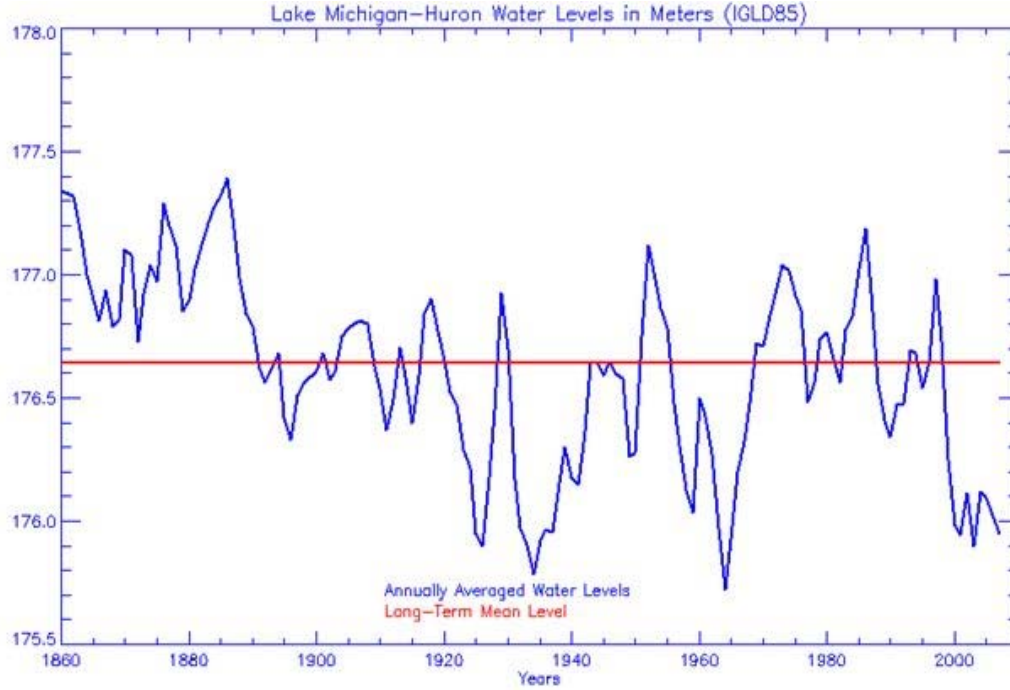


Figure 6-1 Long-term average water levels in Lakes Michigan-Huron
Source: National Oceanic and Atmospheric Administration

LAKES MICHIGAN-HURON WATER LEVELS - APRIL 2008

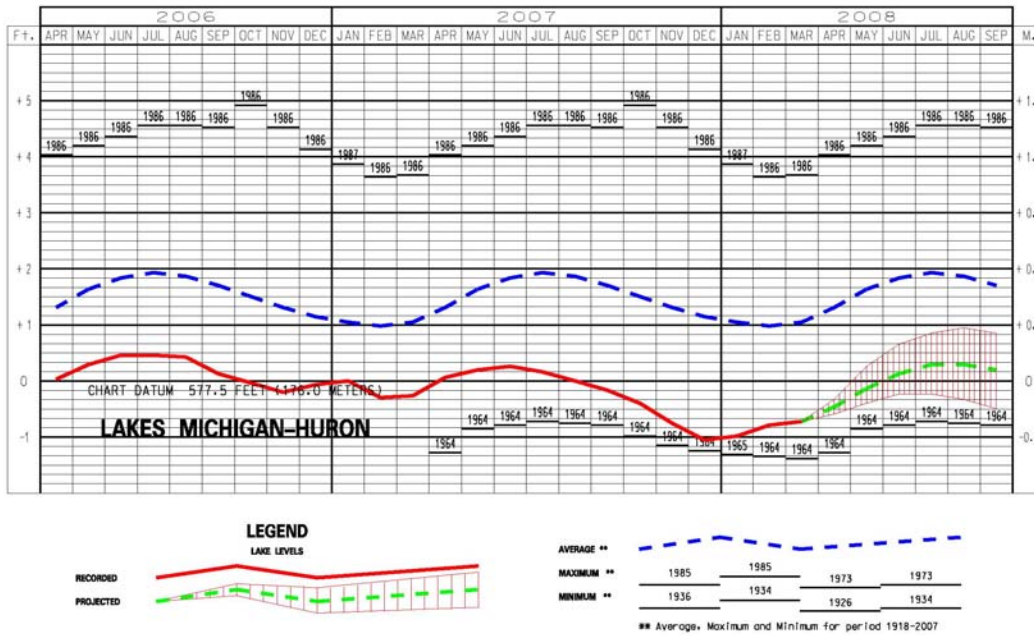


Figure 6-2 Lakes Michigan-Huron Water Levels, April 2006 - April 2008
Source: U.S. Army Corps of Engineers



Lake Michigan Toolbox Climate Change and Water Quality *Climate Change Adaptation*

A May 2007 National Summit at the University of Michigan: Coping with Climate Change highlighted the potential economic impacts of climate change on the Great Lakes region. Many of the speakers referenced the conclusions and recommendations of a 2003 IJC Water Quality Board report entitled "Climate Change and Water Quality in the Great Lakes Basin" (<http://www.ijc.org/php/publications/html/climate/index.html>).

The report focuses on the need to adapt to changes in climate in order to ensure effective protection of the environment and maintain the region's economic strength.



The Lake Michigan Toolbox: The Sustainable Sites Initiative *Climate Change Mitigation*

The Sustainable Sites Initiative is an interdisciplinary partnership between the American Society of Landscape Architects, the Lady Bird Johnson Wildflower Center, the United States Botanic Garden and a diverse group of stakeholder organizations to develop guidelines and standards for landscape sustainability. The motivation behind this initiative stems from the desire to protect and enhance the ability of landscapes to provide services such as climate regulation, clean air and water, and improved quality of life. Sustainable Sites™ is a cooperative effort with the intention of supplementing existing green building and landscape guidelines as well as becoming a stand-alone tool for site sustainability.

More information is available at: www.sustainablesites.org/

immediate water level and meteorological data from water level stations. There is a six minute interval between data readings, and NOAA plans for real time wind speed and direction data, in addition to barometric pressure and air temperature data. This augments the U.S. Army Corps of Engineers website that provides water level information <http://huron.lre.usace.army.mil/levels/hmpglv.html>.

Land Use Impacts Water Quality

The urbanized land area in the United States has quadrupled since 1954. To compound the problem, populations in coastal areas, which contain some of the most sensitive ecosystems, have been increasing even faster than in the rest of the country. From 1982 to 1996, the population in the Chicago-Northwest Indiana area grew by 10.9 percent but consumed 44.2 percent of the land. (Urban Roadway Congestion: Annual Report 1998) Wetlands, which naturally help control runoff from urban areas by storing flood and surface water and slowly releasing and filtering it, have been destroyed in the Lake Michigan basin to a greater degree than elsewhere in the country.

USEPA's Office of Environmental Information states that "the construction of impervious surfaces such as roads and rooftops leads to the degradation of water quality by increasing runoff volume, altering regular stream flow and watershed hydrology, reducing groundwater recharge, and increasing stream sedimentation and water acidity." A 1-acre parking

lot produces a runoff volume 16 times as large as that produced by an undeveloped meadow. Many impervious construction materials have higher surface temperatures that may cause ambient air temperatures to rise. When combined with a decrease in natural vegetation, areas are subject to what is called the urban heat island phenomenon, which may increase utility bills, cause health problems associated with heat stress, and accelerate formation of harmful smog. Clearly the effect of urban development on our communities and environment is a cross-cutting issue.

Oil and Gas Drilling in the Great Lakes

Due to the high cost of fuel, there has been renewed interest in tapping oil and natural gas reserves below the Great Lakes. In the Great Lakes basin, much of these resources lie under the lakes themselves. Drilling under the lakes raises concerns because a spill would lead to harm of the world's single largest source of freshwater providing drinking water to 33 million people.

Due to this concern, an amendment to the Energy and Water Development Appropriations Act of 2002 prohibited all federal and state governments from issuing leases or permits for new oil and gas directional or offshore drilling in or under the Great Lakes for two years. This moratorium was made permanent in the Energy Policy Act of 2005.

Michigan's legislature passed legislation that would ban all direct and directional drilling in its portion of the Great Lakes basin. Furthermore, a proposed natural gas pipeline for lake bed of Lake Michigan from Wisconsin to Indiana was withdrawn in 2001.

Currently in the Lake Michigan basin, only Illinois has never issued an oil or gas mineral lease for Lake Michigan bottomlands. Indiana has permitted limited exploratory drilling, but no oil or gas has been produced. Wisconsin allows drilling for oil and gas in certain circumstances and, in the past, Michigan has allowed drilling that begins on land with the pipes "slanting" under the lake.

Brookings Institute Studies: Building Leadership for North America's Fresh Coast

Over the last two years, the Great Lakes Economic Initiative for the Metropolitan Policy Program at the Brookings Institute has produced three studies aimed at the economic leadership and stability for the binational Great Lakes region.

The recommendations offered by the Institute are organized around a limited set of ambition goals, goals that would serve to prioritize and unify efforts.

- By 2010, develop a binational innovation fund and strategy
- By 2010, redevelop North America's freshwater coast
- By 2015, define and implement the U.S.-Canada "Border of the Future"
- By 2025, realize binational Great Lakes carbon goals and renewable energy standards
- By 2030, create a common market for commerce and human capital

More information is available at www.brookings.edu/metro.



In July 2008, 460 sailboats and more than 4,500 sailors will flood the Straits area during the 100th sailing of Chicago Yacht Club's Race to Mackinac, filling the Mackinac Island marina and spilling over into St. Ignace and Mackinaw City, MI. This is the world's longest freshwater sailing race at 333 miles.

Photo courtesy of Darren Beck