

Preparing for
CLIMATE CHANGE
in the **GREAT LAKES**
REGION



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UNIVERSITY OF MICHIGAN

PREPARING FOR CLIMATE CHANGE IN THE GREAT LAKES REGION

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EXECUTIVE SUMMARY

On June 27, 2008, forty representatives from Great Lakes foundations, non-governmental organizations, agencies, and universities, convened in Flint, Michigan for a one-day workshop titled “Preparing for Climate Change in the Great Lakes Region.” The workshop was sponsored by the Mott Foundation, Joyce Foundation, Kresge Foundation, the Great Lakes Fishery Trust, and Michigan Sea Grant.

The objectives of the workshop were to:

- Identify policy changes that will enable Great Lakes communities to adapt to climate change and protect major ecosystems.
- Identify strategies for implementing those policy changes.

Summary of Events

Andy Buchsbaum, Director of the National Wildlife Federation’s Great Lakes Natural Resource Center, opened the plenary session. He presented the day’s agenda and reminded participants that the workshop’s focus was on adaptation, not mitigation, and that discussion should be focused on processes that connect climate change to the Great Lakes, including watershed impacts. Following Buchsbaum’s introductory comments, three presentations provided the background for the workshop. Please see page 6 for the background papers.

Don Scavia, professor in the University of Michigan’s School of Natural Resources and director of Michigan Sea Grant, addressed current and future climate impacts. He emphasized that air and lake temperatures are increasing, winters are getting shorter, ice cover is decreasing, and precipitation patterns are moving toward more extreme events. Those trends are likely to continue, and most modeling efforts suggest lake levels will decline. These climate-driven changes are exacerbating most of the well-known stresses on Great Lakes ecosystems.

Tracy Mehan of the Cadmus Group Inc. discussed broad-scale policies that can influence adaptation. He pointed out that climate variability bolsters the case for implementing sustainable/sensible, long-term strategies that protect the Great Lakes ecosystem, such as “no regrets” activities and policies. He emphasized that under a changing climate our understanding of lake levels and the Great Lakes ecosystem varying around a long-term, fixed baseline is no longer true. He added that this realization requires planning for uncertainty through adaptive management implemented at watershed scales, involving stakeholders in the process, and tracking progress through continuous monitoring and review of resources.

The Great Lakes Commission’s Executive Director, Tim Eder, discussed climate change policy from a state and regional perspective. He summarized examples of state and regional efforts that should consider climate change adaptation in their policy analysis and suggested that even

in the face of uncertainty, there is a need to develop and implement adaptation policies and practices today that will help manage future changes.

Panelists reacted to the presentations and provided thoughts on policies and strategies that would advance adaptation efforts in the Great Lakes region. The conference then moved to breakout groups, charged with:

- Identifying new policies or changes to existing policies to guide climate adaptation in the Great Lakes
- Prioritizing “low-hanging fruit” policies, which are those that are both most feasible and will have the greatest impact

The breakout groups reconvened in plenary to report their findings, and the workshop concluded with an open discussion. Workshop participants identified guiding principles, priority issues, policy needs and initiatives, and implementation approaches to guide climate change adaptation efforts.

Guiding principles for adapting to climate change

- Focus adaptation efforts on restoring and promoting ecosystem resiliency, which is the ability of an ecosystem to cope with disturbances without shifting to become a different system;
- Pursue no regrets, low-hanging fruit policies, policies that achieve both mitigation and adaptation, and policies that achieve multiple benefits;
- Avoid reinventing the wheel – existing policies provide opportunities to address climate change adaptation, and we can incorporate adaptation efforts into work already being done;
- Target actions at the scale (local, state, national) where implementation is most feasible and will achieve highest impact;
- Support research that increases confidence in predictions of climate change impacts;
- Be careful about linking current issues to climate adaptation. Will linking it advance progress or could it hinder it?
- Be cognizant that challenges may be more sociopolitical than technical. Increased understanding of climate change processes will help prepare decision makers.

Priority water resource issues

Targeting policy initiatives on the following water resource management issues will have the most impact on restoring and promoting ecosystem resiliency, thus increasing its capacity to adapt to a changing climate.

- **Nonpoint source pollution, flooding, and combined sewer overflows** (more precipitation, and heavier and more frequent storm events will increase runoff)
- **Shoreline management** (increased fluctuations of lake levels may increase erosion and periodically expose formerly submerged lands)

- **Shortages of Great Lakes water** (regional and global supply/demand management presents myriad challenges)

Although these issues are not new, climate change will exacerbate them and force them to the forefront of the policy arena; addressing them will become more urgent than ever.

Recommended areas for policy change – The priority issues listed above can be addressed by focusing a climate change adaptation strategy on policies in four key areas. For each area there are two recommended categories of action. The first is enforcing and strengthening policies that are already in motion to restore and protect ecosystem resiliency. The second is to explicitly integrate climate change into existing and new policies, such as shoreline ownership and pollution permitting. Each area is listed below along with an example of a related policy initiative identified at the workshop.

1. **Fiscal setting** – Adapting to climate change will require a shift toward fiscal policies that discourage activities reducing adaptive capacity, and provide incentives to those that promote ecosystem resiliency. The state level fiscal setting (tax structure, subsidies, funding opportunities, etc.) could play an influential role in this shift by charging for actions that harm the Great Lakes, which would create a pool of funding for restoration and adaptation measures.
2. **Land use planning and community development** – Through their planning and zoning capacity, local governments present a powerful opportunity for increasing adaptive capacity. A policy initiative to promote low-impact development practices and green infrastructure at the local level is one way to take advantage of this opportunity.
3. **Water conservation and efficiency** – One of the simplest ways to expand adaptive capacity in the face of increased water demand is to use Great Lakes water more efficiently. An example of a policy initiative in this area is one aimed at removing subsidies so that the cost of supplying and conveying Great Lakes water approaches its true cost, thereby discouraging waste.
4. **Wetland restoration** – The significant role that wetlands play in filtering runoff and controlling flooding makes wetland restoration a tremendous opportunity for increasing ecosystem resiliency. Policies that provide economic incentives for protecting wetlands and restoring their ecological function will increase our capacity to deal with changing precipitation and runoff patterns.

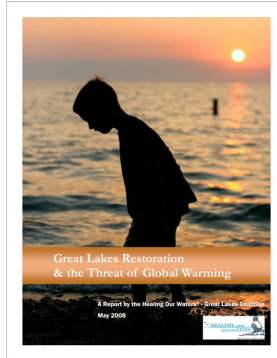
Implementation approaches

There are many ways to approach developing new policies and revising existing ones, as well as a range of scales for implementation. Participants in the workshop agreed generally that policies that enhance integrated watershed management efforts are likely to be the most effective way to adapt to the impacts of climate change. Integrated watershed management will restore ecosystem resiliency in the near term, and build adaptive capacity in the longer

term. New and revised policies can help by removing regulatory and financial barriers to building and supporting watershed-scale capacity.

Implementation of those policies can be aided by support for problem-driven integrated assessment, facilitated by neutral parties that engage stakeholders in connecting formal and traditional knowledge with problem definition and analysis of solution options.

BACKGROUND PAPERS

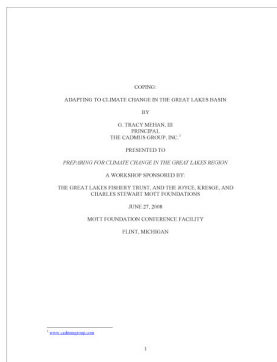


Impacts: Climate change impacts in the Great Lakes region

Donald Scavia, University of Michigan

See background paper:

<http://www.miseagrant.umich.edu/climate/workshop/images/Scavia-Excerpt-from-Global-Warming-Report.pdf>

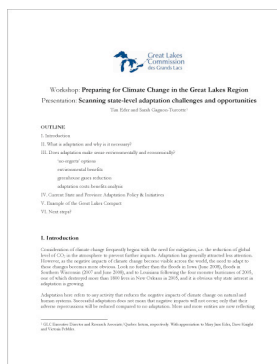


Coping: Adapting to climate change in the Great Lakes Basin

Tracy Mehan, The Cadmus Group, Inc.

See background paper:

<http://www.miseagrant.umich.edu/climate/workshop/images/COPING.pdf>



Scaling: Scanning state-level adaptation challenges and opportunities

Tim Eder, Great Lakes Commission

See background papers at:

<http://www.miseagrant.umich.edu/climate/workshop/images/Adaptation-Policy-in-the-Great-Lakes-FINAL-6-20.pdf>

KEY OBSERVATIONS AND FINDINGS

After the background presentations, panelists reacted to the presentations and provided thoughts on policies and strategies that would advance adaptation efforts in the Great Lakes region. The conference then moved to breakout groups, charged with:

- Identifying new policies or policy changes to guide climate adaptation in the Great Lakes
- Prioritizing “low-hanging fruit” policies, which are those that are both most feasible and will have the greatest impact

The breakout groups reconvened in plenary to report their findings, and the workshop concluded with an open discussion. In pursuit of the objectives listed above, workshop participants identified priority water resource management issues, guiding principles for adapting to climate change, policy needs and ideas for how to increase adaptive capacity of Great Lakes communities, and implementation approaches.

Priority water resource issues

Targeting policy initiatives on the following water resource management issues will have the most impact on restoring and promoting ecosystem resiliency, thus increasing the capacity to adapt to a changing climate.

- **Nonpoint source pollution, flooding, and combined sewer overflows** (more precipitation, and heavier and more frequent storm events will increase runoff)
- **Shoreline management** (increased fluctuations of lake levels may increase erosion and periodically expose formerly submerged lands)
- **Shortages of Great Lakes water** (regional and global supply/demand management presents myriad challenges)

Although these issues are not new, climate change will exacerbate them and force them to the forefront of the policy arena; addressing them will become more urgent than ever.

Guiding principles for adapting to climate change

Focus adaptation efforts on restoring and promoting ecosystem resiliency. Ecosystem resiliency is the ability of an ecosystem to cope with disturbances without shifting to become a different system. For example, the removal of a dam allows a river to shift from a reservoir to a more free-flowing system, which provides multiple restorative benefits. Specifically related to climate change, dam removal increases ecosystem resiliency by restoring floodplain wetlands which allow the river system to handle the projected increases in precipitation and heavy storm events associated with climate change.

Pursue “no regrets” policies. “No regrets” policies encourage actions that will provide many benefits even if climate change impacts are different than expected. For example, addressing the regulation and management of Great Lakes shorelines as water levels fluctuate will have positive impacts on habitat regardless of climate change impacts.

Pursue policies that achieve both mitigation and adaptation, and policies that achieve multiple benefits; Mitigation policies reduce greenhouse gas emissions with the goal of slowing or stopping warming, while adaptation policies are designed to protect against the climate changes that are already occurring. An example of a policy that had both mitigative and adaptive outcomes is one that encourages homeowners to replace turf grass lawns with more pervious surfaces such as rain gardens. It mitigates climate change by reducing emissions associated with mowing. It is also an adaptive strategy because the pervious surfaces can absorb more runoff and reduce pressure on municipal stormwater management systems as predicted increases in precipitation and heavy storm events occur. Other examples of actions that provide mitigation and adaptation include water conservation (reduces energy used for pumping and treating, and saves water in the instance of drought), and installation of green roofs.

Avoid reinventing the wheel – existing policies provide opportunities to address climate change adaptation, and we can incorporate adaptation efforts into work already being done. For example, implementing key recommendations of the Great Lakes Regional Collaboration Strategy (e.g., improve and protect drinking water sources and infrastructure, wetland restoration, improve watershed hydrology) would increase adaptive capacity.¹ In addition, climate change impacts present an opportunity to breathe new life into the Great Lakes Water Quality Agreement by renegotiating it through the lens of climate change, resulting in an international watershed approach to adaptation and revised Lakewide Management Plans (LaMPs) that incorporate climate change.

Target actions at the scale (local, state, national) where implementation is most feasible and will achieve highest impact. Workshop participants agreed that adapting to climate change impacts needs to be a local process. This is because the issues most likely to become exacerbated by climate change will have impacts felt largely on the local scale, and because many of these impacts will affect services and infrastructure for which cities have primary responsibility, including drinking water supply and quality, stormwater management, and natural areas preservation, among others. Given the diversity of communities in the Great Lakes basin, there will be no “one size fits all” adaptation strategy; local discussions are needed to determine which projects/priorities are most important to meet the needs and challenges of each community. However, state, regional, and national institutions and organizations will play an essential role in enabling and promoting these local level actions. For example, adaptation work on the state scale may involve examining laws and regulations – such as those governing

¹ http://www.glrc.us/documents/strategy/GLRC_Strategy.pdf. Accessed January 14, 2009.

the creation of watershed councils or other bodies likely to address climate change impacts locally – to identify state level regulatory impediments to local adaptation.

Support research that increases confidence in predictions of climate change impacts. Without greater precision and confidence in predictions of climate change impacts, it will remain a challenge to integrate these impacts into future planning. For example, the City of Chicago and the U.S. Army Corps of Engineers have completed more than \$300 million of infrastructure improvements along 9 miles of City of Chicago’s Lake Michigan shoreline during the last 10 years. However climate change impacts were not specifically integrated into the designs because of lack of confidence in predicted water level changes.

Be careful about linking current issues to climate adaptation. Will linking it advance progress or could it hurt? Promoting a policy for its ability to help communities adapt to climate change may increase short-term support for the policy by transcending some existing policy barriers, but it could also hinder progress. First, linking to climate change could complicate the issue and make it difficult to understand. Second, once a program or activity is linked to climate change it will stay there inextricably. This is an especially important consideration for the “no regrets” solutions that we are already promoting. For example, if we link reductions of nonpoint source pollution to climate change, this inextricable link may jeopardize long-term support and funding for pollution reduction efforts if climate change has less of an impact than predicted. Before promoting an initiative, we should ask: what are the costs and benefits of linking this issue to climate change? We also must keep in mind that the answers may be different depending on the audience.

Be cognizant that challenges may be more sociopolitical than technical. Increased understanding of climate change processes will help prepare decision makers.

While there are indeed some technical challenges to overcome regarding adapting to climate change (e.g. increased confidence and precision in predictions of impacts) the biggest challenge may be to create the policies and initiatives that will engage and empower decision makers and citizens to take action to prepare their communities for climate change impacts. Adapting to climate change may require significant education and outreach efforts, as well as technical.

Recommended areas for policy change

The priority issues listed on page 7 can be addressed by focusing climate change adaptation strategy on policies in four key areas. For each area there are two recommended categories of action. The first is enforcing and strengthening policies that are already in motion to restore and protect ecosystem resiliency. The second is to explicitly integrate climate change into existing and new policies, such as shoreline ownership and pollution permitting. Each area is listed below, along with reason why the area is pertinent to ecosystem resiliency and adaptive capacity.

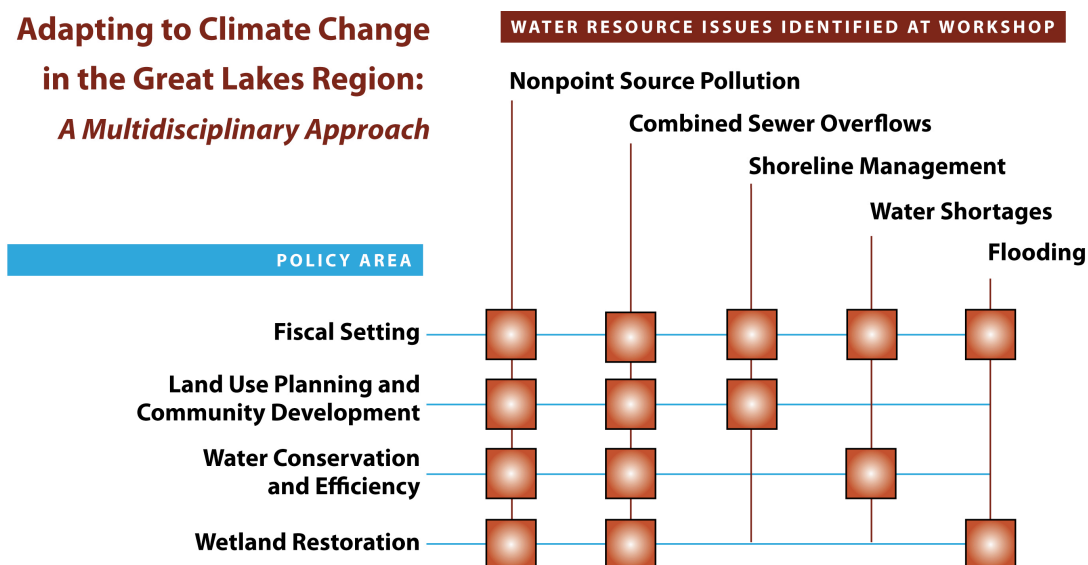
Fiscal setting – Adapting to climate change will require a shift toward fiscal policies that discourage activities that reduce adaptive capacity, and provide incentives to those that promote ecosystem resiliency.

Land use planning and community development – Through their planning and zoning capacity, local governments present a powerful opportunity for increasing adaptive capacity.

Water conservation and efficiency – One of the simplest ways to expand adaptive capacity in the face of increased water demand is to use Great Lakes water more efficiently.

Wetland restoration – The significant role that wetlands play in filtering runoff and controlling flooding makes wetland restoration a tremendous opportunity for increasing ecosystem resiliency.

The following matrix demonstrates how these policy areas connect to the water resource issues identified at the workshop.



The projected impacts of climate change will exacerbate existing water resource issues, as well as create new ones. Addressing these issues will become more urgent than ever, and will require a multidisciplinary approach.

How to increase adaptive capacity

Keeping in mind the priority water resource issues that would be most exacerbated by climate change, in breakout groups the workshop attendees brainstormed the most effective and feasible ways to prepare the Great Lakes basin to adapt to climate change. The collective list of ideas included a wide range of needs and activities that, if filled or pursued, would independently improve adaptive capacity. This section expands on the ideas that generated the most discussion among participants.

It should be noted that this is not an exhaustive list of all the ideas discussed at the workshop, nor is it exhaustive of all ideas for increasing adaptive capacity in the Great Lakes basin. This list should not be viewed as either an integrated or exhaustive agenda for adapting to climate change, rather it is a set of ideas designed to spark discussion about climate adaptation strategies. In addition, for some of these ideas, an extensive body of literature exists therefore the purpose here is to provide as much information as is necessary to clearly convey the essence of the idea.

However, these ideas are significant because they provide an expert-vetted starting point for discussions on adapting to climate change. We present them with the intention of furthering the discussion by providing more explanation than was allowed during the workshop given its time constraints. Our goal is that this summary will lead to thoughtful discussions on the potential for these ideas to be refined and applied in the Great Lakes basin.

The ideas are organized according to the policy areas identified above: fiscal setting, land use planning and community development, water conservation and efficiency, and wetland restoration.

Policy area: Fiscal setting

Adapting to climate change will require a shift toward fiscal policies that discourage activities reducing adaptive capacity, and provide incentives to encourage those that promote ecosystem resiliency. The following ideas are designed to encourage this shift in fiscal environment. Ideas in this policy area can be applied to policies and programs in any topic area, for example they have the potential to address all of the water resource issues listed on page 73. Creating a fiscal environment that supports ecosystem resiliency will help communities in the Great Lakes basin address all of the critical issues that workshop participants identified.

Financing mechanism dedicated to restoration and adaptation

The current policy approach is reactive, responding to events or crises instead of preventing them. Additionally, in order to support these responses the entire policy community must invest significant resources to obtain funding from Congress. A new, more efficient approach

would be one that has a built-in financing structure and mechanisms that gives the policy community the flexibility to respond to climate change opportunities/challenges as they arise.

The state level fiscal setting (tax structure, subsidies, funding opportunities, etc.) could play an influential role in this shift by charging for actions that damage ecological resiliency (such as developing a wetland), which would create a pool of funding for restoration and adaptation measures, including any of the ideas discussed in this report.

This potential pool of funding could go to existing financing mechanisms that could be tweaked to support activities that increase adaptive capacity. One such mechanism is the Clean Water State Revolving Funds (SRFs). The SRFs are low interest loan financing programs that assist municipalities with funding water quality projects. The SRFs currently support grey infrastructure (bricks and mortar construction), however with a shift in focus from grey infrastructure to green infrastructure, the SRFs could finance projects that increase adaptive capacity using low impact development techniques.

In addition to using existing funding mechanisms, a new fund that is dedicated to a specific purpose, such as wetland restoration, could be developed. For example, changes to the tax policy could provide economic incentives for protecting wetlands and restoring their ecological function rather than developing them or allowing them to be degraded by charging more taxes on property where a wetland has been degraded or destroyed. The additional taxes collected on degraded wetland could be dedicated to wetland restoration.

Examination of current fiscal system

In order to develop a state-level financing mechanism dedicated to climate change adaptation measures, we must first understand where incentives and disincentives lie in the current state fiscal system. An independent examination of state level tax policies, funding opportunities, subsidies, etc., will be helpful in identifying the governance structures and policies that support ecosystem resiliency and those that discourage it. After an examination it will be easier to understand how the state could enact new, or revise existing, policies to charge for actions that harm the Great Lakes ecosystem, which would create a pool of funding for restoration and adaptation measures.

Improved system for valuing ecosystem services

The fiscal setting described above, one with market-based incentives and disincentives for maintaining and promoting ecological resiliency cannot happen without an understanding and re-evaluation of economic value that healthy ecosystems provide, especially in terms of adaptive capacity. Workshop participants identified the need for an improved system for valuing ecosystem services. The EPA Science Advisory Board has released a draft report that reviews EPA's revised *Guidelines for Preparing Economic Analyses*, which are guidelines for EPA policy on the preparation of economic analysis required by legislation and administrative orders. The final version of the report may help further discussion in this area and lead to new

ideas for how to change funding structures. It would be useful to ensure that this report gets into the hands of the policy makers who can generate the changes.²

Policy area: Land use planning and community development

Adapting to climate change impacts needs to be a local process, and one that is tailored to each community. Local discussions are needed to determine which projects/priorities are most important to meet the needs and challenges of each community. Land use planning provides an excellent milieu for these discussions and actions because it is an inherently local institution that is highly stable, and it is the venue where local governments make policies and regulations regarding land use, development, and storm and wastewater management.

Through their planning and zoning capacity, local governments (e.g., municipalities, townships, counties, and regional planning organizations) present a powerful opportunity for increasing adaptive capacity. A policy initiative to promote elements of green infrastructure at the local level is one way to take advantage of this opportunity. **Green infrastructure** is a planning concept that highlights the importance of the ecological services (e.g., water quality, flood control) and quality of life benefits (e.g. recreation, shade) provided by the natural environment. A green infrastructure approach to stormwater management is one that attempts to use natural hydrology to manage stormwater. This includes large scale natural features such as wetlands, floodplains, and forests and small scale technologies such as rain gardens, green roofs, and porous pavement.³

By specifically focusing on two components of green infrastructure – **land protection** and **low impact development**– communities can prepare themselves to address the changing water regimes predicted to come with climate change and their impacts on nonpoint source pollution, combined sewer overflows, shoreline management, and flooding.

Land protection

Protecting land from development is an action that can both mitigate climate change effects and help communities adapt to climate change. It mitigates climate change effects because it preserves vegetation that offsets emissions. Land protection also helps retain the hydrologic function of natural features, such as wetlands, forests, and floodplains, which provide valuable ecological services that are necessary for maintaining adaptive capacity. Finally, land protection can be used to ensure the quality and quantity of municipal drinking water in the face of climate change by protecting source lands, such as headwaters and aquifer recharge areas, from unwise development.

² The draft of the external review is available on the EPA Science Advisory Board website at <http://yosemite.epa.gov/EE/epa/eerm.nsf/vwRepNumLookup/EE-0516?OpenDocument>. Accessed January 14, 2009.

³ For more information on using green infrastructure for stormwater management, please see http://cfpub.epa.gov/npdes/home.cfm?program_id=298. Accessed January 14, 2009.

Local governments, utilities, land trusts, and watershed organizations use a variety of methods to protect land from urban development. Some common tools include: land acquisition through fee simple purchase, conservation easements, purchase of development rights (PDR), development regulations, and overlay zones.

The City of Austin, Texas utilizes both conservation easements and PDR to protect groundwater recharge areas. The mission of the city's Wildland Conservation Division of the Austin Water Utility is "to acquire land in fee title and conservation easement in the Barton Springs contributing and recharge zone to provide for the conservation and maintenance of quality of the city's water supply." The lands absorb rain, which alleviates flooding and allows more runoff to flow to natural water bodies rather than the stormwater sewers. A total of 23,577 acres of these lands are specifically held as Water Quality Protection Lands (WQPL), where the objective is "to produce the optimum level of clean, high quality water from project lands to recharge the Barton Springs segment of the Edwards Aquifer." Over half of the WQPLs are conservation easements.⁴

While local governments cannot legally restrict development on privately owned parcels, they can use their regulatory authority to require property owners to protect natural features - and the ecological services they provide - on their properties.⁵ For example, the City of Ann Arbor, Michigan has an ordinance that protects natural features through the Development Review portion of the city code. The regulations are triggered when an applicant submits a site plan for development. Planners ensure that the site plan meets requirements to avoid harm to wetlands, endangered species habitats, one-hundred year floodplain, landmark trees and woodlands, steep slopes, and water courses. If some damage is unavoidable, the applicant must provide on-site mitigation.⁶

Another common method used by local governments to protect natural features is to add overlay zones to the zoning ordinance. An overlay zone applies additional regulations (e.g., setbacks, lot sizes, impervious surface) to development within the zone. This is a useful tool for protecting lands that are important for maintaining adaptive capacity in the face of climate change, such as floodplains, wetlands, and woodlands. Additionally, features such as groundwater recharge areas and steep slopes can also be protected from development, and thus maintain protection of valuable drinking water sources and reduce sediment load into rivers and lakes during rainfall events. Overlay zones work well for natural features that are

⁴<http://www.ci.austin.tx.us/water/wildland/default.htm> Accessed January 14, 2009.

⁵ For more information on how local governments can use their planning and zoning power to protect natural features, see: http://www.michigan.gov/deq/0,1607,7-135-3313_3677_3696-73358--,00.html or <http://www.uwsp.edu/cnr/landcenter/>. Accessed January 14, 2009.

⁶ For the text of the natural features section of the city code (Chapter 57, 5. 127, Mitigation of Natural Features), see <http://www.a2gov.org/government/communityservices/planninganddevelopment/planning/Documents/ch57a.html>. Accessed January 14, 2008.

continuous, such as groundwater recharge zones, intact forests, and floodplains, whereas development regulations are better for addressing discrete features such as landmark trees.⁷

Low impact development

Low impact development (LID) is an alternative approach to stormwater management that attempts to manage runoff closer to its source by using on-site natural features or small scale hydrologic controls. Some of these features include green roofs, rain barrels, rain gardens, permeable paving, swales, and water retention ponds. As much as possible LID mimics natural hydrology, reducing runoff volume by allowing it to infiltrate the ground or evaporate after a storm, rather than piping it offsite.⁸

Local governments can use their regulatory authority to allow, encourage, or require LID. The following examples demonstrate the variety of ways that local governments have taken a lead on implementing LID techniques in their communities:

Olympia, Washington – mandatory low impact development regulations

Driven by a desire to protect aquatic habitat for threatened salmon in the Green Cove Creek watershed, elected officials and city staff in the City of Olympia, Washington, undertook a comprehensive policy revision. In 2001, after three years of research, analysis, and peer review, the City revised the comprehensive plan, municipal code, development guidelines and public works standards, and *Drainage Design and Erosion Control Manual*. Revisions covered multiple aspects of planning and development, including development density, impervious surface coverage, lot size, open space/tree retention, street design, street width, block sizes, parking, sidewalks, and stormwater management requirements.⁹

Ann Arbor, Michigan – incentive-based LID

The City of Ann Arbor, Michigan uses an innovative incentive to encourage residents to reduce stormwater runoff from their properties using LID techniques. In 2007 the city implemented a new rate structure for the stormwater utility fee. Rates are now determined by the amount of impervious area on a property (as determined by a computer analysis of aerial infrared photography) rather than a structure in which all consumers pay the same rate. The city incentivizes LID by giving customers the opportunity to earn credits to reduce their bill by reducing the amount of water flowing off of their property. Customers can earn credits by enrolling in the county's RiverSafe Home program, and by installing LID technologies - specifically rain barrels, rain gardens, cisterns, or drywells - on their properties.¹⁰

Toronto, Ontario – Downspout Disconnection Program

⁷ For more information on overlay zoning, see <http://www.uwsp.edu/cnr/landcenter/pdffiles/implementation/OverlayZoning.pdf>. Accessed January 14, 2009.

⁸ For more information on LID, see www.lowimpactdevelopment.org. Accessed January 14, 2009.

⁹ For a case study detailing the review process and outcomes, see http://www.psparchives.com/publications/our_work/stormwater/lid/ordinances/Green_Cove.pdf. Accessed January 14, 2009.

¹⁰ http://www.a2gov.org/government/publicservices/systems_planning/waterresources/Pages/StormWater.aspx. Accessed January 14, 2009.

In 2007, the City of Toronto approved the Mandatory Downspout Disconnection Program that requires all Toronto homeowners to disconnect their downspouts connected to the combined sewer system by 2009. The purpose of downspout disconnection is to reduce flows to the combined sewer system and reduce combined sewer overflows that lead to basement flooding, contaminated Lake Ontario water, and closed beaches. Since 1998 the City of Toronto had run a voluntary program where property owners could register with the city for a free disconnection. Although the free program has been discontinued, the City now provides resources to help property owners, such as financial assistance for low income residents and a "Do-It-Yourself" Downspout Disconnection Guide.¹¹

Milwaukee, Wisconsin - discounted rain barrels

There are many examples of local governments purchasing rain barrels in bulk and selling them at discounted prices or with rebates. For example, the Milwaukee Metropolitan Sewerage District offers up to five rain barrels at the discounted rate of \$30 each to any Wisconsin resident who orders through the district and can pick up their barrels in Milwaukee.¹²

Chicago, Illinois – Green Roof Grants Program

In 2005 the City of Chicago Department of Environment launched the Green Roof Grants Program, where residential and small commercial building (less than 10,000 ft²) owners can apply for a \$5,000 grant to help with the planning and installation of a green roof. In the first year of the program 20 grants were awarded. In 2006, the number of grants reached forty. The program continued in 2007, with grants awarded in October of 2008. All grantees must commit to maintain the green roof project for at least 5 years.¹³

Land protection and LID help to reduce total runoff and provide initial treatment of polluted runoff, thereby helping communities avoid combined sewer overflow events and reducing pollutant load entering stormwater sewer systems and water bodies. When these techniques are implemented at a wide scale throughout a community, the result is a landscape more functionally equivalent to pre-development hydrologic conditions. This will position communities to manage the predicted increases in runoff (due to more frequent heavy storm events) associated with climate change without having to add treatment capacity, thereby saving resources for use in other areas.

Boost organizational capacity of watershed councils and land trusts

Because water regime is a crucial aspect of climate change within the Great Lakes basin, a watershed by watershed approach may be an ideal way to address climate change impacts on a local level. Local governments should consider watershed organizations and land trusts to be key partners in preparing their communities for climate change.

Watershed organizations, often named watershed councils or associations, are nonprofit entities that focus specifically on protecting and restoring watershed health. These groups can

¹¹ http://www.toronto.ca/water/protecting_quality/downspout.htm. Accessed January 14, 2009.

¹² <http://v2.mmsd.com/RainBarrels.aspx>. Accessed January 14, 2009.

¹³ For more information, see <http://egov.cityofchicago.org/city/webportal/portalEntityHomeAction.do?entityName=Environment&entityNameEnumValue=05>. Accessed January 14, 2009.

have a tremendous impact on developing and implementing key strategies on adaptive capacity through their watershed planning and LID efforts. The Huron River Watershed Council (HRWC) in Ann Arbor, Michigan is an example of a high capacity watershed council. The HRWC is a coalition of residents, businesses, and local governments whose mission is to “inspire attitudes, behaviors, and economies that protect, rehabilitate, and sustain the Huron River system.” Programs at HRWC are wide-ranging and include pollution prevention, natural resource planning, river monitoring, citizen and mass media education, and floodplain protection. The HRWC works with local governments within the watershed to enact plans and ordinances to protect watershed resources and manage stormwater.¹⁴

Local governments should work cooperatively with organizations like the HRWC to develop and implement resiliency plans and strategies for specific, localized climate challenges. However, in Michigan, the administrative and financial demands required to obtain funding for watershed planning have been a barrier to capacity-building and proliferation of watershed planning organizations.

The two major funding sources for watershed planning efforts in Michigan are the Clean Michigan Initiative (CMI) Nonpoint Source Pollution Control Grant program and the Clean Water Act (CWA) Section 319 Grant Program, both administered by the state. To be eligible for implementation funds from either program, a group must write a watershed management plan that meets specific criteria to be approved by the state Department of Environmental Quality (DEQ) or U.S. EPA. These requirements mean that obtaining plan approval requires a high level of existing institutional and financial capacity, which is a disincentive to new or small organizations to take up watershed planning. In addition, a community must obtain the Michigan Watershed General Storm Water Permit in order to undertake watershed-based stormwater management in Michigan. When applying for this permit, three plans must be submitted, including a watershed management plan. These rigorous requirements ensure that watershed planning is conducted by qualified organizations, and ensures good outcomes, however they are a disincentive to pursue watershed scale planning, especially for groups with minimal capacity and resources, both financial and legal.¹⁵

In some states, watershed planning and implementation is more strongly supported financially and administratively. For example, the state of Washington has a policy requiring watershed planning, provides multiple funding opportunities, and has a centralized agency in charge of watersheds.¹⁶ Workshop participants identified a need for resources for capacity-building for watershed councils for watershed planning and implementation.

¹⁴ <http://www.hrwc.org>. Accessed January 14, 2009.

¹⁵ For more information on Michigan’s nonpoint source pollution program, see http://www.michigan.gov/deq/0,1607,7-135-3313_3682_3714---,00.html. For more information on the Clean Water Act section 319 funding program, see <http://www.epa.gov/nps/cwact.html>. Accessed January 14, 2009.

¹⁶ For more information on watershed planning in the State of Washington, see <http://www.ecy.wa.gov/watershed/index.html>. Accessed January 14, 2009.

In addition to watershed councils, land trusts have the potential to play a pivotal role in preparing communities for climate change impacts through land protection efforts. Local governments should partner with land trusts to identify and preserve the ecological resiliency of lands that are most valuable from an adaptation perspective.

Land trusts are “non-profit organizations that work with landowners and the community to conserve land by acquiring conservation easements or providing stewardship on the land.”¹⁷ The Leelanau Conservancy in Traverse City, Michigan is an established, longstanding land trust that demonstrates the potential for land trusts to protect and restore land at a large scale.¹⁸ However, not all land trusts share the organizational and financial capacity of the Leelanau Conservancy. Similar to watershed councils, land trusts generally have limited resources.

In June 2008, the Land Trust Alliance and the Heart of the Lakes Center for Land Conservation Policy announced the ACE (Advancing Conservancy Excellence) initiative, providing Michigan land trusts and conservancies with an opportunity for enhancement. This program will “provide three years of sustained coaching, training and capacity-building to strengthen land conservancies across the state. The ACE program will accelerate the growth and development of Michigan conservancies so that they have the ability to scale up their operations and the sustainability to increase greatly the number of conservation transactions.”¹⁹

Strengthening watershed groups and land trusts by building technical capacity and increasing state level financial support for them should be a priority to help ensure an increase in the ecosystem’s capacity to adapt to climate change.

Partnerships and collaboration

Effectively implementing watershed planning requires the support and cooperation of a variety of public and private partners, because most watersheds cross multiple jurisdictions. Local governments should partner with other municipalities, watershed councils and land trusts, business and industry groups, landowner groups, and other stakeholders to pursue watershed planning. Specifically, municipal water, wastewater, and stormwater utilities are the local agencies best suited to explore these public-private synergies and partnerships. In addition to having the motivation and revenue stream to be effective in watershed planning, engaged utilities can serve as a watershed planning anchor in the watershed.

For example, in Milwaukee, Wisconsin the Milwaukee Metropolitan Sewerage District (MMSD), the local waste and stormwater utility, has partnered with the Conservation Fund to protect and restore floodplains through the Milwaukee Watershed Conservation Plan. In response to studies showing future intensification of flood problems in metropolitan Milwaukee, the plan

¹⁷ <http://www.landtrustalliance.org/conservancy/about-land-trusts>. Accessed January 14, 2009.

¹⁸ <http://www.theconservancy.com>. Accessed January 14, 2009.

¹⁹ For more information on the ACE program, see <http://www.landtrustalliance.org/about-us/news/alliance-news/ace-program-6-30-08>. Accessed January 14, 2009.

identifies undeveloped private properties which could provide future flood prevention benefits, but that are at risk for development. The Conservation Fund, hired by MMSD to implement the plan, is working to acquire properties through conservation easements or outright purchase. The MMSD will partner with local governments and/or land trusts to provide management on the properties acquired by the Fund. By the end of 2008, the partnership had protected nearly 1800 acres.²⁰

Another example of a public-private partnership to protect land, in this instance drinking water sources, is in Austin, Texas.²¹ In February of 2008, the City of Austin partnered with The Nature Conservancy of Texas to negotiate conservation easements to protect more than 3,000 acres of water quality land in the Barton Springs Recharge Zone. This effort will help conserve drinking water quality and quantity, in addition to many other benefits.²²

Will Wynn, the mayor of Austin, highlighted the benefits of partnering with the Nature Conservancy when he stated that "They were able to act with greater speed and agility than the City could have, securing exceptional environmental protections and helping leverage public dollars in a very judicious way. Frankly, they negotiated this deal at a phenomenal bargain price."²³

Outreach and education for public servants and professionals

Wide scale implementation of green infrastructure at the local level will require outreach and education build support from local citizens. However, elected officials and municipal staff, including planners, civil engineers, and other public works officials who have influence over local policies must first support the ideas and process so that legal and institutional barriers to watershed planning techniques can be removed. These officials and professionals need to understand predicted climate change impacts and how they will affect their communities both physically and financially, as well as how alternative stormwater management strategies such as LID and land protection can save them money and protect property, especially in light of predicted water regime changes.

Professional development through conferences, seminars, workshops, continuing education courses, and other outreach and education materials, provides an excellent opportunity for

²⁰ <http://www.conservationfund.org/node/404>. Accessed January 14, 2009.

²¹ A 2004 report by the American Water Works Association and the Trust for Public Lands illustrates how land protection can be an important source water protection tool under the *Safe Drinking Water Act* involving state, public (municipal departments and utilities) and private land agencies and trusts. The report, called *Protecting the Source: Land Conservation and the Future of America's Drinking Water*, provides five best practices for developing and implementing a source water protection plan. The report is available online at http://www.tpl.org/tier3_cd.cfm?content_item_id=14288&folder_id=175. Accessed January 14, 2009.

²² <http://www.nature.org/wherewework/northamerica/states/texas/press/press3381.html>. Accessed January 14, 2009.

²³ http://www.ci.austin.tx.us/council/mw_env_acres.htm. Accessed January 14, 2009.

local government officials and staff to learn about LID and other strategies for adapting to climate change.

For example, the American Public Works Association (APWA) provides a variety of professional development opportunities for members and non-members through online and in person training courses, workshops, and lectures. In 2007 the APWA held an audio/web broadcast titled, “The Trend to Low Impact Development and What it Means for Public Works.” While not explicitly tied to climate change in the description, the broadcast provided an opportunity for listeners to earn continuing education credits to learn about LID.²⁴

Another professional organization, the American Planning Association (APA), already has climate change programs in place, including research and education on planning for climate change; however these initiatives focus on mitigation.²⁵ The APA does address and promote techniques to adapt to climate change, such as LID and land protection, but it is classified under green communities/sustainable communities themes; they are not linked to climate change explicitly.²⁶

In addition to professional organizations, another opportunity for information sharing are organizations such as the United States Conference of Mayors, and the International Council for Environmental Initiatives (ICLEI), both of which have existing climate change programs that could be expanded to address adaptation. The U.S. Conference of Mayors, through its Mayors Climate Protection Center, has created the Climate Protection Agreement (which has been signed by over 500 mayors), held a climate protection summit and developed a best practices guide to demonstrate what mayors and their cities are doing to fight climate change, among other local environmental initiatives. This organization is well positioned to expand their efforts to address how mayors and their cities can mitigate and adapt to climate change.²⁷

The Cities for Climate Protection (CCP) program is an ICLEI initiative that “assists cities in integrating climate change mitigation into their decision-making processes.” Currently there are over 800 cities worldwide that participate in CCP. Although the main focus is on mitigation by helping cities “adopt policies and implement quantifiable measures to reduce local greenhouse gas emissions, improve air quality, and enhance urban livability and sustainability,” the CCP campaign aims to include approaches on adaptation to existing climate change in the future.²⁸

An existing regional forum with the potential to have an impact on generating and sharing ideas is the Great Lakes and St. Lawrence Cities Initiative (GLSLCI). The GLSLCI is “a binational coalition of mayors and other local officials that works actively with federal, state, and

²⁴ For more information, see <http://www.apwa.net/events/eventdetail.asp?ID=2737>. Accessed January 14, 2009.

²⁵ <http://www.planning.org/research/energy/index.htm>. Accessed January 14, 2009.

²⁶ See <http://www.planning.org/pts/workshops/sustainablezoning.htm> and <http://www.planning.org/nationalcenters/green/index.htm>. Accessed January 14, 2009.

²⁷ For more information, see <http://www.usmayors.org/climateprotection/>. Accessed January 14, 2009.

²⁸ For more information, see <http://www.iclei.org/index.php?id=800>. Accessed January 14, 2009.

provincial governments to advance the protection and restoration of the Great Lakes and the St. Lawrence River.” This coalition has already begun discussions of city level adaptation to climate change. This group and others like it should be engaged to help identify and disseminate options for local level adaptation to climate change.²⁹

Shoreline land use regulations

One regulatory area that will require significant attention as climate change impacts are increasingly felt and water levels fluctuate, is that area where the land meets the water: Great Lakes shorelines. Current regulations are not adequate to deal with the formerly submerged land that will be exposed if lake levels drop as predicted. On a federal level, the *Coastal Zone Management Act*, or Section 404 of the *Clean Water Act* are two pieces of legislation that could integrate climate change impacts.

States and municipalities have significant – if not more significant – authorities than federal agencies to manage local land use decisions, including coastal development. For example, Illinois in recent years saw a boom in applications for large-scale piers and other structures along private lakefront properties, often proposed under the guise of “shoreline protection.” Concerned about the scale and appropriateness of these proposed developments, municipalities such as Highland Park passed temporary moratoria on any new lakefront building. Other cities followed suit, prompting the state to pass its own moratorium (with limited exceptions) until it promulgated more comprehensive guidelines for shoreline protection guidelines.

Policy area: Water conservation and efficiency

Considerable attention has been given to how LID and green infrastructure can help communities adapt to climate change, but one of the simplest ways to expand adaptive capacity in the face of increased water demand is to use Great Lakes water more efficiently. Water conservation can mitigate climate change (it reduces energy consumed for pumping and treating) as well as be an adaptation measure (it saves water in case of drought). On the supply side, water conservation involves replacement of inefficient and old infrastructure, while on the consumption side it involves retrofitting buildings to reduce leakage and inefficiencies and replacing inefficient fixtures and appliances in addition to examining use patterns and adjusting those to reduce amounts used at peak times. Scaled up, these efforts will lead to more efficient use of Great Lakes water.

Conservation rate pricing for water

Of the issues that workshop participants identified as most critical to address, using water more efficiently will address nonpoint source pollution, combined sewer overflows, and water shortages. An example of a policy initiative in this area is one directed at removing subsidies so

²⁹ For more information on the GLSLCI see <http://www.glslicities.org/index.html>. Accessed January 14, 2009.

that the cost of supplying and conveying Great Lakes water approaches its “true cost,” thereby discouraging waste. Water use is currently heavily subsidized in Great Lakes communities. Workshop participants identified the need to remove subsidies so that users are paying closer to the true cost for water. A U.S. EPA report highlights a number of case studies in which municipalities utilized conservation rate pricing as part of their water conservation efforts. Some of the cities include: Albuquerque, New Mexico; Ashland, Oregon; Cary, North Carolina; Gilbert, Arizona; Houston, Texas; and Irvine, California.³⁰

Implement the Water Resources Compact

One of the most obvious no regrets policies that decision makers could pursue is to ratify and implement the Great Lakes—St. Lawrence River Basin Water Resources Compact (Compact). The Compact is an opportunity for states to implement aggressive policies modeled after local programs that are successful (e.g. model building standards, conservation rate pricing).

After ratification, the next step is for participating jurisdictions to apply the Compact to implement water conservation measures. For example, under Compact §4.2, by December 8, 2010, each participating party must develop a “voluntary or mandatory” water conservation and efficiency program that implements goals and objectives consistent with the Compact’s own goals and objectives.

Also within that same time period, the parties must develop water conservation and efficiency efforts that:

- a. Measure and promote efficiency;
- b. Identify and share of best management practices and state of the art conservation and efficiency technologies;
- c. Apply sound planning principles;
- d. Implement demand-side and supply-side measures or incentives; and,
- e. Develop, transfer and apply of science and research.

By December 8, 2013, the Council established under the Compact must review and recalibrate Great Lakes basin-wide water conservation/efficiency goals and objectives.³¹ The clear intent with this provision of the Compact is to ensure that its goals and objectives reflect changes to the Great Lakes resulting from climate change and other dynamics. In short, this provision is a smart way to compel adaptive management of the basin’s water use practices.

Water conservation as economic recovery

One way to get funding for water conservation efforts is to urge Congress to include funding for water conservation/efficiency and green infrastructure projects in future economic recovery efforts. A report by the Alliance for the Great Lakes estimates that spending \$10 billion on

³⁰ http://www.epa.gov/WaterSense/docs/utilityconservation_508.pdf. Accessed January 14, 2009.

³¹ <http://www.ilga.gov/legislation/publicacts/95/PDF/095-0238.pdf>. Accessed January 14, 2009.

water conservation and efficiency could create more than 200,000 jobs and “lead to a more resilient national infrastructure, with the money used to retrofit buildings, reduce leakage and otherwise make more efficient use of the nation’s water.”³²

Policy area: Wetland protection and restoration

The significant role that wetlands play, in filtering runoff and controlling flooding, makes wetland restoration a tremendous opportunity for increasing ecosystem resiliency. Policies that provide economic incentives for protecting wetlands and restoring their ecological function will increase our capacity to deal with changing precipitation and runoff patterns. Of the issues that workshop participants identified as most critical to address, restoring wetlands will address nonpoint source pollution, combined sewer overflows, and flooding. Wetland restoration and protection will have a very high impact on increasing ecological resiliency in Great Lakes watersheds, however feasibility is dependent on ownership, and it is an effort that is limited in quantity. Workshop participants identified a number of ideas that could improve wetland restoration efforts.

Evaluation of wetland restoration programs

Existing wetland restoration policies and programs need to be adjusted to take into account the more frequent and intense rain storms that are predicted to come with climate change. Participants suggested an evaluation of existing wetland restoration programs to see what aspects of the programs are working to encourage and successfully restore wetlands and what parts could be improved. In other words, what are internal and external barriers to wetland restoration? What are the strengths and weaknesses of current wetland restoration programs?

Targeted restoration

Workshop participants identified the need for a mapping effort to target the application of where wetland restoration funds. In an effort to not diffuse efforts too widely, we should target highly sensitive areas, which are the places where restoration would most reduce flood peaks. This effort needs to consider scale (watershed, lakewide, basinwide), location (on Great Lakes shoreline, in Maumee watershed, private upland habitat) when determining areas to target.

Dam removal

Dam removal is often seen as a low hanging fruit when it comes to measures to adapt to climate change; it can be one of the most effective methods for restoring ecological resilience in a watershed. In areas where natural flood plains have not been converted to agricultural or urban lands, removal of a single dam can provide multiple benefits to a watershed. While not every dam can or should be removed, we should identify those where removal would provide the most benefit to the watershed in areas such as flood storage capacity, fish passage, natural

³² “Water Works: How Water Conservation Can Create Jobs & Leave Our Nation’s Waters Better for Future Generations,” <http://www.greatlakes.org/Document.Doc?id=504>. Accessed January 14, 2009.

flow regime restoration, habitat, human safety, and focus efforts on implementing dam removal programs. In addition, because of the sociopolitical concerns surrounding the removal of dams, implementing dam removal efforts are excellent opportunities for collaboration that can lead to improved coordination and relationships among watershed stakeholders. In Wisconsin, the Baraboo River Restoration project is an example of a successful collaborative effort to restore a river through dam removal.³³ Dam removal alone will not fully restore ecological resilience. There will still be need for active wetland restoration, reforestation, and other watershed management activities to restore and enhance ecological function post dam-removal. As such, dam removal must be supported by a comprehensive approach to watershed planning and management.

In areas where dam removal is not feasible, dam management can be used as a tool to adjust water regimes in response to climate change impacts. For example, dams may actually help in climate change adaptation by holding water in reservoirs during drought periods. Dam managers and utility managers can mete out water for use when needed. Similar to dam removal, however, this is not a simple solution to implement. To do so requires dam operators to consider a wide range of water uses both upstream and downstream, as well as sociopolitical factors related to those uses, when optimizing dam operation. Identifying and including stakeholders in the planning and management of dams is a time and resource intensive process, but is also a key opportunity to educate stakeholders about predicted climate change impacts and find common ground on adaptation strategies.

Floodplain management

Floodplain management allows communities to take corrective and preventative measures to reduce flood damage. Local governments can regulate how development occurs within floodplains through floodplain zoning and other land use planning techniques. When crafting these regulations, local governments commonly use federal flood maps. One way for the federal government to incorporate climate change into federal policies that would have a strong local impact is to revisit flood insurance programs, and to redefine the 100 year flood maps differently taking predicted climate change impacts into account.

On a state level, in 2003 the German state of Bavaria developed the “Action program 2020, flood control in Bavaria” after widespread floods in 1999 and 2002. Through 2020, the program will spend more than 2 billion Euros to reduce flood risks, with specific focus on natural flood retention. This includes sustainable development in floodplains, protecting and restoring rivers and streams, preserving or restoring the natural conditions of floodplains as inundation areas,

³³ For more information dam removal in the Baraboo River, see <http://www.dnr.state.wi.us/org/gmu/lowerwis/baraboo.htm>; For more information on the benefits and impacts of dam removal, see <http://www.americanrivers.org/site/DocServer/EcologyOfDamRemoval.pdf?docID=222>. Accessed January 14, 2009.

and mapping flood endangered areas to inform the public via internet about the risks of flooding.³⁴

Ideas that can be applied to all policy areas

Climate-proofing

Another idea to come out of the workshop is the concept of “climate-proofing.” Climate-proofing is the process of reviewing and revising a document, policy, system, process, program, or governance structure (or any combination of these) to ensure that climate change impacts are taken into account and that it provides the right incentives for behaviors that increase adaptive capacity and provides disincentives for activities that reduce it. This idea has the potential to address all of the water resource issues; policies and programs in any discipline can be climate-proofed.

One method for implementing climate-proofing would be to develop and apply standardized protocols, such as “climate change preparedness audits,” to evaluate how a selected document, policy, system or process (or set of these) explicitly or implicitly takes into account climate change impacts. The audit could result in a “Climate Change Preparedness Plan” or similar product that details a strategy for increasing adaptive capacity through local government regulations, policies, and initiatives. Of course, one protocol would not fit all climate-proofing efforts, given the multiple factors to consider when designing the audit. These factors include scale (e.g., local, watershed, state, basin, regional, federal), extent (a single regulation, plan, policy, program, or governance structure, or a suite of many of them), and coverage (is the review through the lens of a single important climate change adaptation theme, such as LID, or through a broader climate change lens that looks at many themes, such as wetlands, LID, and land protection.)

At the local level, climate-proofing could be applied in a number of ways. An example of an audit of a single local level policy is reviewing a city’s stormwater management regulations for new developments to identify to how they could be changed to allow and encourage on-site LID techniques. With more funds and commitment, this effort could be intensified to become a comprehensive audit of the entire body of city regulations, policies, and plans to identify ways in which the city can implement LID on a large scale. This is what happened in Olympia, Washington, where the City of Olympia undertook a comprehensive policy review process to identify ways to increase low impact development in the community. (See the example of Olympia, WA in the Low Impact Development section.)

Another method for climate-proofing at the local level could involve a citywide effort in which each department of the city government conducts a self-audit of ways in which they could

³⁴ For more information on the Bavarian flood program, see http://www.ecrr.org/pdf/3rd_conference_abstracts/02_binder.pdf. Accessed January 14, 2009.

incorporate preparing for climate change impacts into their policies, resulting in department specific plans, policies, and initiatives for adapting to climate change. This effort could be modeled after the City of Portland, Oregon’s initiative to fully integrate environmental sustainability throughout all city departments and policies. The City of Portland has had an Office of Sustainable Development since 2001. In 2006, the City adopted a resolution that formally created the Sustainable City Government Partnership. The goal of this partnership is “to foster a collaborative, citywide effort to integrate sustainable practices and resource efficiency into municipal operations. Based on employee and bureau-level innovation, the Partnership promotes the City’s sustainability goals and strengthens existing policies and efforts.” In addition to appointing a sustainability liaison from their bureau, the resolution required the directors of each city bureau to “adopt, implement and update a bureau specific sustainability plan and progress report.”³⁵

Climate-proofing on the state level may look quite different than at the local level, because the role of the state in increasing adaptive capacity will largely be to facilitate local adaptation. Therefore, climate-proofing on the state level should be focused on discovering and removing barriers to local adaptation activities, specifically within the fiscal setting (tax structure, subsidies, funding opportunities, etc.). Adapting to climate change will require a shift toward fiscal policies that discourage activities that reduce adaptive capacity, and provide incentives to those that promote ecosystem resiliency. Creating a fiscal environment that supports ecosystem resiliency will help communities in the Great Lakes basin address all of the issues that workshop participants identified as most critical to address. Thus, climate-proofing at the state level could be an evaluation of fiscal policies to see how the state fiscal environment encourages/discourages activities on the local and watershed scale that increase adaptive capacity.

Create a Portland of the Great Lakes

The City of Portland, Oregon is well-known for its progressive and innovative environmental policies, including climate change mitigation. Although the city does not explicitly address climate change adaptation in the same way that it addresses mitigation, many of the ideas discussed in this report, especially related to LID and green infrastructure, are already underway in Portland and will likely continue without an explicit link to climate change.

Portland is an excellent case study to consider when planning strategies for adapting to climate change at the local level in the Great Lakes basin.

The City of Portland’s efforts are coordinated through the Office of Sustainable Development and the Bureau of Environmental Services. Specific programs/plans to take note of within these departments include:

³⁵ For more information on the Sustainable City Government Partnership, see <http://www.portlandonline.com/osd/index.cfm?c=41482>. Accessed January 14, 2009.

- City of Portland Sustainable City Government Partnership³⁶
- Sustainable Stormwater Management in Portland³⁷
- Portland Watershed Management Plan³⁸
- Grey to Green Initiative³⁹

In addition, Portland is unique in that the city has formally integrated LID and green infrastructure into its Long Term Control Plan for Combined Sewer Overflows (CSOs) with U.S. EPA consent. If Great Lakes cities were to follow suit it would provide great incentives, financial and environmental, for the proliferation of LID and green infrastructure practices.⁴⁰

The Great Lakes needs its own version of Portland, a city to be the regional leader on implementing measures to address climate change impacts. Instead of using available funds to diffuse efforts across the basin, one city could be chosen as a pilot location where investment and attention could be focused on helping the city incorporate climate change into land use planning and stormwater management more directly by building in strategies and resiliency plans for specific, localized climate challenges. This city would be the role model for other Great Lakes communities and would demonstrate how the ideas discussed in this summary (specifically LID, land protection, climate-proofing, and continuing education for public servants and professionals) and future ideas can increase community preparedness for climate change impacts, or simply how it can make financial sense.

Collaborate with Canada

Developing basin-wide strategies to adapt to climate change impacts will require collaboration between and among US and Canadian decision makers, in order to share ideas and ensure that climate change policies and programs on both sides of the border are well-aligned. On the Canadian side of the Great Lakes basin, governments at all levels (federal, provincial, and local) have already begun to develop climate change adaptation strategies in the Great Lakes basin.

The Federal Department of Natural Resources led a project called Climate Change on the Great Lakes, from 2003-2005. The purpose of the project was to “identify coastal features and processes around the Great Lakes that are likely to be affected by climate change and to determine sustainable management practices that will reduce the vulnerability of these features and processes.”⁴¹ This project brought together partners from many disciplines and communities in a series of workshops organized around the geography of each of the Great

³⁶ <http://www.portlandonline.com/osd/index.cfm?c=41630>. Accessed January 14, 2009.

³⁷ <http://www.portlandonline.com/bes/index.cfm?c=34598>. Accessed January 14, 2009.

³⁸ <http://www.portlandonline.com/bes/index.cfm?c=38965>. Accessed January 14, 2009.

³⁹ <http://www.portlandonline.com/bes/index.cfm?c=47203>. Accessed January 14, 2009.

⁴⁰ <http://www.portlandonline.com/bes/index.cfm?c=31030>. Accessed January 14, 2009.

⁴¹ http://www.public-participation.ca/Climate_Change_001.htm. Accessed February 13, 2009.

Lakes. The final product was a report guiding adaptation options for the coastal zones of the Great Lakes.⁴²

At the provincial level, in 2007 the Ontario Ministry of the Environment established an “Expert Panel on Climate Change Adaptation” to recommend strategies for communities and ecosystems to adapt to climate change impacts. The panel consists of eleven leading scientists and environmental experts.⁴³ Panel members have contributed to workshops and conferences on adapting to climate change in cities across Ontario, including Toronto, Thunder Bay, and St. Catherine’s in 2008, and Ottawa in January 2009.⁴⁴ These events are coordinated by the Ontario Centre for Climate Impacts and Adaptation Resource (OCCIAR), to which the Ontario Ministry of the Environment committed \$220,000 in 2007. OCCIAR is a university-based resource hub for researchers and stakeholders that supports the work of the Expert Panel, liaises with partners across Canada to encourage adaptation to climate change, communicates the latest research on climate change and adaptation to Ontario stakeholders through workshops and educational materials, and develops tools, such as an Adaptation Kit for Municipalities, designed to “mainstream” climate change adaptation into government policies and the decision-making process.⁴⁵

At the local level, the city of Toronto is a leader in climate change mitigation and adaptation efforts, and municipalities throughout the Great Lakes Basin should look to their efforts for guidance in planning for climate change. The City of Toronto is unique among municipalities in explicitly recognizing that both mitigating climate change and preparing for climate change are necessary. In 2008 the Toronto City Council unanimously endorsed a report called *Ahead of the Storm: Preparing Toronto for Climate Change*.⁴⁶ This report was written by the Toronto Environment Office in collaboration with the City of Toronto Climate Adaptation Steering Group, and it provides a series of actions to improve Toronto’s resilience to climate change. The report is essentially a climate change adaptation strategy for the City of Toronto. Included in the report are “a series of short-term actions beginning in 2008 that will help prevent and/or minimize the impacts of climate change, and a series of actions that will guide the City’s development of a comprehensive, long-term strategy to adapt to climate change.” This report, along with background information on the city’s adaptation planning efforts, can be found on the City of Toronto’s Climate Change Adaptation website, which is located at <http://www.toronto.ca/teo/adaptation.htm>.

⁴² The Climate Change on the Great Lakes project website is located at http://www.public-participation.ca/Climate_Change_001.htm, and the final report can be found at http://adaptation.nrcan.gc.ca/projdb/pdf/85a_e.pdf. Accessed February 13, 2009.

⁴³ <http://www.ene.gov.on.ca/en/news/2007/121201mb.php>. Accessed February 13, 2009.

⁴⁴ <http://www.climateontario.ca/index.html>. Accessed February 13, 2009.

⁴⁵ <http://www.ene.gov.on.ca/en/news/2007/121201.pdf>. Accessed February 13, 2009.

⁴⁶ *Ahead of the Storm: Preparing Toronto for Climate Change*, can be accessed at http://www.toronto.ca/teo/pdf/ahead_of_the_storm.pdf. Accessed February 13, 2009.

Implementation Approaches

There are many ways to approach developing new policies and revising existing ones, as well as a range of scales for implementation. Participants in the workshop agreed generally that policies that enhance integrated watershed management efforts are likely to be the most effective way to adapt to the impacts of climate change. Integrated watershed management will restore ecosystem resiliency in the near term, and build adaptive capacity in the longer term. New and revised policies can help by removing regulatory and financial barriers to building and supporting watershed-scale capacity.

Implementation of those policies can be aided by support for problem-driven integrated assessment, facilitated by neutral parties that engage stakeholders in connecting formal and traditional knowledge with problem definition and analysis of solution options.

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Dave Naftzger	Council of Great Lakes Governors
Jon Narosz	University of Michigan - Flint
Sam Passmore	CS Mott Foundation
Barry Rabe	University of Michigan
Jen Read	University of Michigan
Milton Rohwer	Frey Foundation
Jill Ryan	Freshwater Future
Don Scavia	University of Michigan
Maureen Smyth	CS Mott Foundation
Melissa Soline	Great Lakes and St. Lawrence Cities Initiative
Derek Stack	Great Lakes United
Donna Stine	Michigan United Conservation Clubs
Mandy Valentine	The Kresge Foundation
Russ Van Herick	Great Lakes Protection Fund
Donn Waage	National Fish and Wildlife Foundation
Charley Wooley	US Fish and Wildlife Service