



Chapter II

Partnerships for Implementation

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Partnerships for Implementation

The Great Lakes Coastal Wetlands Consortium (Consortium) was formed in 2000 through funding from the U.S. Environmental Protection Agency (U.S. EPA), with the goal of producing a cohesive, long-term program to monitor Great Lakes coastal wetlands. Staff from the Great Lakes Commission served as coordinator and secretariat for the Consortium and more than 50 partners contributed to the development of the plan from the initial pilot studies through the drafting of the final monitoring protocols.

In 2002, initial stakeholder meetings were coordinated on both sides of the border to raise awareness of the Consortium's intention of developing a science-based, binational coastal wetland monitoring protocol for the Great Lakes. Presentations and discussion groups were used to begin partner engagement. Since the initial outreach, the Consortium has been a significant presence at the State of the Lakes Ecosystem Conferences (SOLEC), where representatives from a variety of agencies and organizations from around the basin meet to discuss Great Lakes issues and science. The biennial SOLEC conferences have offered a venue for presentation of Consortium protocol developments and results from pilot investigations. From the beginning, it has been clear that agencies and organizations wishing to adopt Consortium protocols would need assistance in implementing the monitoring plan and forming partnerships to optimize staff, funding and equipment resources.

The Consortium's Partnerships for Implementation Committee (PIC) was formed to aid interested agencies and organizations in implementing the protocols outlined in this document. The first task of the PIC was to identify various agencies and organizations that are currently conducting coastal wetland monitoring or other wetland monitoring programs. To do so, the committee utilized the Great Lakes Commission's 2006 report titled *Environmental Monitoring Inventory of the Great Lakes Basin*, which assessed gaps and overlaps in observing systems and monitoring programs throughout the basin. The gap analysis summarized monitoring efforts for 21 areas, highlighted potential gaps in monitoring coverage, and provided recommendations for improvement.

A second task of the PIC was to identify agencies and organizations that might benefit from adoption of the Consortium basinwide, standardized monitoring protocols and to analyze whether these entities would have the capacity to conduct this monitoring. This task was accomplished through discussion and through a telephone survey to collect information from agency and organization contacts. Survey questions addressed aspects of current or former coastal wetland monitoring activities, staff or volunteer expertise, available equipment, funding mechanisms, and protocol training requirements.

Finally, the PIC was assigned the responsibility of suggesting an implementation strategy to interested agencies, so the process of possibly adopting (or adapting) these protocols would be less daunting for organizations that already lack sufficient resources for existing tasks. The implementation strategy presented in this chapter is based on existing coastal wetland monitoring efforts in the Great Lakes basin and adaptive management strategies to make it more readily implementable. This chapter highlights the findings of the PIC.

The Need for Partnership

Over the last two decades, Great Lakes coastal wetlands have received increasing attention regarding the need for a system, and associated indicators, to effectively monitor coastal wetland quantity and quality, as well as loss and degradation. Although many institutions and organizations devote resources to monitoring and/or restoring specific Great Lakes coastal wetlands, no single organization has overarching, basinwide responsibility for collecting, interpreting and disseminating monitoring information for wetlands. Biological, chemical, physical and landscape information is highly fragmented across federal, state, provincial, tribal/First Nations and local agencies, organizations and governments. For example, encroachment by human development and by aggressive invasive plant

species has substantially transformed natural coastal wetlands, but the magnitude of these changes cannot be quantitatively assessed because of the lack of comprehensive data throughout the basin (Great Lakes Regional Collaboration, 2005). Data fragmentation severely compromises science-based water resources management decisions for the basin. In September 2004, the U.S. Government Accountability Office, a group charged with oversight of congressional decisions, responded by issuing a report entitled *Great Lakes: Organizational Leadership and Restoration Goals Need to be Better Defined for Monitoring Restoration Progress* (GAO-04-1024), which identified coordination of restoration and monitoring activities as a key challenge facing Great Lakes leaders.

Common protocols for the monitoring of Great Lakes ecosystem components have, prior to this effort, not been established between the U.S. and Canada or between the states and provinces. Consistency in monitoring protocols and coordination of activities will considerably enhance the quality of the information base for development and reporting of indicators. Indicators are the gauges that provide information on the state of the Great Lakes to citizens, resource managers and stakeholders. Indicators detail the conditions at a particular point in time, allow us to monitor changes over time, provide a basis for management decisions, and allow us to track the success of actions intended to restore the ecosystem. When appropriately formulated and implemented, indicators should be an integral part of the decision-making process regarding the Great Lakes system. Indicators build significantly on observing and monitoring programs by integrating the information produced by these programs with our understanding of the ecosystem to provide information regarding the past, current and future response of the system to stressors. When built upon a firm scientific basis, a comprehensive suite of indicators can help explain observed changes in the ecosystem and may lend some predictive ability regarding future changes (Great Lakes Regional Collaboration, 2005).

Partnerships among agencies will be imperative to ensure the success of implementing a Great Lakes coastal wetlands monitoring program and its associated indicators and monitoring protocols. Federal, state, provincial, tribal/First Nation and local governments, agencies and organizations are already responsible for satisfying various monitoring mandates. For example, the U.S. federal *Clean Water Act* requires that states and tribes monitor and report on the condition of all waters of the United States, including jurisdictional wetlands. Similarly, the Canadian *Clean Water Act* requires all provinces to report and measure actions taken to protect drinking water sources. Coordinated monitoring efforts are also essential to the success of binational efforts such as Lakewide Management Plans (LaMPs) and the Great Lakes Water Quality Agreement (GLWQA). The establishment and success of the Consortium is proof that partnerships already exist, and that multiple diverse agencies can work closely together to achieve the common goal of monitoring Great Lakes coastal wetlands.

Existing and Historical Great Lakes Coastal Wetland Monitoring

In 2006, the Great Lakes Commission developed a report based on its inventory of Great Lakes monitoring activities that assessed gaps and overlaps in observing systems and monitoring programs. The report included policy recommendations to address gaps and improve effectiveness of monitoring efforts (Great Lakes Commission, 2006). The gap analysis compared results from the monitoring inventory to monitoring needs identified through the SOLEC indicator process, and summarized monitoring efforts for 21 resource areas.

In order to identify current monitoring efforts, the PIC reviewed the gap analysis and found that the majority of sampling programs are conducted at the state/provincial level, followed by federal governments, local governments, universities, nongovernmental organizations and, finally, private organizations. Overall, wetland monitoring programs in general, and specifically coastal wetland monitoring programs, were severely lacking, even though both the United States and Canada have identified the need for wetland monitoring. Reviewing the gap analysis in conjunction with a review of U.S. and Canadian monitoring policies revealed a number of existing federal programs that would benefit and mandates that would be better met through the establishment of a consistent Great Lakes coastal wetland monitoring program. Consortium protocols would be an excellent jump start to such a program.

In the United States, land-use permit decisions are affected by both federal and state legislation and policy. The U.S. Army Corps of Engineers (Corps), under Section 404 of the Clean Water Act (U.S. CWA), has federal authority to issue permits for activities in wetlands. Most states utilize the Corps' authority in this regard, but a few states (e.g. Michigan) have adopted their own legislation for wetlands permitting and protection. Many water quality monitoring efforts are based on the requirements of the U.S. CWA. Wetlands are included as waters of the U.S. (40 CFR 122.2, 40 CFR 230.3, and 40 CFR 232.2, U.S. CWA Section 502(7)). However, these monitoring programs are often poorly and inconsistently funded or are improperly designed and carried out, making it difficult to collect a sufficient number of samples over time and space to identify changes in system condition, or to estimate average conditions with statistical rigor (U.S. EPA, 2002).

Existing water quality monitoring programs based on the requirements of the U.S. CWA, outlined below, would benefit from the addition of a wetland monitoring component:

- **Water Quality Standards: U.S. CWA Section 303**
States are required to establish water quality standards defining specific goals for all waters of the United States. States must identify each waterbody's designated uses (recreation, water supply, aquatic life, agriculture), develop criteria to protect those uses, develop anti-degradation policies, and address implementation issues (e.g., low flows, mixing zones). Wetlands are often assigned the same designated uses and criteria of adjacent rivers or lakes, which may be ecologically inappropriate. Water quality standards could be specifically tailored to coastal wetlands, providing a consistent basis for the development of policies and technical procedures for managing activities that impact wetlands (U.S. EPA, 2001).
- **Tracking and reporting conditions: U.S. CWA Section 305(b)**
Under U.S. CWA Section 305(b), states and tribes are required to report on the quality of all U.S. waters. States must determine if a waterbody satisfies the criteria associated with each of its designated uses. The reporting requirement also has the practical aspect of offering individuals and public officials an opportunity to better understand the implications of their decisionmaking on the condition of their state's water resources (U.S. EPA, 2001). The addition of wetland data to these reports may thus influence federal, state and local permitting and other policies.
- **Identifying impaired waters and total maximum daily load implementation plans: U.S. CWA Section 303(d)**
U.S. CWA Section 303(d) requires states and tribes to identify impaired waters and develop total maximum daily loads (TMDLs) for those waters. The addition of wetland monitoring to these monitoring programs would provide information on whether wetlands need to be added to or removed from the list of impaired waters. In addition, wetland monitoring would support the development of restoration plans for waters that do not meet TMDL standards, thus aiding in the recovery of impaired waters (U.S. EPA, 2001).
- **Influencing federal permits and licenses: U.S. CWA Section 401**
U.S. CWA Section 401 water quality certification gives states and tribes broad authority to certify, condition, or deny any federal permit or license that would violate the state's established water quality standards. Wetland monitoring would provide more information on the condition of water bodies that could be impacted by federal decisions, and would allow for better analysis of permit applications. (U.S. EPA, 2001).
- **Evaluating effectiveness of nonpoint source controls, restoration, and Best Management Practices: U.S. CWA Section 319**

Many federal, state, and local programs attempt to restore wetlands and require best management practices to reduce the amount and impact of nonpoint source pollution. Few programs evaluate the impact of these activities on the overall ecological condition of wetlands. Monitoring wetlands would allow evaluation of the effectiveness of restoration and best management practices designed to improve the condition of wetlands. (U.S. EPA, 2001).

Recognizing the need for guidance on implementation of wetland monitoring programs, the U.S. EPA released *Elements of a State Water Monitoring and Assessment Program for Wetlands* in April 2006. The report indicates that a state's progress in developing a comprehensive wetland monitoring program will serve many federal, state, and local program goals, including the need to:

- Establish a baseline of wetland condition and/or report changes in wetland condition;
- Evaluate the environmental consequences of a federal action or group of actions, including the effectiveness of compensatory wetland mitigation;
- Evaluate the performance of wetland restoration projects;
- Evaluate the cumulative effects of wetland loss and/or restoration, and develop watershed plans for the recovery of impaired water bodies that are listed pursuant to U.S. CWA Section 303(d); and
- Refine or create wetland-specific water quality standards pursuant to U.S. CWA Section 303, including identification of appropriate reference conditions.

To accomplish these goals, the U.S. EPA recommends that states use a three-tiered approach to wetland monitoring. Level 1 involves assessing landscapes and watersheds using remote sensing to create a broad view of wetland condition. Level 2 involves creation of a Rapid Assessment Method (RAM) which uses simple field indicators to analyze the general condition of individual wetlands. Level 3 is based on intensive site investigations, and typically includes using Indices of Biological Integrity (IBI) or conducting a hydrogeomorphic function analysis. This final level is meant to evaluate the success of wetland restoration, or to provide a more detailed assessment of wetland condition for other purposes.

Since the release of the U.S. EPA's guidelines, a number of states have developed monitoring plans utilizing the three-tiered system. In order to comply with U.S. CWA guidelines, all states will eventually need to establish a long-term wetlands monitoring program. The Great Lakes states are all in various stages of developing and implementing monitoring strategies. Because Consortium protocols would fit into the level 3 analysis suggested by U.S. EPA, it is likely the protocols could be relatively easily incorporated into most states' strategies.

In Canada, land-use decisions are affected by both federal and provincial legislation and policy. However, while both the federal and provincial governments have wetland policies, neither has legislation specifically directed to the protection of wetlands. Ontario's wetland policy must be regarded by local governments through the *Provincial Planning Act*. The Canadian federal government delivers on its commitment to Great Lakes protection through domestic policies and legislation as well as through partnerships formed primarily with binational programs and local organizations.

For example, Environment Canada (EC) has taken a role as the lead federal agency participating in the Lakewide Management Plan (LaMP) process. The agency also coordinates provincial and local governments and stakeholders to meet Canada's commitments to ecosystem goals and in the monitoring of progress to achieve those goals. Partnerships are key to the success of the LaMP program. As such, EC has formed relationships with partners such as the Department of Fisheries and Oceans (DFO), which collects information on fish population and fish toxicity, the Ontario Ministry of the Environment (OMOE), which collects water quality, clarity and nutrient input information for the Great Lakes and tributaries, and the local Conservation Authorities (watershed management agencies), which collect information on local watershed natural resources. Coastal wetland monitoring contributes to the LaMP

biennial reporting requirement, but LaMP priorities have previously focused more on protection and rehabilitation of wetland habitats than monitoring wetlands. Monitoring coastal wetlands would allow LaMP partners to begin to assess the biological and ecological outcomes of protection and rehabilitation efforts and to evaluate the role of such actions in improving the overall health of wetland ecosystems.

The Canadian federal government is also involved with monitoring programs through its commitment to the GLWQA. The GLWQA is implemented and expanded upon through the *Canada-Ontario Agreement: Respecting the Great Lakes Basin Ecosystem*, which obligates the provincial and federal governments to coordinate resources and work with stakeholders to protect water quality and the health of the Great Lakes ecosystem. The Canada-Ontario Agreement also calls for studies assessing the potential impacts of climate change on the Great Lakes and protection of the Great Lakes as a source of drinking water. Some researchers believe that climate change may cause significant drops in Great Lakes water levels. Since water level cycles are a major driver affecting coastal wetland function, persistent low water levels could have impacts on the diversity of current wetland plant and wildlife communities (Mortsch et al., 2006). At the same time, if water levels continue to drop, the role wetlands play in recharging aquifers, filtering pollutants, and trapping sediments will be even more important to the protection of the water supply for millions of people. The linkage between wetland functions and emerging global environmental impacts and trends further supports the need for a long-term coastal wetland monitoring program.

Wetland monitoring in Canada is also accomplished through other reporting methods established for specific conservation targets. For example, the *Migratory Birds Convention Act* of 1994 aims to protect migratory birds and their habitats. Many of these birds utilize and depend on healthy wetland habitats for components of their lifecycles. Thus, bird monitoring activities can contribute to assessments of wetland habitat. Adaptation of Consortium protocols would improve both bird and wetland monitoring in an efficient manner. Without wetland-specific drivers, wetland monitoring programs in Canada have historically been implemented as a series of localized, short-term efforts, geared at answering specific research questions. This does not provide for a broader ecosystem picture of the status of, or processes within the Great Lakes environment. A commitment by local agencies to use Consortium protocols for meeting specific targets would vastly increase the amount of reliable data available to satisfy legislative mandates such as those outlined in the *Migratory Bird Convention Act*.

As part of GLWQA commitments, both the Canada and the United States have committed to developing Remedial Action Plans (RAP) for restoring Areas of Concern (AOC), the most degraded waterways in the Great Lakes basin. The restoration and rehabilitation of wetlands have been identified within RAPs as crucial to the restoration of beneficial uses in AOCs. Wetland monitoring in the AOCs has been predominantly priority-based and is indirectly implemented through consolidating and assessing related datasets. Coastal wetland monitoring is essential in AOCs to determine RAP success, and the program would greatly benefit from utilization of Consortium protocols.

Based on the PIC's review of existing monitoring efforts, it appears that both the United States and Canada have a variety of programs that could adapt or adopt Consortium protocols, thus helping to satisfy the needs of the programs described above. Coastal wetlands monitoring may be separated into three types of indicators: biological, physical and chemical, and landscape indicators.

Biological Indicators

Currently, a number of programs monitor the biological characteristics of coastal wetlands in the Great Lakes basin. Some programs, such as the *Durham Region Coastal Wetland Monitoring* (Durham project) in Ontario and the *Critical Trends Assessment Program* in Illinois, are tracking several biological indicators for a small group of wetlands. Other programs, such as Ohio's *Wetland Bioassessment Program*, are more inclusive and seek to develop measures and assess the health and integrity of wetlands across several biological indicators. Ohio's program specifically uses IBIs for plant, invertebrate, fish and amphibian communities, which are similar to those methods specified in the SOLEC

Coastal Wetland Plant Community Health, Coastal Wetland Invertebrate Community Health, Coastal Wetland Fish Community Health, and Coastal Wetland Amphibian Diversity and Abundance indicators (SOLEC indicator numbers 4862, 4501, 4502, 4504, and 4862, respectively).

In Canada, the Durham project was established to assess coastal wetland biological communities and habitat in AOCs. The project is a partnership between the Central Lake Ontario Conservation Authority and Environment Canada – Canadian Wildlife Service (EC-CWS). The project was initiated to organize and consolidate regional indicators of coastal wetland health and to field-test monitoring protocols, which were developed for the goal of establishing a regional monitoring program on Lake Ontario. A number of IBIs were developed for this program in order to incorporate an assessment of biological community indicators, such as submerged aquatic vegetation, aquatic macroinvertebrates, fish, amphibians and breeding birds. Use of the IBIs allows the EC-CWS to conduct an assessment of coastal wetland ecosystem health in the Durham Region (Environment Canada and the Central Lake Ontario Conservation Authority, 2004a, and 2004b). Implementation of the program requires a partnership approach, where science and implementation committees are created to assist program implementation on a local level. The Durham project was developed in support of the Consortium and is intended to be a prototype framework for the long-term, binational monitoring program in the Great Lakes basin. The Durham project framework for coastal wetland monitoring has been adopted in other regions of the Great Lakes basin in Canada, and use of these protocols is likely to aid in the delisting of a number of AOCs.

Basinwide biological data sets for Great Lakes coastal wetlands appear to be limited to data collected by the *Marsh Monitoring Program* (MMP), which was developed by the EC-CWS and Bird Studies Canada (BSC). This program is a binational, basinwide, long-term monitoring program that coordinates the skills and interests of hundreds of citizens across the Great Lakes basin to help understand, monitor and conserve the basin's wetlands and their anuran and bird inhabitants (SOLEC indicator #4507). The MMP was initiated in 1994, and has been developed and expanded through the additional support of the U.S. EPA and the Great Lakes Protection Fund. The MMP protocols have contributed to the binational assessment of Great Lakes AOCs (Timmermans et al. 2004; Archer et al. 2006) and are currently incorporated into the Consortium monitoring plan. Over ten years of data have been collected through the MMP. These data are being used to support and help guide the management and remediation of marshes in Ontario and the Great Lakes (e.g., see Timmermans and McCracken, 2004). Several U.S. programs, such as the *Michigan Frog and Toad Survey* and *Frogwatch U.S.A* use methods similar to those used for the MMP for surveying amphibians.

Data collection for other types of biological indicators is not being conducted consistently across the basin. The Consortium protocols outlined in other chapters of this document offer a solution to address this gap.

Physical and Chemical Process Indicators

Few programs are currently using chemical and physical indicators such as nutrient loads, sedimentation, and existence of contaminants in the assessment of wetland health and integrity. Several short-term studies have examined the effects of nutrients and sediments on wetlands, and the Durham project includes assessment of water quality, sediment quality and watershed land use. However, a program to systematically track nutrient or sediment loads to coastal wetlands does not exist. Local sediment and chemical conditions in streams are frequently monitored but these programs rarely, if ever, extend to wetlands. Nutrient concentrations such as phosphorus and nitrogen levels (SOLEC indicator #4860) and sediment flowing into coastal wetlands (SOLEC indicator #4516) change rapidly over time, which could be one reason why programs do not exist to consistently track these indicators.

Many gaps exist in monitoring of physical parameters of Great Lakes coastal wetlands as well. Great Lakes water levels are monitored with lake level gauges maintained by the National Oceanic and Atmospheric Administration (NOAA) in the United States and Canada's DFO, but there are currently no programs addressing the effects of water level fluctuation on coastal wetlands (SOLEC indicator #4861). Similarly, contaminants are infrequently monitored.

The EC-CWS administers a program to study contaminants in snapping turtle eggs (SOLEC indicator #4506), which focuses primarily on Canadian and binational AOCs. There is no comparable U.S. program.

Landscape Indicators

Several SOLEC indicators cover large-scale ecosystem monitoring, which are efforts typically conducted using remote sensing tools such as satellite or aerial imagery and interpretation. Currently, an inventory effort to track changes over time does not exist. The Ontario Ministry of Natural Resources (OMNR) has recently developed a detailed land cover map for southern Ontario which will be useful in providing a landscape context to coastal wetlands. Land use changes are tracked as part of NOAA's *Coastal Change Analysis Program*, but wetland classification at this coarse scale can include only four types. The program revisits the Great Lakes every five years and tracks coarse-scale wetland area and land cover adjacent to coastal wetlands (SOLEC indicator #4863). Fine-scale land cover and land use maps are also generated by each of the Great Lakes states and provinces, while the U.S. Geological Survey (USGS) maintains the *National Land Cover Dataset* at a coarse scale for the entire U.S. These map products can be used to assess land use change adjacent to wetlands.

One of the most critical indicators for wetland management is the measure of coastal wetland area extent by type (SOLEC indicator #4510). Several ongoing efforts to map wetland areas exist throughout the Great Lakes basin. The U.S. Fish and Wildlife Service (U.S. FWS) operates the *National Wetlands Inventory* project, which delineates wetland polygons from aerial photographs for all U.S. wetlands (coastal and inland), except those in the state of Wisconsin, which has developed its own classification scheme. Several other states, including Ohio and Michigan, have developed additional inventories to supplement *National Wetlands Inventory* maps. In Canada, the OMNR developed the *Ontario Great Lakes Coastal Wetland Atlas*, a consolidation of all field evaluated wetlands inventories that have delineated wetland extent using similar methods, but with a different classification scheme from the U.S. inventories. In order to eliminate confusion for those who adopt Consortium protocols, the Consortium compiled all coastal wetlands inventories into a unified *Great Lakes Coastal Wetland Inventory* (see the Landscape-Based Indicators chapter of this document) with a single wetland classification system.

Framework for Implementation

As emphasized above, implementation of Consortium protocols will require ongoing partnerships among many agencies in order to successfully result in a basinwide data set. The PIC attempted to identify agencies that would be candidates for adopting all or some of the Consortium-recommended monitoring protocols for various portions of the Great Lakes basin.

U.S. Framework for Implementation

Federal Partners

The following U.S. federal agencies already have developed programs that could be modified to include certain Consortium protocols. Although it is not expected that any one of these agencies could take full responsibility for implementing this monitoring strategy, each entity has responsibilities and programs that would benefit from the adoption of the protocols, and/or each has the ability to serve as a useful partner to those that choose to implement them.

- *U.S. Fish and Wildlife Service (U.S. FWS)*
The U.S. FWS is responsible for coordinating the compilation of wetland status and trends reports on a biennial basis. The agency is also responsible for developing and updating the National Wetlands Inventory.

- *U.S. Army Corps of Engineers (U.S. ACE)*
 The U.S. ACE provides technical and engineering support to the International Joint Commission, a binational organization established to advise the U.S. and Canada on the use and quality of Great Lakes waters. This support is particularly important for matters dealing with lake level regulation and impact assessments of proposed projects seeking permits. The agency also administers various programs that support state and local habitat restoration and protection projects. These activities frequently require monitoring, and could lend themselves to use of Consortium protocols. Finally, the U.S. ACE administers Section 404 of the U.S. CWA which provides authority for permitting changes within coastal zones adjacent to navigable waterways, including protection of wetland resources.
- *U.S. Environmental Protection Agency (U.S. EPA)*
 The U.S. EPA is the major federal agency supporting the GLWQA and the agency also manages development, implementation and reporting of SOLEC indicators and LaMPs. The agency also manages cleanup and restoration efforts within the 30 U.S. AOCs, including monitoring the progress of restored beneficial uses.
- *National Oceanic and Atmospheric Administration (NOAA)*
 NOAA's National Estuary Restoration Program and Coastal Zone Management Program provide funding for the purchase of ecologically important coastal properties. Both programs have distinct requirements for coastal wetlands landscape monitoring and could likely partner with agencies that adopt Consortium protocols.
- *U.S. National Park Service (U.S. NPS)*
 The U.S. NPS monitors wetlands within park boundaries both adjacent to and within the Great Lakes watershed. Some parks may have wetlands that could be monitored using Consortium protocols. If the agency chooses to implement this plan, it could provide great incentive to other property owners such as states and local governments, to monitor their coastal parks as well.
- *U.S. Natural Resources Conservation Service (NRCS)*
 NRCS conducts soil surveys and conservation needs assessments. This agency also maintains the National Resources Inventory to provide a basis for resource conservation planning activities, and to provide an assessment of the condition of private lands. NRCS programs designed to restore or enhance wetlands, such as the Wetland Reserve Program, have resulted in reduced wetland losses across the country.
- *U.S. Geological Survey (USGS)*
 The USGS Great Lakes Science Center is heavily involved in research on coastal ecology and processes. Currently the center is sponsoring research on the effects of low water levels on coastal wetlands and the effects of global climate change on dune and swale complexes. The USGS also has operational requirements for assessing hydrologic characteristics of streams, rivers and near shore waters of the Great Lakes. The agency also participates in conducting specialized research investigations on groundwater, overland flow, bacterial contamination of beaches and other water quality conditions. It is possible that scientists with USGS funding could implement Consortium protocols as a substitution for or along with their own methods for assessing biological indicators, thus allowing information to be collected for their own projects and for the benefit of anyone interested in Consortium data.

State Partners

In order to determine the capacities of each Great Lakes state for coastal wetlands monitoring, the PIC conducted telephone surveys with each state agency that would be most likely to conduct monitoring projects. Tables 10-1 and

10-2 summarize the responses to the survey, and identify wetland monitoring efforts for each state. Agencies queried for the survey were based on Great Lakes Commission contacts and the initial expressions of interest state agencies made during the formative stage of the Consortium. It should be noted that the PIC did not survey every state agency that may participate in wetland monitoring, but only those that would be expected to take a lead role in a coastal wetland monitoring effort. It is likely that the lead agency in each state would work with other state agencies and a number of partners, including the federal agencies listed above, nonprofit organizations, colleges and universities, local governments, and other state agencies to carry out the Consortium monitoring protocols efficiently.

The agencies identified in Table 10-1 all appear to have the ability to conduct a long-term monitoring program, though some agencies may be more likely to implement this plan since adopting Consortium protocols would coincide with their current monitoring mandates. Although availability of staff and equipment are limiting factors, it appears that each state has effective resources to conduct at least a portion of the recommended monitoring protocols. Table 10-2 displays information regarding each Great Lakes state's current staffing and equipment availability, as well as a description of the types of training that will likely be necessary.

Gaps in staff and equipment capacities could likely be addressed through coordination with other agencies. For example, the Land and Water Management Division of the Michigan Department of Environmental Quality, which is the wetlands regulatory agency for the state, does not possess fyke nets or macroinvertebrate survey equipment. However, representatives from the agency indicated that they could work with the Michigan Department of Natural Resources Fisheries Division to coordinate monitoring efforts and share equipment. Other survey participants also indicated that a good working relationship exists among natural resource agencies in their state. Coordination among these groups will allow easier implementation of the Consortium protocols. Even so, some initial funds to purchase equipment may be needed for implementation of these protocols. This funding could include contributions from a combination of federal and state sources with perhaps some contributions from other funding entities such as state trust funds and foundations.

Table 11-1. Results from Consortium Phone Survey: Current Agency Monitoring Efforts and Partnerships.

State	Agency	Coastal Monitoring Description	Other Wetland Monitoring	Partners
Illinois	Illinois Natural History Survey	The Critical Trends Assessment Program (CTAP) has monitored some coastal areas as part of the program's random sampling protocol	CTAP monitors wetland condition throughout the state on public and private land.	The Nature Conservancy, University of Illinois, Illinois Department of Natural Resources
Indiana	Indiana Department of Environmental Management	Currently no monitoring based on coastal wetlands alone.	Environmental Protection Agency (EPA) based monitoring strategy has been developed; on the ground monitoring has not yet begun. National Wetland Inventory (NWI) maps are being updated.	Indiana University; Ducks Unlimited
Michigan	Michigan Department of Environmental Quality (MDEQ), Land and Water Management Division	Currently no monitoring based on coastal wetlands alone.	Currently field testing Michigan Rapid Assessment Method (RAM), and planning to use indices of biological integrity (IBIs) in coastal and inland wetlands as part of a three tiered monitoring plan. NWI Maps are being updated.	Michigan Department of Natural Resources (MDNR); MDEQ Water Bureau; Ducks Unlimited
Minnesota	Minnesota Department of Natural Resources; Minnesota Pollution Control Agency	Some plots of the state's random sampling protocol fall in coastal areas, but currently no monitoring based on coastal wetlands alone.	Random wetland sampling using IBIs and Minnesota RAM	Other state agencies
New York	New York Department of Environmental Conservation (DEC), Division of Fish, Wildlife and Marine Resources	Currently no monitoring based on coastal wetlands alone.	Currently no wetland monitoring program has been developed. The states has been surveying streams for 20 to 30 years.	DEC Freshwater Wetlands Regulatory Program

State	Agency	Coastal Monitoring Description	Other Wetland Monitoring	Partners
Ohio	Ohio EPA	Near shore fish and macroinvertebrate IBIs used in coastal areas, some plots of the state's random sampling protocol fall in coastal areas.	Ohio RAM used to sample throughout the state,	Midwest Biodiversity Institute, Kenyon College, Ohio State University
Pennsylvania	Pennsylvania Department of Environmental Protection (PDEP), Pennsylvania Game Commission	Gannon University has been monitoring chemistry and habitat at Presque Isle for 20 years. PDEP has monitored coastal wetlands in the past as part of its three tiered random sampling monitoring plan	Random sampling of inland and coastal wetlands is conducted. Currently using NWI to develop detailed functional assessments of random wetlands	Pennsylvania Fish and Boat Commission, Pennsylvania Department of Conservation
Wisconsin	Wisconsin Department of Natural Resources	Working with Ontario to conduct a Marsh Monitoring program, which focuses on birds and amphibians.	Currently involved in a number of grant funded monitoring projects focusing on specific locations. The state has developed a wetland monitoring strategy and a Wisconsin RAM	Ontario Marsh Monitoring, University of Wisconsin, Northland College, Great Lakes Indian Fish and Wildlife Commission

Table 11-2. Results from Consortium Phone Survey – State agency staffing and available equipment for each Consortium indicator and anticipated training needs.

State	Macroinvertebrates		Fish		Plants		Birds and Amphibians		Landscape features		Training needs
	staff	equipment	staff	equipment	staff	equipment	staff	equipment	staff	equipment	
Illinois	In house expertise	Accessible	In house expertise	Accessible	In house expertise	Accessible	In house expertise	Accessible	In house expertise	ArcMap	Limited training on specific protocols may be needed
Indiana	In house expertise	Accessible	In house expertise for stream fish	No current access to fyke nets	In house expertise	Accessible	No staff currently available	bird and frog song CDs	In house expertise	ArcInfo	If new staff are hired, extensive training would be needed.
Michigan	Expertise available within other divisions	Accessible through other divisions	Expertise available within other divisions	Accessible through MDNR	In house expertise	Accessible	No staff currently available	Accessible	In house expertise	ArcView 3	Training on birds and amphibians would be needed as well as general training on use of specific protocols
Minnesota	In house expertise	Accessible	In house expertise	Accessible	In house expertise	Accessible	In house expertise	Accessible	In house expertise	ArcMap, ESRI	Depends on abilities of new hires.
New York	In house expertise	Accessible	No staff currently available	No current access to equipment	No staff currently available	Accessible	In house expertise	Accessible	In house expertise, limited by funding	ArcView 9.2	Depends on abilities of new hires.

State	Macroinvertebrates		Fish		Plants		Birds and Amphibians		Landscape features		Training needs
	staff	equipment	staff	equipment	staff	equipment	staff	equipment	staff	equipment	
Ohio	In house expertise	Accessible	In house expertise	No current access to fyke nets	In house expertise	Accessible	In house expertise	CD player with speakers	In house expertise	Arc View 9.2	New staff would need extensive training. Existing staff would need limited training on protocols
Pennsylvania	Expertise available within other state agencies	Accessible	Expertise available within other state agencies	Accessible	In house expertise	Accessible	No staff currently available	Accessible	In house expertise	Arc 1 and 2	Some training may be needed, but contractors would likely be hired to collect data.
Wisconsin	Collection: In house expertise. Identification: outside lab	Accessible	In house expertise	Accessible	In house expertise	Accessible	In house expertise	Accessible	In house expertise	Arc 9.2 and Erdas Imagine	Staff would need training on using specific protocols

Tribal Partners

Tribal governments were not included among the survey participants. It is expected that tribes, like the states, are in various points in the development of monitoring strategies. At this time, no tribe is known to have a fully developed wetland monitoring program. However, several tribes throughout the basin may have the ability to implement Consortium protocols. Many tribes are interested in the condition of coastal and other wetlands that support wild rice or specific wildlife such as turtles. Monitoring of these interests could be accomplished, in part, by tribal implementation of the protocols. Tribes could also consider becoming a part of existing monitoring programs, such as the MMP, in order to begin implementation of a coastal wetlands monitoring program. Again, coordination and funding will be the most important aspects of the tribes' abilities to participate.

Local Partners

Local partners in the U.S. include various universities, colleges, nonprofit organizations, local governments and conservation groups. Thousands of these groups exist throughout the Great Lakes basin, thus the PIC did not evaluate each to determine their potential for participation in Consortium monitoring strategy. However, groups such as the Nature Conservancy and Ducks Unlimited have a vested interest in maintaining wetland functions and many universities have academic and research programs that focus on coastal ecology. These organizations could further their goals of promoting a strong, viable coastal ecology in the region by implementing all or a portion of Consortium protocols. In addition, these groups may be able to use this methodology to answer specific research questions pertaining to coastal wetlands. Although cost and properly trained staff will be a limiting factor for local governments, it may be possible for interested municipalities to partner with each other or with various nongovernmental organizations to implement Consortium protocols for the purpose of assessing the health of important wetland resources in their communities.

Canadian Framework for Implementation

Federal Partners

Canada may choose to follow a previously established framework for implementation of Consortium protocols. The Great Lakes Wetlands Conservation Action Plan (GLWCAP) is an effort that has been highly successful at forging partnerships among government and nongovernmental interest groups with the goal of preventing further losses of wetlands in the Great Lakes basin. Through the GLWCAP, wetland conservation and monitoring activities are coordinated and priorities focused so that entities with limited resources and capacity can operate in a more efficient and effective manner. The GLWCAP provides the opportunity for government and interest groups to develop tools for use in wetland conservation and monitoring. Through this partnership these organizations have the means to promote the use and broader applicability of such tools throughout the Great Lakes basin. The GLWCAP has well-developed partnerships among wetland experts which will be extremely helpful in the implementation of Consortium protocols.

The following federal agencies are valuable potential partners of the Consortium due to their extensive expertise and relevant mandates:

Environment Canada – Canadian Wildlife Service (EC-CWS)

EC-CWS is mandated to protect migratory birds and their habitats (Migratory Birds Act (1994)), and to identify critical habitat on federal lands for species considered "at risk" according to the Committee on the Status of Endangered Species in Canada, and implement plans for their recovery, in accordance to the Species at Risk Act (2002). The EC-CWS has the wetland ecology expertise, excellent GIS capacity and most equipment necessary to carry out Consortium monitoring protocols in designated National Wildlife Areas that contain coastal wetlands.

A number of other federal monitoring programs have linkages to coastal wetland health and may have potential for future integration with a coastal wetland monitoring program:

- **Ecological Monitoring and Assessment Network (EMAN)**
 EMAN coordinates organizations and individuals involved in ecological monitoring, especially those who actively conduct long-term monitoring. EMAN also fosters collaboration to improve the effectiveness of ecosystem monitoring and to better detect, describe and report on ecosystem changes. EMAN works to coordinate efforts through use of standardized protocols in study design, sampling procedures, data analyses and reporting, and provides a database for community-based monitoring groups to share information and collection protocols. This system is an excellent example of the types of partnerships that could be used in GLCWC monitoring plan implementation.
- **Water Survey of Canada**
 This national hydrometric program provides real-time, long-term, surface water quantity data and information, including information about the Great Lakes and its tributaries. Wetland diversity and function is directly related to natural water level fluctuations, with coastal wetlands influenced by both lake levels and stream flow or discharge.
- **National Wildlife Toxicity Program (NWTP)**
 The National Wildlife Toxicity Program aims to establish cause-effect relationships between toxic substances in the environment and wildlife. Monitoring and evaluation studies occur throughout the Great Lakes basin and sites often include coastal wetlands. Integrating monitoring sites between the Consortium monitoring program and the NWTP could provide opportunities for resource and knowledge sharing.
- **Parks Canada Agency (PCA)**
 Parks Canada Agency is mandated to monitor and report on the ecological integrity of national parks in fulfillment of its responsibilities to the Canada National Parks Act (2001) (Zorn et al. 2006). Ecological integrity is determined through analysis of various indicators, one of which is a wetland ecosystem indicator. Among seven “measures” constituting the wetland ecosystem indicator, PCA selected the Bird Studies Canada (BSC) MMP/Consortium marsh bird and anuran monitoring protocols due to their potential value to inform wetland ecological integrity. BSC partnered with PCA in 2007 to oversee aspects of preparation for MMP/Consortium protocol application among each of PCA’s five Great Lakes bioregion parks. Most of these parks contain varying amounts of coastal wetland habitat, especially Point Pelee National Park and St. Lawrence Islands National Park. Therefore, MMP/Consortium marsh bird and anuran monitoring protocols will be utilized at several of these wetland sites. Additionally, following its methodology selection process, PCA selected the Consortium aquatic vegetation sampling protocol (Zorn et al. 2006). Consequently, PCA is a potential partner to contribute marsh bird, anuran and wetland vegetation monitoring and assessment data to the Consortium data management system.
- **Department of Fisheries and Oceans(DFO)**
 The DFO is responsible, in part, for ensuring the existence of healthy and productive aquatic ecosystems within Canada’s marine and freshwater environments. As an agency engaged in LaMPs, the DFO is committed to research, conserve and protect Great Lakes aquatic habitats and the aquatic species that depend on them. As such, the DFO has engaged in several fish and habitat-related research initiatives on the Great Lakes, some of which encompass coastal wetland habitats. The DFO could greatly benefit from being engaged as a partner of the Consortium to incorporate recommended fish monitoring protocols as part of sampling studies conducted within coastal wetland habitats.

Provincial Partners

The entire length of the Canadian shoreline of the Great Lakes lies within the province of Ontario. Thus, provincial programs and partnerships will be essential to successful implementation of the Consortium monitoring plan. The following agencies have programs and mandates that may benefit from adoption of Consortium protocols.

- Ontario Ministry of the Environment(OMOE)
The OMOE monitors and assesses water quality on the Great Lakes as a partner of the LaMPs to deliver on the COA and the GLWQA. OMOE also coordinates water quality and quantity information for inland lakes and streams, including two, long-term, volunteer-based monitoring programs that may be of interest to a coastal wetland monitoring program. One is the Lake Partner Program, where citizens collect information about water clarity and nutrient inputs. A second is the Provincial Groundwater Monitoring Network, which, in partnership with all Conservation Authorities and several municipalities, collects and manages ambient groundwater level and quality information of key aquifers located across Southern Ontario, including the lower Great Lakes. Both of these programs provide key information toward building better hydrologic models for the Great Lakes and are very useful to monitor how lake hydrologic inputs are influenced by land use and water use to identify trends and emerging issues.
- Ontario Ministry of Natural Resources(OMNR)
OMNR's primary objective is to protect and manage Ontario's natural resources, including several coastal wetland habitats. In particular, the OMNR Lake Erie Management Unit (LEMU) has been actively involved in wetland monitoring. Beginning in 2007, the OMNR is engaging in a three-year, multi-component ecological assessment study of Long Point Bay. This study will include fish community assessments, water quality monitoring, macroinvertebrate surveys, marsh bird and amphibian monitoring, and aquatic vegetation surveys, among other assessments. Preliminary discussions between BSC, EC-CWS and OMNR-LEMU staff have indicated that MMP/Consortium protocols will likely be utilized to meet marsh bird and anuran monitoring objectives. OMNR-LEMU will be utilizing the Consortium aquatic macroinvertebrate and, possibly, fish survey protocols. OMNR will continue their role as a willing and enthusiastic partner of the Consortium by submitting data generated through use of any Consortium-recommended protocols that they have adopted for their own purposes. The OMNR has also been involved in a number of remote wetland mapping initiatives. Their research and development expertise in these technologies will be an asset to the monitoring of landscape indicators.

First Nation Partners

The First Nations have a close connection with the environment and a vested interest in the management and conservation of the Great Lakes resource. There are at least 20 First Nations communities along the Great Lakes shoreline that have been identified as containing coastal wetland habitat. Many First Nations communities have contributed to or implemented a number of natural resource programs and ecosystem management plans to protect and restore coastal wetlands. Building partnerships with First Nation peoples and communities in the science and monitoring of coastal wetlands and finding ways to link traditional knowledge and values with current environmental challenges will continue to be an important part of partner engagement for wetland conservation decision making.

Nongovernmental Partners

In Canada, wetland monitoring programs have historically been implemented as a series of localized, specific and short-term efforts. Although these programs have been effective in meeting priority needs, differing scientific questions and protocols among constituent program members limits coastal wetland data integration.

Bird Studies Canada (BSC)

BSC's MMP marsh bird and amphibian monitoring protocols have been adopted by the GLCWC for use to provide long-term marsh bird and anuran monitoring. BSC is well positioned to provide much data in this regard through use

of its extensive volunteer monitoring network. Queries of the MMP database will identify those monitoring routes which occur at coastal marsh-type wetlands, and resulting data will be submitted through the appropriate channels. BSC staff periodically conduct coastal wetland assessments as part of various special projects, which may include: MMP marsh bird and amphibian surveys, and associated habitat characterizations; physical/chemical water quality measurements; aquatic macroinvertebrate community assemblage assessments; landscape feature/land use descriptions; and fish surveys. As such, BSC staff have expertise and access to various equipment required to conduct these activities.

Conservation Authorities

Conservation Authorities (CA) are generally the best equipped local organizations to implement Consortium coastal wetland monitoring protocols. CAs are local watershed management agencies that deliver services and programs that protect and manage water and other natural resources in partnership with government, landowners and other organizations. Many CAs are mandated to monitor and assess ecological condition and integrity within their watersheds. These mandates are often related to CA responsibilities to oversee watershed-level protection of constituent municipalities' drinking water sources, as required by the Government of Ontario's *Clean Water Act* (2006). Since many CA jurisdictions include coastal areas or their major interconnecting waterways, several already engage in coastal wetland monitoring or assessment activities for various parameters and in various intensities. In many cases, these coastal wetland sampling activities are components of larger, watershed-wide ecological assessment or inventory projects.

CAs participating in monitoring projects can be considered current and natural partners of the Consortium for protocol implementation. In an effort to assess the current monitoring roles of various CAs and to gauge the potential of each CA's involvement in implementation of Consortium protocols, the PIC included many of Ontario's CAs in the phone survey. The results of the survey are summarized below and in Tables 10-3 and 10-4.

Among those CAs whose representatives responded to inquiries, Credit Valley Conservation Authority (CVCA), Grand River Conservation Authority (GrRCA), Niagara Peninsula Conservation Authority (NPCA) and Raisin Region Conservation Authority (RRCA) are all involved in some degree of coastal wetland monitoring. A primary coastal wetland sampling focus for these CAs is wetland vegetation monitoring, which in some cases occurs in conjunction with similar sampling at inland wetlands. Anuran monitoring has also occurred at CVC, GrRCA, and NPCA coastal wetland sites, the latter two of which use the MMP/Consortium protocol.

The St. Clair Region Conservation Authority and Quinte Conservation are not currently conducting coastal wetland monitoring activities, but may be able to in the future, provided funding is available. Each has most of the in-house expertise and equipment necessary to implement Consortium protocols, although staff training would be required. Quinte Conservation, in particular, has formerly partnered with CWS to monitor coastal wetland habitats using Consortium protocols, and currently partners with BSC to deliver local MMP volunteer training workshops. Cataraqui Region Conservation Authority (CRCA), encompassing the Kingston, Ontario region, is another example of an organization with several coastal wetlands with its jurisdiction, but currently lacking a wetland monitoring/assessment initiative. CRCA also chairs the Kingston Wetlands Working Group, a coalition committed to protecting and restoring wetland ecosystems in the Kingston area. Lakehead Region Conservation Authority, within the Lake Superior watershed, currently has no dedicated biological monitoring staff and little in-house expertise required to adopt Consortium protocols. However, much coastal monitoring potential exists in this region given the large extent of coastal wetland habitat, provided that adequate funding sources can be secured. There is a good possibility that these organizations will be supportive of the Consortium's coastal wetland monitoring plan and should be engaged and explored further.

Other Localized Nongovernmental Organizations

Aside from CAs, other potential Canadian local partners include nongovernmental and nonprofit research organizations. One example is the St. Lawrence River Institute of Environmental Sciences (SLRIES), based in

Cornwall, Ontario, which has a mandate to conduct research and promote community action relating to large river systems, with a focus on the St. Lawrence River. The SLRIES has been involved with water quality monitoring and fish and macroinvertebrate sampling within the St. Lawrence River and its surrounding coastal wetland habitats. The Royal Botanical Gardens (RBG), located within Hamilton and Burlington, Ontario, has a research arm that is involved with significant biotic and abiotic monitoring activities within Cootes Paradise Marsh, a marsh complex located at the western end of Lake Ontario. In conjunction with local partners, the RBG tests water quality, conducts wetland vegetation surveys, summer fish surveys, annual marsh bird and anuran monitoring, migratory bird surveys, turtle surveys and GIS-based wetland land cover assessments. The RBG is currently utilizing MMP/Consortium marsh bird and anuran monitoring protocols, carried out by staff and local MMP volunteers.

All contacted organizational representatives were receptive, and in many cases, enthusiastic about the objectives of the Consortium. There is common interest among these organizations to adopt Great Lakes basinwide standardized coastal wetland monitoring protocols. Providing that issues of funding can be adequately addressed to offset implementation costs, CAs and the nonprofit groups listed above represent ideal and likely partners for protocol implementation.

Table 11-3. Current coastal wetland monitoring efforts and partnerships among potential Canadian Consortium partners who responded to information inquiries.

Organization	Jurisdiction	Great Lake Basin	Coastal Monitoring Description	Partners
Bird Studies Canada	Great Lakes basin	N/A	Various coastal wetlands are monitored by volunteers using Marsh Monitoring Program protocols as part of larger monitoring network, and by staff. Periodic water quality assessments conducted by staff and some volunteers.	Various Conservation Authorities, Environment Canada, U.S. Environmental Protection Agency, St. Lawrence River Institute of Environmental Sciences, Area of Concern Remedial Action Plan committees, various community volunteer monitoring groups, Marsh Monitoring Program volunteer participants
Central Lake Ontario Conservation Authority	Encompasses 15 watersheds within the municipalities of Oshawa, Pickering, Uxbridge, Clarington, Ajax and Whitby	Lake Ontario	Leads Durham Region Coastal Wetland Monitoring Project activities	Canadian Wildlife Service, Ganaraska Region Conservation Authority, Toronto and Region Conservation Authority
Credit Valley Conservation	Credit River watershed	Lake Ontario	Wetland vegetation surveys and anuran surveys currently ongoing	University of Guelph, local naturalist clubs and community groups
Ganaraska Region Conservation Authority	Ganaraska River watershed	Lake Ontario	Contributes to Durham Region Coastal Wetland Monitoring Project activities	Canadian Wildlife Service, Central Lake Ontario Conservation Authority, Toronto and Region Conservation Authority
Grand River Conservation Authority	Grand River watershed	Lake Erie	Primarily vegetation monitoring at Dunnville Marsh on Lake Erie	Ontario Ministry of Natural Resources, University of Waterloo

Table 11-3. (Continued)

Organization	Jurisdiction	Great Lake Basin	Coastal Monitoring Description	Partners
Niagara Peninsula Conservation Authority	Ontario and Lake Erie portion of the Niagara River watershed	Lake Ontario/Lake Erie	Currently engaged in anuran monitoring at two marsh locations	Ontario Ministry of Natural Resources
Quinte Conservation	Moira, Napanee and Salmon River watersheds, and Prince Edward County	Lake Ontario	None currently; have worked with Canadian Wildlife Service to implement coastal wetland monitoring and assessment activities for various biotic and abiotic parameters	Bird Studies Canada
Raisin Region Conservation Authority	Raisin River watershed and surrounding smaller watersheds	St. Lawrence River	Primarily vegetation mapping and fish habitat monitoring within St. Lawrence River shoreline marshes	None for coastal wetland monitoring/assessment activities
Royal Botanical Gardens	Cootes Paradise Marsh and surrounding tributaries, located at western end of Lake Ontario	Lake Ontario	Monitoring and assessment activities of various biotic and abiotic parameters within Cootes Paradise Marsh and surrounding tributaries	McMaster University, Bay Area Restoration Council, various other community volunteer groups
St. Clair Region Conservation Authority	Ontario portion of the St. Clair River watershed	Lake Erie	None currently	N/A
Toronto and Region Conservation Authority	Watersheds located within the City of Toronto	Lake Ontario	Contributes to Durham Region Coastal Wetland Monitoring Project activities	Canadian Wildlife Service, Central Lake Ontario Conservation Authority, Ganaraska Region Conservation Authority

Table 11-4. Expertise and equipment availability, and training requirements for each Consortium indicator, among potential Canadian Consortium partners who responded to information inquiries.

Organization	Macroinvertebrates		Fish		Plants		Birds and Amphibians		Landscape features		Training needs
	staff	equipment	staff	equipment	staff	equipment	staff	equipment	staff	equipment	
Bird Studies Canada	In-house expertise	Accessible	In-house expertise	Accessible	No current in-house expertise	None currently available	In-house expertise	Accessible	In-house expertise	ArcView	Staff training to conduct wetland plant surveys would be required.
Central Lake Ontario Conservation Authority	In-house expertise	Accessible	In-house expertise	Accessible	In-house expertise	Accessible	In-house expertise	Accessible	In-house expertise		
Credit Valley Conservation	In-house expertise	Accessible	In-house expertise	Accessible	In-house expertise	Accessible	In-house expertise for anuran surveys only	Accessible	In-house expertise	ArcView, ArcGIS	Staff would need training to use specific protocols. Funding required to hire a staff member trained to conduct bird surveys.
Ganaraska Region Conservation Authority	In-house expertise	Accessible	In-house expertise	Accessible	In-house expertise	Accessible	In-house expertise	Accessible	In-house expertise	ArcView	Further staff training would be required to implement macroinvertebrate surveys and bird and amphibian monitoring
Grand River Conservation Authority	In-house expertise	Accessible	In-house expertise	Accessible	In-house expertise	Accessible	In-house expertise	Accessible	In-house expertise	ArcView, online GIS mapping	Staff would need training to use specific protocols

Table 11-4. (continued)

Organization	Macroinvertebrates		Fish		Plants		Birds and Amphibians		Landscape features		Training needs
	staff	equipment	staff	equipment	staff	equipment	staff	equipment	staff	equipment	
Niagara Peninsula Conservation Authority	In-house expertise	Accessible	In-house expertise	No current access to fyke nets	In-house expertise	Accessible	In-house expertise	Accessible	In-house expertise	ArcGIS	Further staff training would be required to implement macroinvertebrate, fish and vegetation surveys
Quinte Conservation	No current in-house expertise	Accessible	In-house expertise	No current access to fyke nets	In-house expertise	Accessible	In-house expertise	Accessible	In-house expertise	ArcGIS	Further staff training would be required to implement fish, plant surveys and bird, amphibian monitoring. Staff training required for invertebrate sampling.
Raisin Region Conservation Authority	In-house expertise	Accessible	In-house expertise	No current access to fyke nets	In-house expertise	Accessible	In-house expertise	Accessible	In-house expertise	ArcView	Further staff training would be required to implement macroinvertebrate surveys and bird and amphibian monitoring
Royal Botanical Gardens	In-house expertise	Accessible	In-house expertise	No current access to fyke nets	In-house expertise	Accessible	In-house expertise	Accessible	No staff currently available		Further staff training would be required to implement macroinvertebrate surveys
St. Clair Region Conservation Authority	In-house expertise	Accessible	In-house expertise	No current access to fyke nets	In-house expertise	Accessible	In-house expertise	Accessible	In-house expertise	ArcView	Further staff training would be required to implement wetland vegetation sampling and bird and amphibian monitoring
Toronto and Region Conservation Authority	In-house expertise	Accessible	In-house expertise	Accessible	In-house expertise	Accessible	In-house expertise	Accessible	In-house expertise		

Implementation Strategy

In order for implementation of this plan to be successful an organization such as the Great Lakes Commission (possibly via the Consortium or similar entity) will be essential to coordinate monitoring initiation, data collection and communication among partners. As part of the implementation process, a series of workshops will be necessary to train state, provincial, and other partners in the various aspects of this coastal wetlands monitoring plan. Training workshops would likely take place in most Great Lakes jurisdictions, with the possibility of combining entities (such as Illinois and Indiana) that do not have a large number of coastal wetlands in their jurisdiction to monitor. The purpose of such workshops will be to engage prospective partners, discuss the monitoring protocols and identify plausible frameworks for implementing this Great Lakes coastal wetlands monitoring plan.

From its inception, the Consortium has been a partnership of federal, state, provincial, university, nonprofit and other stakeholders from both the U.S. and Canada. Communication among the various partners was essential throughout all phases of the development of this plan – from the original pilot studies where monitoring protocols were tested through the drafting of final protocols.

Due to the Great Lakes basinwide nature of the monitoring called for in this plan, communication will continue to be an essential aspect throughout the plan's implementation. Field personnel will not only need to report their data and findings to their respective agency or organization, but will also be charged with sharing their monitoring data and information with field partners across the basin and their respective agencies. This will facilitate the comparison of data and results necessary for the development of periodic basinwide monitoring reports.

In addition, a central data hub will be needed to coordinate communication and serve as a data storage and information center. The entity housing this hub will be charged with producing periodic updates on the health, status and trends of Great Lakes coastal wetlands based on the data submitted by all agencies and organizations who conduct the monitoring. These reports will be circulated widely throughout the Great Lakes via a wide spectrum of communication channels, including a web site serving as the clearinghouse of information on Great Lakes coastal wetlands. Other means of communicating these reports include various listservs, newsletters, and presentations at meetings and conferences across the Great Lakes basin, including the biennial State of the Lakes Ecosystem Conference. See Chapter 10 titled "Great Lakes Coastal Wetlands Consortium Data Management System" for more on the Consortium data sharing process.

A second essential part of Consortium monitoring implementation will be a dedicated source of funding for each entity wishing to adopt these protocols. This is, perhaps, the greatest obstacle potential partners will face in adopting this plan or a portion thereof. Most agencies and organizations described above receive only periodic funding allocations directed toward wetland monitoring and assessment tasks, or larger watershed-scale studies that incorporate wetland sampling activity. In the U.S, only Illinois and Minnesota have funds that are annually allocated to wetland monitoring, and these sources are rarely enough to carry out an intensive monitoring program. Other states must rely solely on periodic streams of federal funding and grants, which creates a "patchwork" of wetland monitoring over space and time. On the Canadian side, Conservation Authorities also must contend with various and limited funding resources.

Hence, monitoring coordinators should strive to identify and procure dedicated funding sources that can be earmarked for Great Lakes coastal wetland monitoring. Especially during the infancy stages of implementation, intense efforts on the part of all partners will be required to secure funding. Optimally, a dedicated source of funding for the program should be procured, and a portion of the funds should be used as "seed money" to engage partner jurisdictions in implementation of this plan. It is expected that partners will utilize their own resources to the extent possible, with funding targeted to help fill gaps in personnel, equipment and other essential needs. For nonfederal partners a logical place to start would be federal programs – e.g., the CWA Section 106 water pollution control

grant program, or other U.S. EPA and EC program grants, etc. – which should consider giving preference to projects using Consortium monitoring protocols as a “best practice” or standard. A variety of potential funding sources are also listed below.

Funding in the United States

The following sources, though not directly targeted toward coastal wetland monitoring, may allow states and tribes to identify funding to implement the Consortium monitoring plan, at least in the short term:

- **U.S. CWA Section 106 Water Pollution Control Grant Program**
This program provides grants to states, tribes, and interstate agencies to develop and implement water monitoring programs, including wetlands. These funds can be used for a wide range of water quality activities including restoration and water quality surveys.
- **EPA Wetland Program Development Grants**
This federal source of funds helps states, tribes and local governments develop new monitoring programs or improve existing programs. States may be able to use this program to fund pilot programs or to develop a comprehensive wetland monitoring strategy that includes Consortium protocols. However, this source is currently limited to development, rather than implementation, of programs and will likely be insufficient to fund monitoring programs to a significant degree.
- **U.S. CWA Section 104(b)(3) State Wetlands Grant Program**
This program makes grants available to states, tribes, local governments, and nongovernmental organizations to conduct wetlands projects. These wetlands projects emphasize the development of a comprehensive monitoring and assessment program, as well as refining the protection of vulnerable wetlands and aquatic resources. These grants may also be used to conduct surveys, studies and investigations related to causes, effects, prevention and extent of pollution.
- **NOAA State Sea Grant Offices**
Each Sea Grant state office offers a variety of funding opportunities for Great Lakes research. While most of this funding is focused towards new and specific Great Lakes research questions, it is possible that funds could be obtained if Consortium protocols were being utilized by a university to study a particular aspect of coastal wetlands.
- **NOAA Coastal Zone Management Grants**
NOAA annually allocates funds to coastal states for a variety of coastal projects, including research and monitoring.
- **U.S. EPA Great Lakes National Program Office**
Funding opportunities are periodically available to conduct monitoring in the Great Lakes basin.
- **U.S. ACE – Estuary Restoration Act of 2000 (Estuaries are defined under the Act to include the Great Lakes.)**
The purpose of the Act is to promote the restoration of estuary habitat, to develop a national Estuary Habitat Restoration Strategy for creating and maintaining effective partnerships within the federal government and with the private sector, to provide federal assistance for and to promote efficient financing of estuary habitat restoration projects, and to develop and enhance monitoring, data sharing, and research capabilities.

- **USGS National Water Quality Assessment Program (NAWQA)**
USGS maintains and operates a monitoring network of surface water gauging stations on streams and rivers draining to the Great Lakes. Data from this multi-state monitoring network provides the USGS and its many collaborators with information on surface water flows, quantity of available water, and water quality characteristics. The goal of the NAWQA program is to develop long-term consistent and comparable information on streams, ground water, and aquatic ecosystems to support sound management and policy decisions. Although this program is not geared specifically towards coastal wetland monitoring, there is potential to build Consortium protocols into various aspects of restoration and/or monitoring work conducted with this funding.
- **U.S. Fish and Wildlife Service**
The U.S. FWS administers several wetland and habitat restoration programs including the National Coastal Wetlands Conservation Grant Program, the Coastal Program, the Partners for Fish and Wildlife Program, and the Fisheries and Habitat Conservation Program. Again, it may be possible to build Consortium protocols into monitoring components of projects funded by these grants.
- *Private Foundations and Consortia*
An array of private charitable organizations exists across the region. Many have explicit funding programs to promote sustainable ecological principles that rely upon fully functional coastal wetland complexes. Included in this category are endowments such as the multi-state Great Lakes Protection Fund and Great Lakes Fisheries Trust.

Funding in Canada

Environment Canada makes funding, incentives, rebates and other financial programs available to individuals and organizations to support activities that foster environmental sustainability in Canada. Although most of these incentive programs will not support the long-term implementation of a coastal wetland monitoring program, they could provide opportunities to target restoration activities, based on the results of a monitoring program, and the monitoring protocols advocated in this document may be applicable to some of the monitoring requirements of these programs.

- **EcoAction Community Funding Program**
EcoAction provides financial support to community groups for projects that have measurable, positive impacts on the environment. Funding can be requested for projects that focus on improving the environment and increasing environmental awareness and capacity in the community.
- **Great Lakes Sustainability Fund**
This program provides technical and financial support to projects that implement and help advance the RAPs that have been developed for Canada's AOCs. Priority funding areas include fish and wildlife habitat rehabilitation and stewardship, contaminated sediment assessment and remediation, and innovative approaches to improve municipal wastewater effluent quality. Some pilot programs in Canada's AOCs have already successfully implemented Consortium protocols.
- **Habitat Stewardship Program for Species at Risk**
Funding from this program supports projects that contribute to the recovery of endangered, threatened and other species at risk, and to prevent other species from becoming a conservation concern. Coastal

wetlands provide habitat to many species at risk and Consortium protocols could potentially be used to monitor recovery projects or existing habitat.

- **Funding Technologies for the Environment**
This group helps broker innovative technology solutions that address Canada's environmental priorities. In terms of the Consortium, this could include implementing the techniques outlined in the "Landscape Based Indicators" chapter of this document.
- Remote sensing technologies could be used to monitor fish and wildlife habitat or changes in land use in the basin.

Using Adaptive Management as an Implementation Strategy

The task of implementing a new program can be daunting and frustrating to agencies that are already overburdened with responsibilities and stretched thin by funding limitations. When considering whether or not to undertake the challenge of adopting Consortium protocols, it is important to convey to agencies and organizations the potential benefits to Great Lakes programs that could come about as a result of focused, consistent resource monitoring at a basinwide level. It is also important for existing Consortium leaders to be responsive to the monitoring needs and existing programs of potential partners, and develop and adapt implementation approaches to recognize those needs and qualities. The Consortium recognizes that agencies will need an implementation strategy in order to successfully negotiate the challenges that are inherent in adopting or adapting new programs.

Adaptive management is a formal, systematic, and rigorous approach to learning from the outcomes of management actions, accommodating change and improving management. It involves synthesizing existing knowledge, exploring alternative actions and making explicit forecasts about their outcomes. Adaptive management was developed in the 1970s by C.S. Holling and co-workers at the University of British Columbia and the International Institute for Applied Systems Analysis. Since then, it has been applied to a range of specific issues, including rehabilitation of salmon stocks in the Columbia River Basin, management of acid rain, and water management in the Florida Everglades (Nyberg, J.B. 1998). Its application to other natural resource activities is now receiving increasing attention.

Coastal wetlands are complex and dynamic. As a result, our understanding of ecosystems and our ability to predict how they will respond to management actions is limited. These knowledge gaps lead to uncertainty over how best to manage Great Lakes coastal wetlands. Despite these uncertainties, wetland managers must make decisions and implement plans. Adaptive management is a way for wetland managers to proceed with this responsibly in the face of such uncertainty. It provides a sound alternative to either "charging ahead blindly" or "being paralyzed by indecision", both of which can foreclose management options, and have social, economic and ecological impacts. Thus, the Consortium believes adaptive management may be the ideal implementation method for agencies who adopt any of the protocols outlined in this document.

The application of adaptive management includes six main steps, as outlined below. The framework formed by these six steps is intended to encourage a more thoughtful, disciplined approach to management, without constraining the creativity that is vital to dealing effectively with uncertainty and change (Nyberg, J.B. 1998).

Step 1 (problem assessment) is often completed in facilitated workshops. Participants define the scope of the management problem, synthesize existing knowledge about the system, and explore the potential outcomes of alternative management actions. Explicit forecasts are made about outcomes, in order to assess which actions are most likely to help the agency meet management objectives. During this exploration and forecasting process, key gaps in understanding of the system (i.e., those that limit the ability to predict outcomes) are identified. Managers may be faced with questions such as: How do I implement the plan in a way that will meet management objectives? How do

we adjust our current monitoring program to include monitoring of coastal wetlands? Which of several possible actions should we implement?

Thus, during step 1, it will be important that agencies discuss the advantages and disadvantages of implementing Consortium protocols and what it means to them, as well as to overall monitoring efforts within the Great Lakes basin. This step may be essential to formulating cohesive grant applications and for presenting program adoption to management or decision makers within the organization. This step is also essential to identify the ways in which implementation of Consortium protocols will aid the agency in achieving its Great Lakes and wetland management goals.

Step 2 (design) involves designing a management plan and monitoring program that will provide reliable feedback about the effectiveness of the chosen actions. Ideally, the plan should also be designed to yield information that will fill the key gaps identified in Step 1. It is useful to evaluate one or more proposed plans or designs, on the basis of costs, risks, informativeness and ability to meet management objectives. To complete step 2, agencies should complete a written strategy detailing how Consortium protocols will be implemented. Such a strategy should include the following information:

- Details of partnerships that will be pursued to optimize available equipment and personnel
- Potential funding options
- A list of sites where monitoring will occur
- A list of dates when monitoring should occur and be completed
- A list of personnel who will conduct the monitoring
- An outline of information that will be included in monitoring reports
- An analysis of costs that will be incurred as a result of implementing this program (see cost analysis chapter of this document)

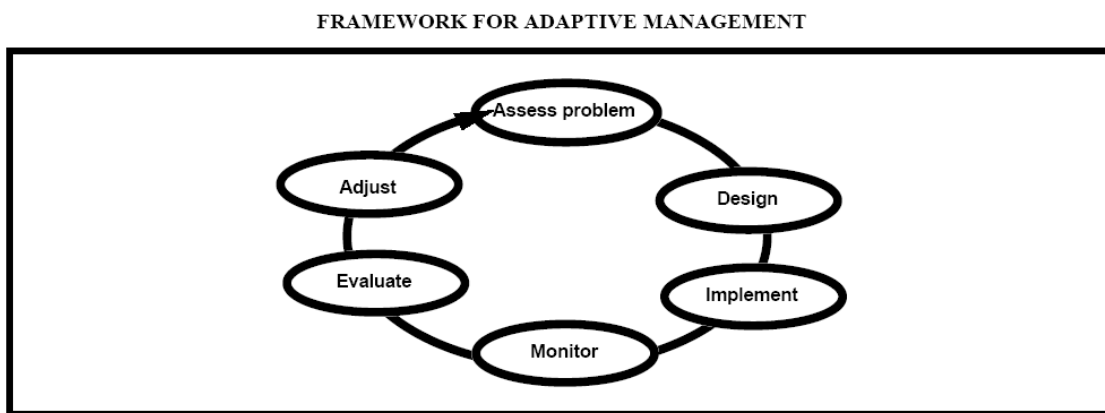


Figure 11-1. Framework for Adaptive Management

In Step 3 (**implementation**), the above plan should put into practice, meaning monitoring using Consortium protocols will begin. In Step 4 (**monitoring**), the agency must evaluate the effectiveness of implementing Consortium protocols in meeting the objectives set forth in step 1. Step 5 (**evaluation**) involves comparing the actual outcomes to forecasts and interpreting the reasons underlying any differences. In other words, managers must evaluate their monitoring program and determine if the proper protocols were chosen, whether the protocols have been valuable to the overall monitoring program, how monitoring can be improved to better meet the agency's monitoring objectives and whether new partnerships can be initiated to further enhance program potential.

Finally, step 6 (**adjustment**) involves correcting the design created in step 2 to reflect the new understanding gained from the monitoring and evaluation steps. Understanding gained in each of these six steps may lead to reassessment of coastal wetland management strategies, new questions, and new options to try in a continual cycle of improvement. In each new monitoring cycle, all 6 steps should be repeated to ensure continuous improvement. Spending a small amount of time each year completing the steps can ensure the agency continues to make the best decisions for its staff, the public, and the resources it seeks to protect.

In reality, some of the steps outlined will overlap, some will have to be revisited, and some may be need to be completed in more detail than others. However, all six steps are essential. Omission of one or more will hamper the ability to learn from management actions. In addition, documenting the key elements of each step, and communicating results are crucial to building a "legacy of knowledge", especially for projects that extend over a long time. For example, state, provincial and tribal/First Nation monitoring personnel should communicate with one another and share successes, problems and lessons learned. Likewise, state, provincial, and tribal/First Nation agencies should communicate with federal agencies. Finally, all feedback loops should return to a central coordinator, in this case, the Consortium communication hub, which will serve as a clearinghouse of information.

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