

**PROGRESS TOWARD DELISTING A GREAT LAKES AREA  
OF CONCERN: THE ROLE OF INTEGRATED RESEARCH  
AND MONITORING IN THE HAMILTON HARBOUR  
REMEDIAL ACTION PLAN**

JOHN D. HALL<sup>1</sup>, KRISTIN O'CONNOR<sup>1,\*</sup> and JOANNA RANIERI<sup>2</sup>

<sup>1</sup>*Hamilton Harbour Remedial Action Plan, Canada Centre for Inland Waters, Burlington, ON,  
Canada L7R 4A6;* <sup>2</sup>*Bay Area Restoration Council, Life Sciences Building, Room B130F, 1280 Main  
Street West, Hamilton, ON, Canada L8S 4K1*

(\*author for correspondence, e-mail: kristin.oconnor@ec.gc.ca)

**Abstract.** The goal of restoring environmental health and qualities to Hamilton Harbour Great Lakes Area of Concern, an embayment at the western end of Lake Ontario, is considered to be achievable by the year 2015. Restoring Hamilton Harbour is a dynamic process that relies heavily on research and monitoring to direct remediation efforts. Three principle means of coordinating this research and monitoring include: research and monitoring workshops; a monitoring catalogue outlining both government and nongovernment initiatives; and an annual report written by a local community group. These tools increase the effectiveness of remedial actions by: (i) improving stakeholders' ability to track trends; (ii) allowing program decision-makers to utilize adaptive management techniques to continuously modify programs based on new results; (iii) integrating interdisciplinary fields, and (iv) increasing accountability. This paper describes in detail these tools used for coordinating research and monitoring in implementing the Remedial Action Plan of the Hamilton Harbour Great Lakes Area of Concern, along with lessons learned to assist other implementers who are considering similar programs.

**Keywords:** accountability, adaptive management, Hamilton Harbour, interdisciplinary integration, Remedial Action Plan, research and monitoring

## 1. Introduction

In 1985, the International Joint Commission (IJC) officially recognized Hamilton Harbour, an embayment at the western end of Lake Ontario, as one of the most degraded bodies of water in the Great Lakes (IJC, 1985). In response, local stakeholders published a Remedial Action Plan (RAP) in 1992, and an update in 2002. This plan utilizes research and monitoring to define remedial actions and increase their effectiveness through a program that tracks trends, promotes adaptive management, allows for interdisciplinary integration, and increases accountability. The goal of restoring environmental health to Hamilton Harbour is considered to be within the community's reach by the year 2015. In order to understand the approach taken to research and monitoring in the Hamilton Harbour RAP, this paper has been divided into sections.

The next section, Section 2 (Background), provides the context for the Hamilton Harbour RAP and its relationship to the Great Lakes Water Quality Agreement

between Canada and the United States. Beneficial Use Impairments and the criteria used to identify areas requiring remedial action plans are defined. An overview of the remedial action planning in Hamilton Harbour is described, along with the organizational structure of the RAP.

Section 3 (Communicating and Reporting Research and Monitoring) describes three methods used to promote the use of research and monitoring results: workshops, a monitoring catalogue, and a community-based report.

Section 4 (Utilization of Research and Monitoring) complementary to Section 3, outlines four major outcomes of the research and monitoring program methods used by the Hamilton Harbour RAP: tracking trends, adaptive management, interdisciplinary integration, and accountability. Section 5 (Lessons Learned) provides the authors' insights on the dynamic role of research and monitoring as utilized in the Hamilton Harbour RAP.

## **2. Background**

### **2.1. HAMILTON HARBOUR**

Hamilton Harbour, also known as Burlington Bay, is a 2,150 hectare (ha) embayment of Lake Ontario draining a watershed of 49,400 ha (Figure 1). The dominating geological feature of the area is the Niagara Escarpment, which surrounds the Harbour on three sides (the fourth is formed by Lake Ontario). Three main streams feed into the Harbour: Grindstone Creek, Red Hill Creek, and Spencer Creek. Spencer Creek reaches the Harbour through a 250 ha shallow area of both marsh and open water called the Cootes Paradise Marsh. Much of the Grindstone and Spencer watersheds remain undeveloped with only 12% and 20% developed respectively, but the Red Hill watershed is approximately 80% urbanized (HH RAP, 2003). The larger Harbour watershed land usage breakdown is approximately: 1/3 urban, 1/3 agricultural, and 1/3 rural.

In the 19th century, Hamilton Harbour had vast marshes, with a diversity of fish and wildlife species. As the local population and economy grew, marshes and shorelines were filled in for industrial and commercial development. By the 1940s, Harbour beaches were closed to swimming. By the 1960s, the Harbour was at its lowest point, with severe water quality problems and limited public access to the shoreline.

By the early 1980s, industry and municipalities had committed hundreds of millions of dollars to waste treatment to reduce the flow of nutrients and contaminants into the Harbour. In 1985, a community stakeholder group was convened to develop a plan to guide further cleanup efforts. This local effort in Hamilton corresponded with a larger international effort to restore other degraded areas on the Great Lakes.

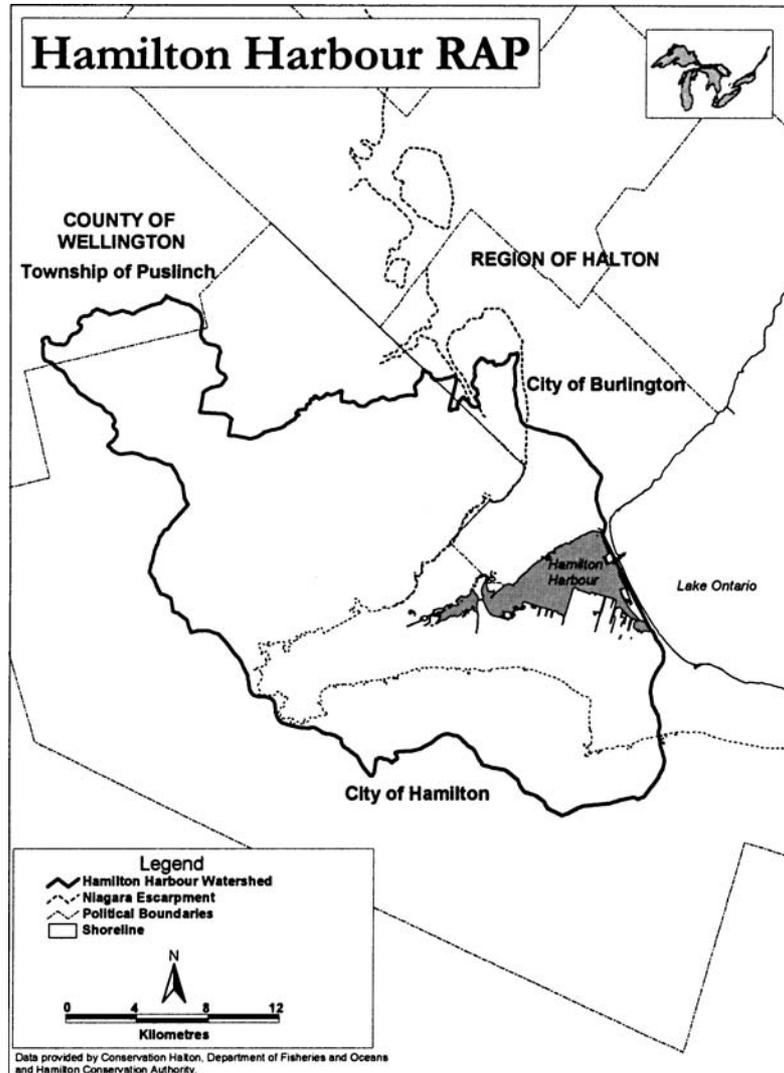


Figure 1. Hamilton Harbour watershed.

## 2.2. AREAS OF CONCERN AND REMEDIAL ACTION PLANS

The International Joint Commission is an independent, binational organization created in 1909 to oversee and advise on boundary water use and quality issues between Canada and the United States (IJC, 2004). By the 1960s, water pollution had become a significant problem in many areas throughout the five Great Lakes situated between Canada and the United States. In a commitment to restore and maintain the environment of the Great Lakes Basin, both countries signed the *Great*

*Lakes Water Quality Agreement (GLWQA)* in 1972 and renewed their commitments in 1978 (IJC, 1972 and 1978). The 1978 Agreement was amended by protocol in 1987, to strengthen actions and increase accountability. As part of this amendment, Annex 2 was added, describing Areas of Concern, Beneficial Use Impairments, and Remedial Action Plans (IJC, 1987).

An Area of Concern (AOC) is a geographic site that has one or more of the fourteen Beneficial Use Impairments (BUI) as defined in the amended GLWQA. A BUI is “. . . a change in the physical, chemical or biological integrity of the Great Lakes system sufficient to cause any of the the following:

- i) restrictions on fish and wildlife consumption;
- ii) tainting of fish and wildlife flavour;
- iii) degradation of fish and wildlife populations;
- iv) fish tumours or other deformities;
- v) bird or animal deformities or reproduction problems;
- vi) degradation of benthos;
- vii) restrictions on dredging activities;
- viii) eutrophication or undesirable algae;
- ix) restrictions on drinking water consumption, or taste or odour problems;
- x) beach closings;
- xi) degradation of aesthetics;
- xii) added costs to agriculture or industry;
- xiii) degradation of phytoplankton and zooplankton populations; and
- xiv) loss offish and wildlife habitat.” (IJC, 1987)

When an area is designated as an AOC, the IJC requires the area to develop and implement a Remedial Action Plan (RAP), divided into three stages (Table I).

TABLE I  
Remedial action plan stages

Stage #	Title of stage	Brief description of stage
Stage 1	Environmental conditions and problem definition	This stage outlines the starting point for the Area of Concern (AOC) and identifies local Beneficial Use Impairments.
Stage 2	Goals, options and recommendations	This stage defines the remedial actions to clean up the AOC.
Stage 3	Evaluation of remedial measures and confirmation of restoration of uses	This stage allows for the designation of an AOC to be removed once the beneficial uses are shown to be restored.

### 2.3. HAMILTON HARBOUR REMEDIAL ACTION PLAN

Forty-three Areas of Concern were identified throughout the Great Lakes, including Hamilton Harbour (IJC, 1985). This designation required Hamilton Harbour to develop a Remedial Action Plan, giving a name and refined direction to the local process already underway.

The *RAP Stage 1 Report* was first released in 1989 and updated in 1992 (HH RAP, 1989, 1992a), with a status report in 1998 (HH RAP, 1998). It described the environmental conditions and problems in Hamilton Harbour according to five components: water quality and bacterial contamination; urbanization and land management; toxic substances and sediment remediation; fish and wildlife; and public access and aesthetics. Education and public information, and research and monitoring were added in the *Hamilton Harbour RAP 1998 Status Report*. Highlighting research and monitoring as a separate component, instead of including it with individual projects, was an important step in recognizing the importance of research and monitoring to the RAP process.

The *RAP Stage 2 Report*, released in 1992, outlined the goals, options and recommendations for remediation (HH RAP, 1992b). The first stakeholder group made 50 recommendations to encourage partnerships and guide cleanup efforts. The stakeholder group was formalized in 1998 as the RAP Forum. Their task was to update the plan. The Forum revised the recommendations to reflect new information that had emerged during the first ten years. *The RAP Stage 2 Update 2002 Report*, released in 2003, is the current guiding plan (HH RAP, 2003). It contains 57 recommendations and 159 tasks. Each task is assigned a timeline and a group of responsible organizations. A RAP Stage 3 Delisting Report is anticipated to be released in 2015.

As shown in Figure 2, the Hamilton Harbour RAP is grouped into three organizational units. The first is the RAP Forum, which involved over 50 stakeholders who developed and updated the RAP from 1998 to 2002. The RAP Forum will be reconvened when it is deemed necessary, for example the preparation of the Stage 3 Report. The second organizational unit is the Bay Area Implementation Team (BAIT), which is a group of 17 agencies from government, industry, academia and the community charged with the responsibility of implementing the RAP. BAIT is co-chaired by the federal and provincial governments and divides its responsibilities among the component areas of the RAP. BAIT includes a Technical Team formed from within its members and other scientists, to oversee the technical aspects of research and monitoring that support the RAP. The RAP Forum and BAIT are supported by a RAP Coordinator and the RAP Office, who act as a secretariat. The third organizational unit is the Bay Area Restoration Council (BARC), which is a confederation of community stakeholders devoted to revitalizing Hamilton Harbour and its watershed. BARC's mandate includes monitoring, assessing and promoting the RAP. It is an incorporated, non-profit organization with over 320 members, electing its own President and Board of Directors, and supported by an

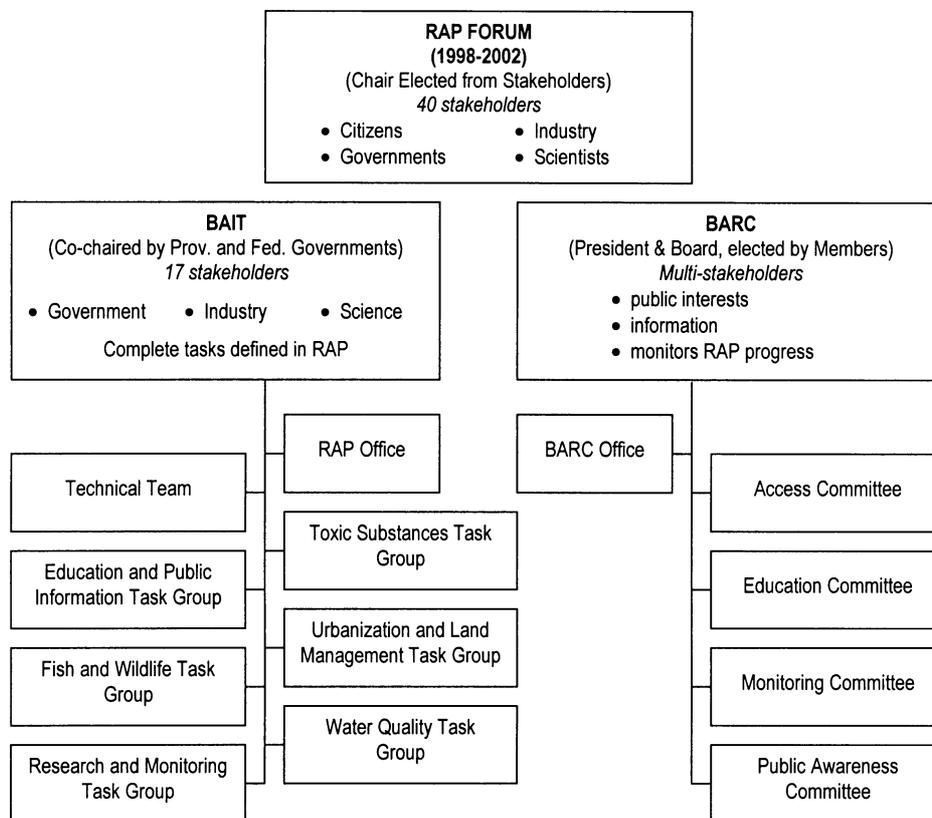


Figure 2. Hamilton Harbour RAP organization.

office staff and volunteers. BARC organizes teams of volunteers to participate in RAP projects and holds public meetings/workshops to inform and educate the public and community leaders about Hamilton Harbour restoration activities. While the BAIT and the BARC are separate groups and maintain their independence, they share the common goal of restoring Hamilton Harbour in order to achieve delisting as an Area of Concern.

A qualitative assessment of the progress since 1990, in BARC's 2002 Toward Safe Harbours Report Card, shows Hamilton Harbour is halfway to being delisted as an Area of Concern (BARC, 2002). Completing the remainder will involve more projects, monitoring of progress, and funding. Prior to 1990, approximately \$600 million was spent on pollution abatement, mostly by local industry and the municipalities. From 1990–2000, approximately \$200 million was spent: \$30 million each from the federal government (principally via the Great Lakes Sustainability Fund) and provincial government, with the remainder funded at the local level. It is estimated that between 2000 and 2015 an additional \$650 million will be needed, bringing the total remediation costs to \$1.4 billion (HH RAP, 2003).

### 3. Communicating and Reporting Research and Monitoring

One of the strengths of the Hamilton Harbour RAP is the significant research capability of the local community. The organizations involved include: federal agencies (Environment Canada and Fisheries and Oceans Canada), provincial agencies (Ontario Ministry of the Environment and Ontario Ministry of Natural Resources), academia (principally through McMaster University), the Royal Botanical Gardens (RBG), two local conservation authorities, and four municipalities. Scientific research into emerging issues and the monitoring of existing conditions continuously helps direct future implementation actions.

The importance of research and monitoring was identified in the *Hamilton Harbour RAP 1998 Status Report* and incorporated into the *RAP Stage 2 Update 2002* as one of the seven components of recommendations for remedial actions. Recommendation number RM – 7 in the *RAP Stage 2 Update 2002* states, “That all agencies, municipalities and industries continue their commitment and enhance where necessary the collection of the surveillance and monitoring data and analyses required for local decision making and ultimately presentation to the public and the International Joint Commission.” (HH RAP, 2003). As part of fulfilling this recommendation, the utilization of research and monitoring is promoted through workshops, a monitoring catalogue, and BARC’S *Toward Safe Harbours* report.

#### 3.1. RESEARCH AND MONITORING WORKSHOPS

The Hamilton Harbour RAP conducts annual presentation-based workshops to report the results of research and monitoring in Hamilton Harbour. These are focused on the previous year’s monitoring and research results. There are three workshops each year with different geographical focuses: Cootes Paradise Marsh, Hamilton Harbour, and the Hamilton Harbour watershed.

The longest running of the three workshops is a field season review of research and monitoring in the Cootes Paradise Marsh, hosted by the Royal Botanical Gardens (RBG) annually since 1993. In the 2004 workshop, the format was modified slightly to include two sessions in one day; the first presented technical aspects of restoration activities, and the second was a less technical evening session open to the general public.

In 2001 the RAP Technical Team hosted the first annual Hamilton Harbour Research and Monitoring Workshop, with a focus on research and monitoring occurring in Hamilton Harbour. The one day workshop has seen a steady increase in attendance and the number of presentations over the past four years.

New in 2003, a third annual workshop was added to focus on the Hamilton Harbour watershed, organized by the Hamilton and Halton conservation authorities. This workshop reports on the many activities occurring within the Harbour’s 49,400-hectare watershed and acknowledges the importance of watershed remediation to the achievement of RAP goals.

For each workshop, approximately 180 invitations are issued to local scientists, implementers, government and non-government agencies to participate and/or give a presentation about recent research or monitoring activities. Presentations are approximately 20 min in length, followed by a question and answer session with the audience. Workshops typically last an entire day, with many opportunities to network and liaise with other participants. Presenters are asked to prepare a six page abstract that is published in the proceedings. Presentation titles and contact information for presenters are posted on BARC's website ([www.hamiltonharbour.ca](http://www.hamiltonharbour.ca)).

### 3.2. RAP MONITORING CATALOGUE

Another tool the Hamilton Harbour RAP uses to promote monitoring and reporting is the publication of the *Hamilton Harbour RAP Monitoring Catalogue* ('the Catalogue') (HH RAP, 2004). This is a summary of metadata about monitoring programs occurring throughout the Harbour and its watershed.

The Catalogue has existed in two forms. In 1996, the RAP Office contracted Environment Canada to prepare a geographical information system (GIS) based research and monitoring database. The database was used to evaluate existing programs and determine new research and/or monitoring needs. The interactive database used on-screen maps to summarize the types and locations of activities in the watershed with points on the maps that could be "clicked" and queried for further information about individual projects (Holland, 1996). Unfortunately, because GIS expertise was needed on a continual basis to maintain and update the database, it became cost prohibitive and was abandoned.

In 2003, following the completion of the *RAP Stage 2 Update*, a catalogue was compiled identifying research and monitoring activities in the Harbour area. In this catalogue, monitoring programs were presented in a standardized chart format, grouped by agency and published in a report, to be updated annually. To collect this information, agencies were asked to submit details about each of their monitoring programs. In its first year of publication (2004), the Catalogue contained metadata for 45 monitoring programs. The information includes the title of the program and organization, sampling protocol, sampling parameters, rationale, frequency of monitoring, location, availability of data to the public, trend analysis, brief description of results and discussion, publications, future monitoring, and contact information. The catalogue does not include the monitoring data, which are maintained by individual agencies and are obtainable by using the contact information.

### 3.3. TOWARD SAFE HARBOURS REPORT

A third tool used to communicate and report on the monitoring of RAP activities is the *Toward Safe Harbours* reports. The *Toward Safe Harbours* reports are researched and published by the Bay Area Restoration Council to monitor and assess the progress made on the Hamilton Harbour RAP. Each report is

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developed by a group of community volunteers and technical assistants who form the BARC Monitoring Committee. Volunteers represent a broad range of experience, including members with agricultural backgrounds, academics with research backgrounds, and individuals from the industrial sector. Reports are presented in a public forum each year and distributed to scientists, politicians and decision-makers. The reports have taken a number of approaches and formats since inception in 1994.

From 1994 to 2001, BARC reports focused on evaluating the adequacy of past remedial actions and their impacts on the Harbour. Topics included yearly progress updates on such things as non-point source pollution, nutrient loadings, and stormwater management. To assess the current status of remedial actions, the *Toward Safe Harbours 2002 Report Card* was produced. It used a large brochure-style format that gave letter grades (A to F) to various components of the cleanup, such as fish and wildlife habitat, beach openings, contaminated sediments, land use, erosion control, and public access. It also published an important conclusion: Hamilton Harbour was halfway to achieving restoration targets (BARC, 2002). The focus of subsequent *Toward Safe Harbours* reports is the monitoring required to be delisted as an Area of Concern. This series of reports is divided into themes, spanning multiple years. The 2003 report provided a work plan outlining the format and scope for report years 2004 to 2006. The 2004 report focuses on the remediation of fish and wildlife. Report year 2005 will focus on water quality, and 2006 will focus on sediment remediation. These reports look at the Beneficial Use Impairments and the Hamilton Harbour RAP's associated delisting objectives, to determine if there are or will be gaps in monitoring to fulfill objectives.

The latest progress reports are based on information collected from in-person interviews with representatives from various research and monitoring agencies, as conducted by the BARC Monitoring Committee. The initial interview list is selected after a review of the *RAP Monitoring Catalogue*. Each representative is asked a standard set of questions (BARC, 2003), and questions specific to their work. The information is compiled, analyzed and recommendations prepared. In 2004, the report focused on fish and wildlife delisting objectives and their associated monitoring programs. The report concluded that "... monitoring programs will be able to provide enough evidence to prove that fish and wildlife in Hamilton Harbour have been restored. It is important that existing monitoring programs continue in order to provide sufficient data for delisting Hamilton Harbour as an Area of Concern." (BARC, 2004).

### **4. Research and Monitoring**

The RAP is able to more effectively implement remedial actions by utilizing research and monitoring to track trends, promote adaptive management, develop interdisciplinary integration, and increase public accountability.

#### 4.1. TRACKING TRENDS

One of the most important reasons for performing monitoring is to track trends. Trends can show the impact of a remedial action. For example, the RAP identifies Harbour water quality targets for phosphorus, un-ionized ammonia, chlorophyll a, secchi disk transparency and dissolved oxygen (HH RAP, 2003). Using trend data generated over time, it is possible to track water quality improvements in the centre of the Harbour and link them to major upgrades when they have occurred at the two large wastewater treatment plants that discharge into the Harbour (Charlton and Milne, 2004). Tracking trends can also help predict future behaviours of an indicator. For example, by measuring population and reproductive rates of colonial nesting waterbirds in the Harbour, their population levels can be more accurately managed in future years (Morris *et al.*, 2001).

Changes in the fish community of Hamilton Harbour are measured by the Index of Biotic Integrity (IBI). This is a quantitative measure of the fish community. It is composed of twelve metrics that affect the IBI score either negatively or positively, and is represented by a single number between 0 and 100 (Minns *et al.*, 1994). The IBI target for the Harbour is 55–60. In 1990, the Harbour had an IBI value of 18 and in 1997 it had an IBI value of 28 (HH RAP, 2003). IBI values can be generated for the entire Harbour or at individual sites, and values can be compared over time and trends developed.

Monitoring to track trends is an extremely important part of the Hamilton Harbour RAP process, and is highlighted in the *Toward Safe Harbours 2002 Report Card* (BARC, 2002). The Report Card relied heavily on graphics and photos to illustrate the success or failure of trends in remedial action, and thus had broad appeal. It was widely distributed to politicians, agencies, all levels of government, other AOCs, the media and members of the public. With a production schedule of every five to six years, the Report Card itself will be showing trends after multiple publications. For example, one of the indicators is public access to the Harbour shoreline. BARC gave this indicator a “B+” and identified a positive trend towards obtaining access to 35% of the shoreline. In 2002, the Harbour was at 21%, from a low of less than 5% in 1990 (HH RAP, 2003). In future publications, this indicator will be evaluated again, and it will be determined if the trend is towards improvement, decline or no change.

#### 4.2. ADAPTIVE MANAGEMENT

In the Hamilton Harbour RAP, results from research and monitoring are shared by those implementing remedial actions, as part of an informed decision-making process. Making modifications based on existing data (i.e. adaptive management) is very important to the RAP process, as it ensures that the best possible solutions are being used for the restoration of the Harbour. One appropriate definition of adaptive management is a “. . . systematic process for continually improving management

policies and practices by learning from the outcomes of operational programs.” (BC, 2000).

Facilitating the incorporation of results from current research and monitoring activities into future programs is an important feature of the RAP workshops. For example, one of the three workshops is focused on remedial action in the Cootes Paradise Marsh. Restoring the Marsh has been based on a process of removing known stressors that prevent or hinder the regeneration of aquatic plants. The workshop provides an opportunity for open discussion of these techniques. Research and monitoring has identified a number of potential stressors, including the invasion of the common carp. Although a significant reduction of carp biomass was achieved in 1997 with the construction of a fishway and carp barrier, the Marsh was still not showing a consistent regeneration of aquatic plants (HH RAP, 2003). Incorporating this result into ongoing research identified that, among other things, high phosphorus levels by stimulating algal blooms may also be a major limitation to the growth of aquatic plants.

This is presently leading to the development of a phosphorus loading model, the re-evaluating of targets for phosphorus levels, and the preparation of a strategy to obtain these targets in order to achieve desired levels of submerged aquatic plants. In subsequent years, information obtained from monitoring will be used to determine the effectiveness of these strategies and make additional modifications as appropriate.

#### 4.3. INTERDISCIPLINARY INTEGRATION

The RAP promotes interdisciplinary integration, which is the formal and informal collaboration between different agencies to monitor and modify remedial actions. Allowing for integration of different disciplines provides a better representation of the status and progress of remedial actions, furthering the connection between monitoring and implementation.

An example of the effectiveness of interdisciplinary integration is the linking of waterfowl populations to the closing of Hamilton's beaches. Monitoring by the City of Hamilton's Health Department required beaches to be posted as unsafe for swimming due to high *E. coli* levels in the water near the shoreline. Environment Canada's monitoring in the centre of the Harbour, however, showed *E. coli* counts at low levels. Environment Canada mapped *E. coli* levels from the offshore to the beaches and determined that high levels were caused by beach use, not discharges from the wastewater treatment plant or combined sewer overflows, as was generally suspected. It was determined that the presence of large waterfowl populations was the probable cause of high *E. coli* levels (Charlton and Milne, 2004). Hence, remedial action in this area is focused on controlling the waterfowl, rather than on expensive infrastructure upgrades. Additional investigation by another group at Environment Canada is now being carried out to examine the genetic makeup of

*E. coli* at the beaches (Edge, 2004). Results of this study may have implications in other areas around the Great Lakes.

This type of interdisciplinary integration is encouraged by the Hamilton Harbour RAP using a number of approaches. Through the annual research and monitoring workshops, there are discussions and integration of conclusions reached by the variety of groups collecting and analyzing data. When required, special task groups have formed to integrate understandings from individual disciplines as part of an ecosystem approach. For example, at one recent workshop a sedimentologist reported higher-than-anticipated PCB contamination in the sediments of a small section of the Harbour (Zeman, 2003). At the same workshop, a biologist reported that channel catfish entering the Cootes Paradise Marsh were found to have higher-than-anticipated PCB levels (Whittle, 2003). While there had not been any previous link between either project, these presentations at the workshop led the Technical Team to undertake a mass balance study to determine if new, ongoing or regenerated sources of PCBs may account for the PCB levels found. Complementary to this investigation, a model is being developed to determine where PCBs may be entering the food web (Rusmir-Woods, 2005).

In addition to the workshops, the *RAP Monitoring Catalogue* helps to facilitate interdisciplinary integration because it provides easy-to-access information on projects, including contact information. Publishing a catalogue with metadata allows individuals and groups to quickly learn what other groups are doing and communicate with them. One such user of the Catalogue is BARC, who utilized the Catalogue in the preparation of the *Toward Safe Harbours* report of 2004 to learn basic information about the various Harbour monitoring programs. BARC then compiled and contacted a list of people to be interviewed, and used information gained from the interviews to compile their report.

#### 4.4. ACCOUNTABILITY

An important reason for monitoring is to increase accountability. It can help to justify the cost and time expenditures required to carry out remedial action, keep funding partners informed, increase the speed of restoration, increase communication between scientists and others in the community, and it can also increase overall interest in the restoration process.

The extensive, regular reporting structure developed by the Hamilton Harbour RAP promotes accountability in a variety of ways, ensuring that scientists and implementers are made accountable for the millions of dollars spent on restoration activities. The three annual workshops encourage scientists to present their work in front of peers for evaluation, using an interactive venue for questions and comments. Funding partners are also encouraged to attend these workshops, participate in the discussion, and offer direction on the efficacy of monitoring related to specific remedial actions. In addition, the RAP scientific community works closely with members of BARC to share information required to produce the *Toward Safe*

*Harbours* reports. In 2002, the RAP Technical Team acted as one of a series of panels that ranked progress and trends towards Harbour remediation, which contributed to BARC's *Report Card*. In 2003, the report was a work plan for the reports of 2004–2006. This series of reports examines monitoring requirements for delisting the Hamilton Harbour RAP, and requires in-depth interviews from scientists, who explain their work and how it contributes to the overall Harbour cleanup. In all cases, the *Toward Safe Harbours* reports evaluate results and publish them in a public forum, subjecting them to scrutiny by politicians, the media, other scientists and the public.

As a supplement to the workshops and the reports, the internet has become an increasingly important method of increasing transparency and accountability of Harbour remediation. A multitude of historic and current information on Harbour restoration activities, including complete *Toward Safe Harbours* reports, RAP workshop agendas and contact information for the presenters, are published on the web.

## 5. Lessons Learned

### 5.1. INVOLVE THE COMMUNITY

Citizens of Hamilton and Burlington use the Harbour as an indicator of the environmental health of the area, and are ultimately affected by remedial efforts. Thus, it is essential that this stakeholder participate in the activities of research and monitoring. Two such benefits of community involvement include: positively influencing political will to support Harbour restoration, and monitoring and evaluating RAP progress in an impartial manner.

Community support and awareness for Harbour restoration has a positive effect on the politicians and agencies who must choose and set funding priorities among a variety of competing interests. Popular public support for Harbour restoration enables politicians to make unpopular decisions, such as increasing water and sewer rates to support infrastructure improvements to the wastewater treatment plant.

The local community can also play an important role in the assessment of RAP progress. One avenue is realized through involvement in BARC's *Toward Safe Harbours* reports. Evaluating RAP progress using a non-partisan approach enables BARC to advocate for such things as Harbour restoration programs to remain in place, or to recommend that more programs be initiated. As these reports are put together by a credible, community-based organization, transparency and accountability between the scientists and the local population is increased. Through this process, the science and the scientists become more accessible to the community and decision-makers, thus increasing public support for Harbour restoration.

The RAP process and attempts to involve all stakeholders (including members of the general public) has also highlighted the community's often-underestimated

interest to receive and evaluate information of a more technical nature. New in 2004, a workshop on the field season review of Cootes Paradise Marsh was developed exclusively for a general audience. While containing fewer technical details than the workshop for scientists that was held the same day, this session conveyed the complex nature of marsh restoration. It was well attended and received, and plans are to continue with this format.

Involving and presenting information to the community results in a more comprehensive approach to research and monitoring and enables this important stakeholder to take an active role in the restoration process.

## 5.2. ENGAGE THE SCIENTISTS

The tools used to support and promote research and monitoring are only as strong as the individuals and groups who utilize them, and thus it is important to have a research community that is engaged and supportive of such initiatives. Because the Hamilton Harbour RAP largely depends on the best advice of these scientists, it is important that they are committed and enthusiastic about remedial efforts. This engagement was fostered when relationships were developed as assistance and advice was sought from the scientific community during the entire length of the process. They were involved in the creation of the goals and targets, with the ongoing monitoring and research, in the project implementation, and in the evaluation. In addition, the scientists are regularly provided with a forum through the annual workshops to present their results and to interact with others. Encouraging collaboration among different disciplines and organizations develops relationships and engages the scientific community. In Hamilton, these relationships are formalized and supported through the RAP Technical Team. Made up of individuals with strong technical backgrounds, they act as a contact point for information and advice.

Sometimes, however, strong support can mean that programs become highly associated with individual leaders, and there could be a threat that the program does not continue when they leave or retire. A developed system of mentorship and the sharing and documentation of knowledge can help alleviate this concern.

## 5.3. PROVIDE ADMINISTRATIVE SUPPORT

It is also important that the tools used to promote monitoring are fostered in a well organized environment. In Hamilton, organizational success can be attributed to the extensive planning and development process for the RAP that was goal-oriented and lists specific tasks and responsible agencies. Tools used to support the monitoring and research are scheduled on a regular basis (i.e. annually), so scientists and other implementers can plan and expect to be asked to frequently report on their activities and/or results.

To ensure that the RAP is implemented as planned and activities occur as scheduled requires extensive administrative support. These activities are coordinated

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by full time staff who arrange meetings, compile information (such as the *RAP Monitoring Catalogue*), report writing, liase among different stakeholders, and help to coordinate funding. Although additional costs and time commitments are associated with this organizational support, it is essential to the coordination of the numerous Harbour restoration programs and monitoring activities.

### 5.4. ESTABLISH AN IMPLEMENTATION TEAM

A multi-year, multi-stakeholder restoration plan such as the Hamilton Harbour RAP requires a comprehensive approach to implementation. Establishing a team to coordinate the numerous recommendations and tasks was found to be necessary for continual progress in remediation. The Bay Area Implementation Team (BAIT) is a group of senior management representatives able to make decisions regarding the RAP on behalf of 17 agencies and organizations. The use of this team model provides the Hamilton Harbour RAP process with four main benefits: collaboration, buy-in, leadership, and peer review.

The collaborative approach used by BAIT encourages agencies and industries, which might normally not interact, to work together and value the input each other brings to projects. The high level membership on BAIT develops buy-in to the RAP as a whole; which in turn, helps to secure commitment and funding for individual remedial actions. BAIT members return to their own organizations and work to continue moving the RAP agenda forward. Leadership for particular projects is often established at the BAIT table. Smaller groups are often formed to work on issues that need more attention than permitted at BAIT meetings.

The BAIT became accountable to itself by developing an internal process of ongoing peer review. Members are frequently asked to report at the BAIT table on their progress with individual RAP recommendations, tasks, and timelines. This format creates a healthy level of peer pressure among members to move their projects along, or be prepared to account for delays in their commitments to the RAP.

Using a large group format requires increased stakeholder commitment and administrative time, but has ultimately resulted in a more comprehensive and successful implementation strategy for the restoration of Hamilton Harbour.

### 5.5. FOCUS ON RESEARCH AND MONITORING

The Hamilton Harbour RAP formally identified the importance of research and monitoring in 1998, and it was used in the *RAP Stage 2 Update 2002* as one of the seven components of recommendations for remedial actions. Firm definitions of research or monitoring are difficult, as they are intrinsically linked and overlapping. In the context of the Hamilton Harbour RAP, however, the following delineations can be drawn. Monitoring programs tend to be those that identify long-term trends and conditions, provide adaptive management for current projects, and quantify the

extensive restoration progress that has occurred to-date. Research programs develop and test hypotheses to define problems and provide solutions. Both research and monitoring together provide a comprehensive picture of progress in the RAP.

In Hamilton, efforts are made to prevent research and monitoring results from “sitting on a shelf.” The greatest benefits occur when researchers share information with each other, and when research in one area affects research in another area. The steady progress of the RAP can be partially attributed to a system that allows research and monitoring to direct remediation efforts. To promote this, the RAP attempts to create specific opportunities to connect monitoring and research with remedial efforts, including workshops, the monitoring catalogue and the *Toward Safe Harbours report*. This process has evolved into a multidisciplinary, multi-stakeholder effort that emphasizes accountability, cooperation, the integration of results, and the tracking of trends essential for directing the Hamilton Harbour Remedial Action Plan.

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### References

- Bay Area Restoration Council (BARC): 2002, *Toward Safe Harbours 2002 Report Card*, Bay Area Restoration Council, Hamilton, Ontario.
- Bay Area Restoration Council (BARC): 2003, *Toward Safe Harbours: Progress Toward Delisting – Work Plan*, Bay Area Restoration Council, Hamilton, Ontario.
- Bay Area Restoration Council (BARC): 2004, *Toward Safe Harbours: Progress Toward Delisting – Fish and Wildlife*, Bay Area Restoration Council, Hamilton, Ontario.
- British Columbia Forest Service (BC): 2000, *Adaptive Management Initiatives in the BC Forest Service*. Available at <http://www.for.gov.bc.ca/hfp/amhome/amhome.htm> (accessed 10/20/2004).
- Canada-Ontario: 2002, *Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem*, Canada.
- Charlton, M. and Milne, J.: 2004, ‘Hamilton Harbour Water Quality Update’, in RAP Technical Team. *Research and Monitoring Report: 2003 Season*, May 2004, Burlington, Ontario, Canada, pp. 60–65.
- Edge, T.: 2004, ‘Preliminary Investigations – Microbial Source Tracking with *Escherichia coli* in Hamilton Harbour’, in RAP Technical Team. *Research and Monitoring Report: 2003 Season*, May 2004, Burlington, Ontario, Canada, pp 90–91.

PROGRESS TOWARD DELISTING A GREAT LAKES AREA OF CONCERN

- Hamilton Harbour RAP (HH RAP): 1992a, Remedial Action Plan for Hamilton Harbour: Environmental Conditions and Problem Definition. *Second Edition of the Stage 1 Report*. Burlington, Ontario, Canada.
- Hamilton Harbour RAP (HH RAP): 1992b, Remedial Action Plan for Hamilton Harbour: Goals, Options and Recommendations. *Stage 2 Report, Volume 2 – Main Report*. Burlington, ON, Canada.
- Hamilton Harbour RAP (HH RAP): 1998, Hamilton Harbour Remedial Action Plan. *1998 Status Report*. Second Printing. Burlington, Ontario, Canada.
- Hamilton Harbour RAP Stakeholder Forum (HH RAP): 2003, Remedial Action Plan for Hamilton Harbour: Stage 2 Update 2002. Burlington, Ontario, Canada.
- Hamilton Harbour RAP Office: 2004, Hamilton Harbour RAP Monitoring Catalogue, Burlington, Ontario, Canada.
- Holland, Susan: 1996, *Hamilton Harbour Research and Monitoring Database: User Manual*, Environment Canada – Ontario Region. Burlington, Ontario, Canada.
- International Joint Commission, Great Lakes Water Quality Board (IJC): 1985, *1985 Report on Great Lakes Water Quality*. Kingston, Ontario, Canada.
- International Joint Commission United States and Canada: 1972, Great Lakes Water Quality: Agreement, with Annexes and Texts and Terms of Reference, Between the United States of America and Canada: signed at Ottawa April 15, 1972, Windsor, ON.
- International Joint Commission United States and Canada: 1978, Great Lakes Water Quality Agreement of 1978: Agreement, with Annexes and Terms of Reference, Between the United States of America and Canada, Signed at Ottawa November 22, 1978, Windsor, ON, Canada.
- International Joint Commission United States and Canada (IJC): 1987, Revised Great Lakes Water Quality Agreement of 1978: Agreement, with Annexes and Terms of Reference, Between the United States and Canada, Signed at Ottawa November 22, 1978 and Phosphorus Load Reduction Supplement signed October 16, 1983: as Amended by Protocol Signed November 18, 1987. Windsor, ON, Canada.
- International Joint Commission United States and Canada: 2004, Who We Are, Available at [http://www.ijc.org/en/background/biogr\\_commiss.htm](http://www.ijc.org/en/background/biogr_commiss.htm) (accessed 09/09/2004).
- Minns, C. K., Cairns, V. W., Randall, R. G. and Moore, J. E.: 1994, 'An Index of Biotic Integrity (IBI) for fish assemblages in the littoral zone of Great Lakes' areas of concern', *Can. J. Fish. Aquat. Sci.* **51**(8), 1804–1822.
- Morris, R. D., Pekarik, C., Weseloh, D. V. C. and Quinn, J. S.: 2001, 'Progress toward colonial waterbird population targets in Hamilton Harbour (1998–2000)', *Ontario Birds*. **19**(1), 12–25.
- Rusmir-Woods, C.: 2005. 'Windermere Arm Sediments' (working title), in RAP Technical Team. *Research and Monitoring Report: 2004 Season*, in preparation, Burlington, ON, Canada.
- Whittle, D. M.: 2003, 'Preliminary Investigations – Hamilton Harbour Contaminant Trend Monitoring Study', in RAP Technical Team. *Research and Monitoring Report: 2002 Season*, March 2003, Burlington, Ontario, Canada, pp. 2–6.
- Zeman, A. J. and Patterson, T. S.: 2003, 'Preliminary Investigations – Contaminated Sediment Mapping, Windermere Arm, Hamilton Harbour', in RAP Technical Team. *Research and Monitoring Report: 2002 Season*, March 2003, Burlington, Ontario, Canada, pp. 51–62.