Niagara Community Observatory

Policy Brief 14
December 2012

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The Niagara River Remedial Action Plan: 25 Years of Environmental Restoration

This policy brief reports on a success story. The past 25 years have seen a significant improvement in the quality of the Niagara River which is an important part of the Great Lakes system. Some important work remains to be done, but great strides have been made in the restoration of the Niagara River.

The Niagara River is an integral part of the largest freshwater system on Earth: the Great Lakes Basin. Famous for its world renowned waterfalls, the Niagara River connects Lake Erie to Lake Ontario and carries with it water from lakes Superior, Huron and Michigan. The Niagara River is also an international waterway, connecting Canada to the United States along its 58-km length. With an average flow rate of 5,700 cubic meters per second, the Niagara River accounts for 83% of the water flowing into Lake Ontario, which is a source of drinking water for millions of Ontarians. In the Niagara Region alone, approximately 130,000 people rely on Lake Ontario and the Niagara River for their drinking water. Other uses for the Niagara River include fish and wildlife habitat, recreational activities, power generation, and water for industry.

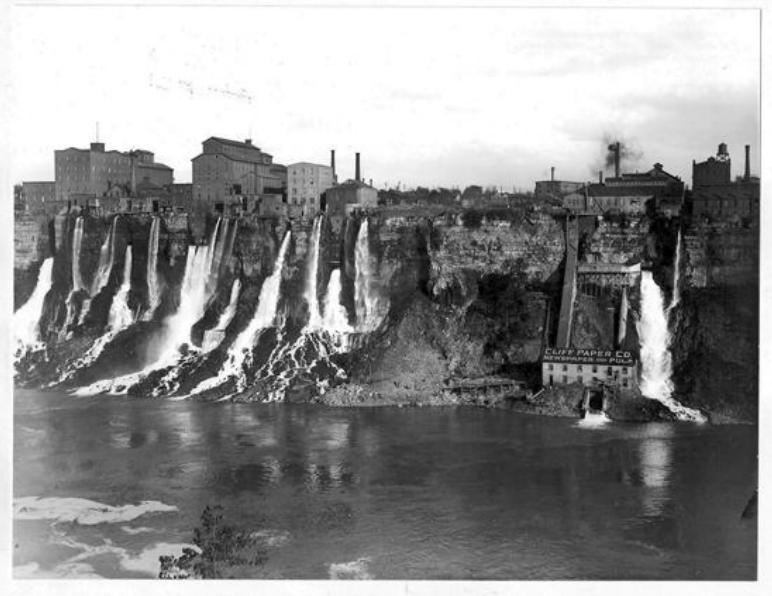


Figure 1. Used by permission, Niagara County Historical Society

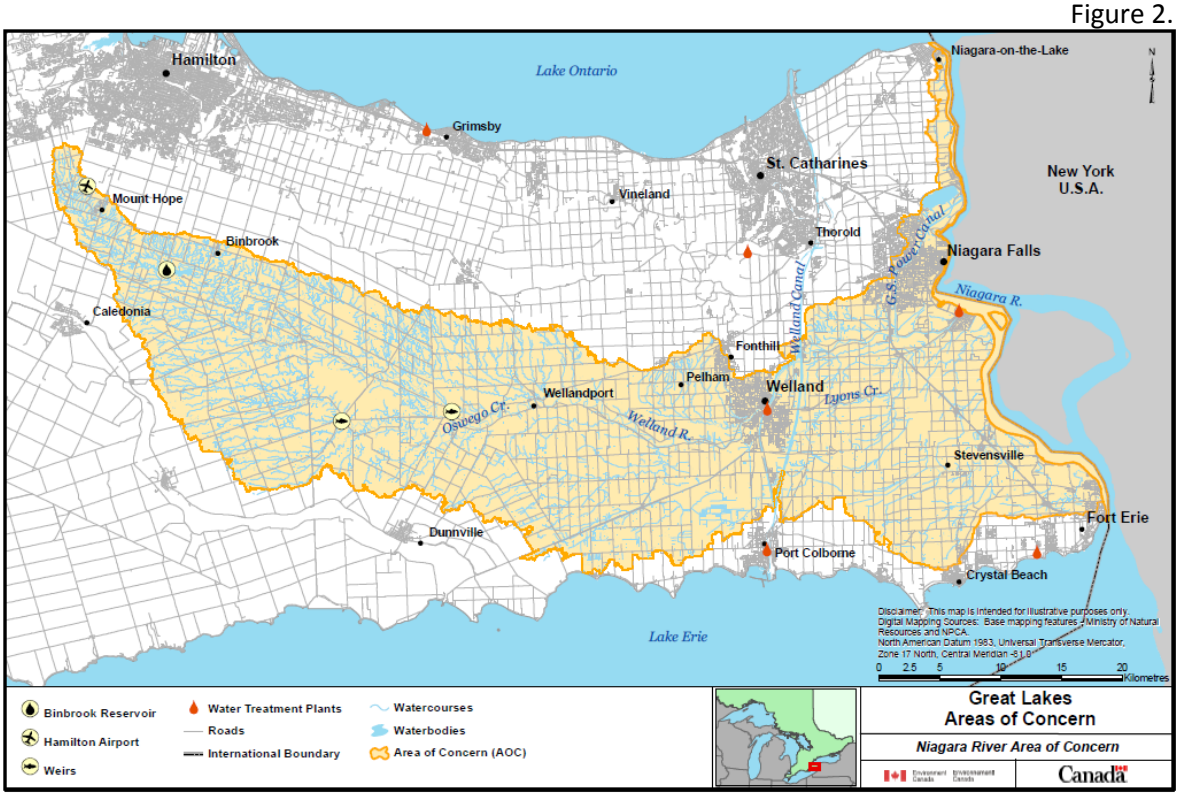
There is a long history of power generation and industrial development along the Niagara River. The advent of hydroelectric power harnessed from Niagara Falls led to the proliferation of chemical industries along the American side of the river (Figure 1). By the 1970s, there were approximately 700 chemical plants, steel mills, oil refineries and other industries discharging over 250 million U.S. gallons of wastewater into the Niagara River each day. As pollution levels increased and gained notoriety through well-publicized public health disasters such as Love Canal, pressure mounted from citizens, environmentalists and politicians to proactively address the severe degradation of the Niagara River. Addressing the environmental issues facing the Niagara River would require the commitment and cooperation of citizens and governments on both sides of the river.

The Great Lakes Water Quality Agreement, first signed in 1972, was renewed in 1978 to express the commitment of Canada and the U.S. to restore and maintain the overall integrity of the Great Lakes Basin ecosystem. In 1987, an amendment to the Agreement called for the development and implementation of Remedial Action Plans (RAPs) to restore ecosystem health at 43 Areas of Concern (AOCs) located within the Great Lakes Basin. That same year, the Niagara River was designated by federal and provincial governments in cooperation with the International Joint Commission (IJC) as one

of the 43 AOCs requiring a RAP. The IJC is an independent binational organization established to prevent and resolve disputes relating to the use and quality of boundary waters between Canada and the U.S. The Niagara River received this designation due to degraded water quality, which impaired the complete use of the river's resources.

Study area

Figure 2.



The development of the Niagara River RAP is a dynamic three-stage process coordinated by multiple government agencies on both sides of the river. Although the Niagara River AOC encompasses the river on both sides of the border, RAPs are developed independently in Ontario and New York State (representing Canada and the U.S., respectively). This policy brief will focus on the status of the Niagara River RAP in Ontario, and will be referred to hereinafter as the Niagara River RAP. The geographic extent of the Niagara River AOC in Ontario extends westward to Mount Hope, and includes several smaller watercourses which flow into the Niagara River. The Niagara River AOC includes the Welland River drainage basin, which is the largest tributary emptying into the Niagara River on the Canadian side (Figure 2). The Welland River drainage basin accounts for 81% of the AOC's total area but contributes less than 0.1% of the Niagara River's total flow. The Niagara River AOC also includes the Niagara Gorge and a portion of the Niagara Escarpment, which was designated by the United Nations as a UNESCO World Biosphere Reserve in 1990 due to its ecological and cultural significance (Figure 3). The Niagara River AOC also contains more than 100 wetlands that are

Figure 3.

recognized as being provincially significant, and the Niagara River corridor has been internationally recognized as an Important Bird Area for bird conservation and biodiversity.

The lead government agencies guiding the development of the Niagara River RAP in Ontario are Environment Canada, the Ontario Ministry of the Environment, and the Niagara Peninsula Conservation Authority. It is important to note that the RAP process is a collaborative, consensus-building process involving many participants, and includes extensive consultation with the public during all stages of its development. Once Stages 1 through 3 have been completed and the issues identified in the RAP have been addressed, the Niagara River AOC will be considered remediated or "delisted" (Table 1). The Niagara River RAP is currently in the third and final stage of the RAP process. The following sections highlight some of the key successes and challenges encountered by the Niagara River RAP as it moves towards delisting.

Table 1: Summary of RAP stages

Stage	Purpose	Status
1	Determine the severity and underlying causes of environmental degradation or impairment of beneficial uses that were the basis for the location being designated as an AOC	Completed
2	Identify and implement actions that will lead to the restoration and protection of beneficial uses and ecosystem health	Completed
3	Confirm, through monitoring, that identified beneficial uses and ecosystem health have been restored	Currently ongoing

Successes

Restored Beneficial Uses

The purpose of the Niagara River RAP is to identify major water quality concerns and take actions to resolve them. Degraded water quality limits the river's ability to provide beneficial uses to humans and wildlife. Examples of beneficial uses include recreational uses such as swimming at local beaches, and ecological uses such as fish and wildlife habitat. Several beneficial uses impacted by poor water quality were identified during Stage 1 of the RAP process. The Niagara River RAP Stage 1 Report was produced in 1993, and provides a description of environmental conditions and problems based on information available at the time of preparation. Since first identified in 1993, several beneficial uses have been restored or re-assessed, and are no longer considered impaired. For example, bird or animal deformities or reproduction problems were flagged in the Stage 1 report as an impaired beneficial use. A government review of scientific data pertaining to deformities and reproduction problems in aquatic wildlife within the Niagara River AOC was completed in 2009. Experts conducting the review concluded that the types and frequency of deformities and reproduction problems in aquatic wildlife associated with exposure to contaminants such as PCBs were similar to non-AOC sites, and as a result this beneficial use was no longer designated as impaired.

Six of the beneficial uses listed in Table 2 continue to be impaired; however, they are moving steadily towards delisting under the guidance of expert technical committees that are reviewing new and emerging data as it becomes available. For example, beach closings are listed in Table 2 as an impaired beneficial use; however, three of the four public beaches located in the Niagara River AOC are currently

meeting water quality targets for safe swimming. The one public beach that remains unsuitable for swimming is currently under investigation to determine the source of water quality contamination. Once this investigation has been completed and the source of contamination has been addressed, it is anticipated that this beneficial use will be re-designated as Not Impaired.

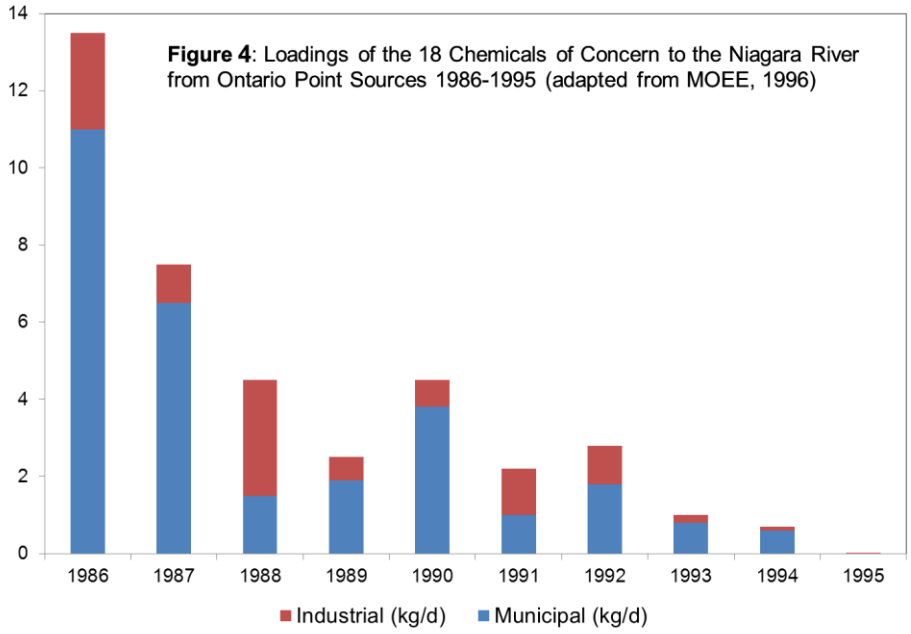
Table 2: Summary of beneficial use impairments for the Niagara River RAP

Not Impaired Beneficial Uses
Restrictions on wildlife consumption
Tainting of fish and wildlife flavour
Fish tumours or other deformities
Bird or animal deformities or reproduction problems
Restrictions on dredging activities
Degradation of aesthetics
Added costs to agriculture or industry
Restrictions on drinking water consumption or taste or odour problems
Beneficial Use Requires Further Assessment to Determine Status
Degradation of phytoplankton and zooplankton populations
Impaired Beneficial Uses
Restrictions on fish consumption
Degradation of fish and wildlife populations
Degradation of benthos
Eutrophication or undesirable algae
Loss of fish and wildlife habitat
Beach closings

Improved Water Quality

In 1987, government agencies from both Canada and the U.S. committed themselves to reducing concentrations of toxic pollutants in the Niagara River through the Niagara River Toxics Management Plan (NRTMP). In this plan, 18 priority toxic pollutants were specifically targeted for reduction because they exceeded the strictest agency standards for water, sediment or aquatic life in Lake Ontario and/or the Niagara River. Ten of the 18 pollutants were slated for 50% reduction from sources in Ontario and New York State by 1996 because they were deemed to have significant sources along the Niagara River.

Overall water quality in the Niagara River has improved significantly since the NRTMP was initiated in 1987. Based on a review of the current trend information, the original goal of a 50% reduction in the concentration of 10 of the 18 priority toxics has either been met or exceeded for most pollutants. Results have also shown that pollutant loads for the 18 priority toxics have been reduced by up to 99% between 1986 and 1995 from monitored point sources in Ontario (Figure 4). Monitored point sources are regulated wastewater discharges from municipalities and industrial facilities. In addition, it is estimated that the remediation of U.S. hazardous waste sites has reduced potential pollutant inputs to the river by more than 90%. Some of the secondary benefits of reducing toxic pollutant loads entering the river include reduced contamination of river sediment and improved ecosystem health. For example, toxic pollutants in the river contribute directly to the impairment of beneficial uses related to fish consumption. Despite the success of the NRTMP, more work is needed to further reduce pollutant concentrations in order to advance the restoration of beneficial uses.



Sediment Clean-up

Due to the fast flowing nature of the Niagara River, most of the river's sediment load is deposited in Lake Ontario. However, several areas in the smaller creeks and rivers flowing into the Niagara River have sediments contaminated with pollutants such as organic compounds (i.e. PCBs) or heavy metals. During Stage 1 of the RAP process, 14 contaminated sediment sites were identified in these smaller creeks and rivers located within the Niagara River AOC (Figure 5). Since first identified in 1993, all 14 sites have been assessed, and it was found that no further action was warranted at most of the sites due to low levels of contaminants, and that these sites would recover naturally over time. Three of the 14 sites required further actions to address elevated levels of sediment contamination.

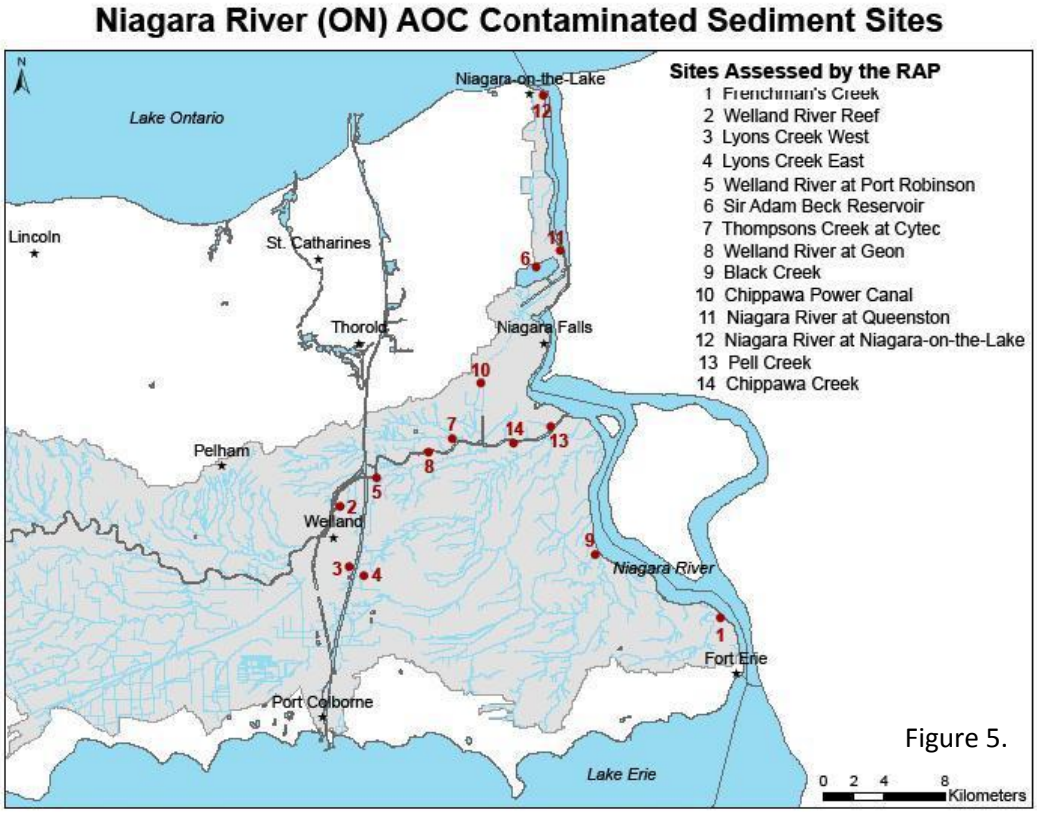


Figure 5.

Source: Niagara River RAP Stage 2: 1995

Actions undertaken to remediate contamination at two of these sites included the removal of contaminated sediment for off-site disposal. For example, approximately 10,000 cubic meters of contaminated sediment were removed from the Welland River in 1995 using state-of-the-art dredging techniques as part of the Welland River Reef Clean-Up Project (Figure 6). Another method used to address contaminated sediments is monitored natural recovery, with administrative controls. Administrative controls restrict certain human activities that could potentially disturb contaminated sediments (i.e. dredging). This remediation method is currently being applied to Lyons Creek East, and is one of only a few sites in Ontario that have applied administrative controls. Long-term monitoring of naturally recovering sediment sites will ensure that contaminant concentrations and their associated ecological risks continue to decrease over time.

Contributions to Science

Since its inception in 1987, the development of the Niagara River RAP has directly contributed to the generation of new and emerging information in several areas of science and technology. Scientific studies led or supported by the Niagara River RAP over the past 25 years have produced countless reports containing data and analysis that provide a greater understanding of the river's chemistry, biology, and ecology. For example, many of the beneficial uses listed in Table 2 have required (or continue to require) further scientific investigation to determine the nature and extent of the impairment. In some cases, the collection of additional information has revealed that a beneficial use previously designated as impaired is in fact not impaired. The Niagara River RAP also supports the implementation of new and emerging technologies for monitoring, analysis and remediation. For instance, the release of untreated sewage was identified as a serious concern in the Stage 1 report. In order to address this concern, the Niagara River RAP continues to work in partnership with local municipalities within the AOC to upgrade their wastewater treatment facilities and prevent the release of untreated sewage into the Niagara River.

Figure 6.

Challenges

Restoring Beneficial Uses

The restoration of the Niagara River's beneficial uses is both a success and a challenge for the Niagara River RAP. The remaining impairments are the result of decades of environmental degradation, with toxic wastewater discharges to the Niagara River dating back to the turn of the 20th century. These discharges have resulted in the current legacy of ecological problems that continue to face the river more than a century later. While pollutant concentrations in the Niagara River have declined steadily in recent years, the complete removal of pollutants from the surrounding ecosystem will require many more years to achieve. Restrictions on fish consumption, the loss of fish and wildlife habitat, and the degradation of benthos, fish and wildlife populations will require long-term strategies to monitor and assess improvements over time.

The restoration of beneficial uses is also challenged by the direct linkages between some of the beneficial uses. Certain beneficial uses cannot be fully restored without the restoration of one or more other beneficial uses. For example, the loss of fish and wildlife habitat contributes directly to the degradation of fish and wildlife populations. In addition, many of the remaining impaired beneficial uses are affected by contaminated sediments, which can expose aquatic life to pollutants. Most of the contaminated sediment sites identified in the Niagara River AOC rely on natural recovery as a means of remediation. There are many advantages to using natural recovery as a clean-up method; however, the process may require several decades to achieve full remediation, depending on the severity of the contamination. Contaminants present in the sediments can also become re-suspended in the water column and contribute to water quality problems such as eutrophication. Eutrophication is caused by excess nutrients (i.e. nitrogen, phosphorus) in the water column, which can lead to algal blooms and depleted dissolved oxygen for aquatic life. Eutrophication continues to impair beneficial uses in the Niagara River AOC, particularly in the Welland River where sediments are believed to play an important role as a source of nutrients.

Another challenge facing the restoration of beneficial uses is the absence of scientific information in certain areas. Restoring impaired beneficial uses in the Niagara River AOC requires a tremendous amount of scientific information for a very broad spectrum of disciplines, ranging from microbiology to municipal engineering. Many of the environmental issues facing the Niagara River and its tributaries are complex, and there are gaps in current knowledge. However, it is anticipated that many of these gaps will eventually be filled as analytical capabilities and scientific understanding continue to evolve over time.

Long-term Investment

One of the most significant challenges facing the Niagara River RAP is the ability to convey the importance of its long-term vision in a world that demands instant results. Many RAP targets, such as the natural recovery of contaminated sediments, will require long-term investments in monitoring and assessment to determine improvements over the course of many years. Achieving a complete environmental clean-up and meeting all restoration targets in the short term will not be possible. However, the overall health of the Niagara River continues to improve with every success that is achieved through the Niagara River RAP. The long-term success of the Niagara River RAP will lie in demonstrating to its many stakeholders through monitoring and assessment that it is meeting its restoration targets, and steadily moving forward towards delisting.

Next Steps

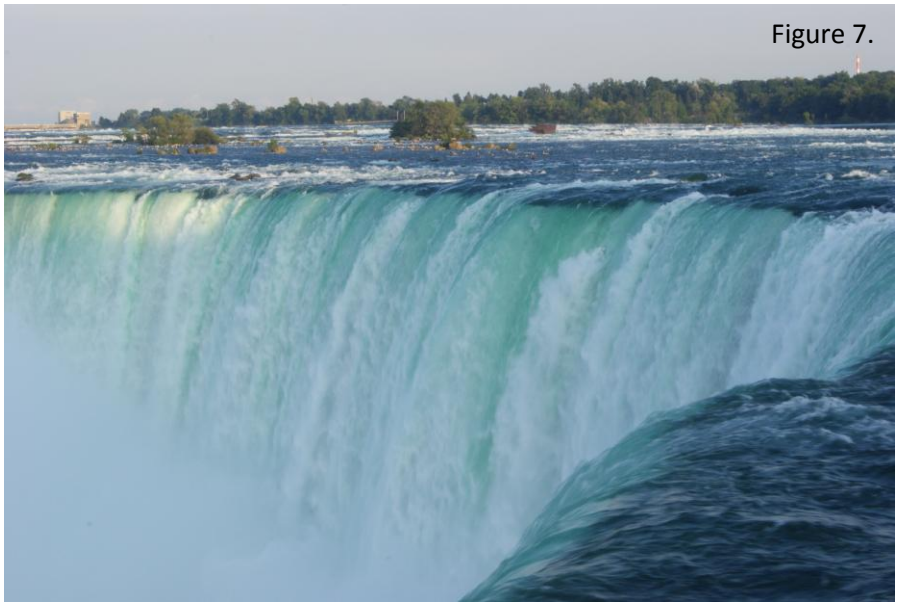


Figure 7.

Significant progress has been made in the Niagara River AOC since the RAP process was first initiated in 1987. Successes achieved over the past 25 years include the restoration of impaired beneficial uses, significant improvements in water quality, and the clean-up of contaminated sediments. These successes have contributed volumes of new scientific information to the existing knowledge base, and have expanded our understanding of the river and its tributaries. The collaborative efforts of the Niagara River RAP have improved the overall health of the Niagara River, and enhanced its ability to support the human and wildlife populations which depend on it. In addition, a recent U.S. study found that ecological restoration efforts in the Great Lakes Basin can generate significant economic benefits in metropolitan areas in the form of increased property values anywhere from $16.1 billion to $26.5 billion, with the largest benefits occurring in large cities located along the Great Lakes.

The successes of the Niagara River RAP would not have been possible without the cooperation of government agencies and the active involvement of the public. Strong inter-agency partnerships and community commitment will continue to play an essential role as the Niagara River RAP advances through its third and final stage. Stage 3 of the RAP is currently ongoing, and will address the remaining challenges facing the Niagara River AOC. Stage 3 includes key actions prioritized to address outstanding beneficial uses that continue to be designated as impaired. It is anticipated that Stage 3 of the Niagara River RAP will be completed in 2015, at which time the AOC will be delisted. Long-term monitoring will continue beyond 2015 to ensure that the environmental health of the Niagara River and its tributaries continues to improve over time.

References are available on the web version located at: www.brocku.ca/nco