Hamilton Harbour Remedial Action Plan
Beneficial Uses

2012 Fact Sheets

Approved by the 2012 HH RAP Stakeholder Forum

Reasonable...Achievable...Measurable
## 2012 Status Summary of the Beneficial Uses

### Beneficial Use Status: Impaired

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
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<tbody>
<tr>
<td>i</td>
<td>Restrictions on Fish Consumption</td>
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</tr>
<tr>
<td>iii</td>
<td>Degradation of Fish Populations</td>
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<tr>
<td>iii</td>
<td>Degradation of Wildlife Populations</td>
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<td>vi</td>
<td>Degradation of Benthos</td>
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<td>viii</td>
<td>Eutrophication or Undesirable Algae</td>
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<td>Beach Closings and Water Contact Sports</td>
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<td>Degradation of Aesthetics</td>
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<td>Loss of Fish and Wildlife Habitat</td>
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### Beneficial Use Status: Requires Further Assessment

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<td>i</td>
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<td>v</td>
<td>Bird or Animal Deformities or Reproduction Problems</td>
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<td>xiii</td>
<td>Degradation of Phytoplankton and Zooplankton</td>
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### Beneficial Use Status: Not Impaired

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<tr>
<td>ii</td>
<td>Tainting of Fish and Wildlife</td>
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<td>ix</td>
<td>Restrictions on Drinking Water Consumption</td>
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<td>Added Costs to Agriculture and Industry</td>
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<tr>
<td>vii</td>
<td>Restrictions on Dredging Activities</td>
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For more information, please visit our website at [www.hamiltonharbour.ca/rap](http://www.hamiltonharbour.ca/rap), send an email to rapoffice@ec.gc.ca, or call (905) 336-6279.
### Hamilton Harbour Remedial Action Plan (HH RAP) Beneficial Uses

<table>
<thead>
<tr>
<th>Status</th>
<th>2002 Status (fish)</th>
<th>2012 Status (fish)</th>
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### APPROVED BY 2012 RAP STAKEHOLDER FORUM:

1. Beneficial Use i status regarding fish consumption remain “impaired”.
2. Beneficial Use i delisting objective wording regarding fish consumption be updated as follows:

   Beneficial Use i (fish) will be considered not impaired when there is no significant difference in the fish consumption advisories for Hamilton Harbour compared to reference location(s) and the contaminants of concern are declining in Hamilton Harbour fish.

### 2002 HH RAP Delisting Objective:

That there be no restrictions on consumption of fish and wildlife from the Harbour attributable to local sources.

### Why Update the 2002 HH Wording?

**Reasonable:** The goal of restoring this Beneficial Use is not to eliminate all restrictive fish consumption advisories, rather to have advisories comparable to appropriate reference sites in the area. Showing a decline in HH fish contaminant levels alleviates concerns that the reference sites are simply deteriorating instead of HH fish actually improving.

**Achievable:** It is difficult to attribute restrictive fish consumption advisories to only local sources, particularly for fish species with large home ranges. A decline in contaminants in HH fish, especially in fish with small home ranges, is being used as a surrogate for improvements in local conditions.

**Measurable:** Likely reference locations are Western Lake Ontario, Lake Ontario central open water, and/or Jordan Harbour.

### What Was the Original Problem in Hamilton Harbour?

In the 1992 Stage 2 it was recognized that some species on the HH advisory list accumulate contaminants lake-wide due to migration into Lake Ontario. Prey fish (smelt, alewife, and gizzard shad) also move contaminants from Lake Ontario into the HH food chain. Mercury, PCB, Mirex, and pesticides were listed as the causes of impairment in fish. For wildlife, PCB concentrations in mallard ducks and snapping turtles were above U.S. standards. Information on wildlife contamination was considered deficient and the 1992 Stage 2 called for a Canadian standard for wildlife consumption to be developed.

### IJC Listing Guideline (1991):

When contaminant levels in fish or wildlife populations exceed current standards, objectives or guidelines, or public health advisories are in effect for human consumption of fish or wildlife. Contaminant levels in fish and wildlife must be due to contaminant input from the watershed.

### IJC Delisting Guideline (1991):

When contaminant levels in fish and wildlife populations do not exceed current standards, objectives or guidelines, and no public health advisories are in effect for human consumption of fish or wildlife. Contaminant levels in fish and wildlife must not be due to contaminant input from the watershed.

### Other AOC Comparisons:

Niagara River AOC specifies no “locally-controllable contaminant sources” focusing on PCBs. Jackfish Bay, Wheatley Harbour, St. Lawrence River, and St. Clair River AOC all refer to an appropriate reference site.
**BACKGROUND INFORMATION**

**What Has Been Done?**
Projects are indirectly related to reducing fish consumption restrictions.
- MISA program reduced inputs of chemicals into HH by industry and municipal WWTPs (Ongoing)
- Natural burying of historical sediments by “cleaner” fill from the watershed and point sources (Ongoing)

**How Are Things Today?**
- Health Canada (Scott 1998) funded a survey of fish consumption from 1995-1997. Only 20% of HH respondents ate their catch in comparison to a 38% average of all five AOCs sites surveyed. In response to “why don’t you eat your catch”: 70% of non-eaters reported polluted water and 32% reported dirty or contaminated fish. Researchers reported a noticeable ‘stigma’ attached to eating fish from HH.
- Current fish consumption advisories are still severely restrictive as shown in the table below with PCBs being the main driver behind fish consumption advisories in HH.

**What Still Needs To Happen?**
- A detailed assessment of fish consumption restrictions in HH needs to be completed. This is being done for the Toronto AOC by OMOE and goes beyond the basic listing in the advisory.
- ArcelorMittal Dofasco Boat Slip Sediment Remediation Project has a PCB component (targeted for 2015 completion)
- The source of PCBs measured in the Windermere Arm area sediments needs to be determined.

**When Will The Status Change?**
- A re-evaluation should be made after all scientifically feasible and economically reasonable actions have been implemented.
- Anticipate years of natural recovery after the last sediment project is completed.

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### Current fish consumption advisories for Hamilton Harbour (meals per month)

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Data Source: OMOE

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### REFERENCES

**Where Can I Learn More?**
- OMOE. 2011.  2011-2012 Guide to Eating Ontario Sport Fish (along with previous versions)
- Scott, F. 1998.  Down by the Bay: a profile of shoreline fishing and fish consumption in the Hamilton Harbour area

Most references can be provided by the HH RAP Office as a PDF upon request
2012 FACT SHEET

Hamilton Harbour Remedial Action Plan (HH RAP) Beneficial Uses

RESTRICTIONS ON WILDLIFE CONSUMPTION

<table>
<thead>
<tr>
<th>2002 Status (wildlife)</th>
<th>2012 Status (wildlife)</th>
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STATUS

APPROVED BY 2012 RAP STAKEHOLDER FORUM:

1. Beneficial Use i status regarding wildlife consumption remain “requires further assessment”.
2. Beneficial Use i delisting objective wording regarding wildlife consumption remain the same:

   Beneficial Use i (wildlife) will be considered not impaired when there are no restrictions on consumption of wildlife from the Harbour attributable to local sources.

2002 HH RAP Delisting Objective:
That there be no restrictions on consumption of fish and wildlife from the Harbour attributable to local sources.

Why Keep the 2002 Status and HH Wording?

Wildlife Population Levels: One of the reasons current wildlife consumption levels are low is that the populations of wildlife traditionally hunted are quite small. Recovery of wildlife populations are anticipated due to the efforts of the HH RAP and safe consumption should remain part of that recovery. By requesting “requires further assessment” the HH RAP would be looking to the future of hunting to return as a beneficial use for this area.

Desire for Hunting: RBG staff report there is a segment of the local population who would like to be able to hunt again in Hamilton Harbour/Cootes Paradise.

Hunting Restrictions: The City of Hamilton and the City of Burlington both have by-laws in place which prohibit the discharge of a firearm or bow within the limits of their cities. The RBG controls the bed of Cootes Paradise and they have a by-law making it unlawful for people to “…kill any bird, animal, vertebrate or invertebrate” within the limits of the Gardens. There is apparently a historical Hamilton Harbour Commissioners (now Hamilton Port Authority) restriction on firearm discharge on the Harbour, but it was not located.

Wildlife Flesh Testing: In 1990 Canadian Wildlife Service released non-flying, farm-raised ducks into HH CDFs and tested the flesh after 10, 30 and 70 days after release. All ducks collected had PCB concentrations exceeding Health and Welfare Canada guidelines for edible poultry. As a result, actions were taken to discourage the use of CDFs by waterfowl.

Consumption Guidelines: There are no current Ontario or Canada guidelines for determining safe wildlife consumption. Health Canada does have edible poultry guidelines which maybe could be consulted.

Remedial Actions: No further remedial actions beyond those already in the works for other Beneficial Uses were envisioned to address this issue.

Monitoring: It would be practical to look to monitor species already studied for other purposes, for example, herring gulls, turtles, and mink. If contaminant levels in the flesh of these animals were found to be safe for human consumption, other “consumption desirable” resident wildlife should also be safe too (e.g. mallards, scaups, Canada Geese).

Dilemma: Do not want to give the impression that wildlife is safe for consumption. Do not want to give the impression that wildlife hunting is a use most stakeholders want restored.

REFERENCES

Where Can I Learn More?
Royal Botanical Gardens. 1989. RBG By-Law No. 01-3_C 3(a).

Most references can be provided by the HH RAP Office as a PDF upon request.
The 1992 Stage 2 Report indicated no known impairment existing in HH fish as there had been no complaints. Tainting of wildlife flavour was also not observed. No formal study of tainting of fish and wildlife had yet been undertaken.

When ambient water quality standards, objectives, or guidelines, for the anthropogenic substance(s) known to cause tainting, are being exceeded or survey results have identified tainting of fish or wildlife flavor.

IJC Delisting Guideline (1991):
When survey results confirm no tainting of fish or wildlife flavor.

How Are Things Today?
Through three lines of evidence (no public complaints, low phenolics loadings, and positive survey of users) this beneficial use can be considered to be not impaired in Hamilton Harbour.

- There are no known records of recent complaints regarding fish or wildlife tainting in Hamilton Harbour (HH) or Cootes Paradise (CP).
- Flavour tainting is traditionally related to phenols and current loadings to HH are likely too low to result in tainting of flavour. The estimated phenolics loadings to HH decreased substantially between 1974 (2600 kg/day) and 1989 (15 kg/day), with further decreases by 2006 (4 kg/day).
- Health Canada funded a survey of fish consumption by people fishing in HH and CP from 1995-1997 which did include a tainting question. There were only 2 reports of “fish taste or smell bad” out of 375 people asked (Scott 1998).

Other AOC Comparisons:
These lines of evidence are consistent with other AOCs. Detroit River AOC and St. Clair River AOC utilize surveys. Ohio AOCs test for water quality standards exceedences of compounds associated with tainting, as well as relying on reports of tainting from wildlife officials. Michigan AOCs rely on reports of tainting to officials followed with an analysis only if there are reports.
Hamilton Harbour Remedial Action Plan (HH RAP) Beneficial Uses

<table>
<thead>
<tr>
<th>DEGRADATION OF FISH POPULATIONS</th>
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APPROVED BY 2012 RAP STAKEHOLDER FORUM:

1. Beneficial Use iii status regarding fish populations remain “impaired”.
2. Beneficial Use iii delisting objective wording regarding fish populations be updated as follows:
   a. Shift from a fish community indicative of eutrophic environments (e.g. White Perch, Alewife, Bullheads, and Carp) to a self-sustaining community more representative of a mesotrophic environment with a balanced trophic composition that includes top predators (e.g. Northern Pike, Largemouth Bass and Walleye) and other native species (e.g. Suckers, Yellow Perch and Sunfishes).
   b. Attain an Index of Biotic Integrity (IBI) of 55-60 for Hamilton Harbour and maintain the target score for two sequences of monitoring carried out a minimum of every three years. The IBI incorporates components of native species richness, numbers and biomass; piscivore biomass; non-native species; and reflects water quality and the quality of fish habitat.

2002 HH RAP Delisting Objective:

That the fish community has the following structure:
   a. Shift from a fish community indicative of eutrophic environments, such as White Perch, Alewife, Bullheads, and Carp to a self-sustaining community more representative of a mesotrophic environment, containing Pike, Bass, Yellow Perch, and Sunfish.
   b. Attain a littoral fish biomass of 200 - 250 kg/ha.
   c. Increase the species richness from 4 species to 6-7 species per transect.
   d. Increase the native species biomass from 37% to 80-90% of the total biomass.
   e. Reduce the spatial variability in fish biomass within the Harbour.
   f. Proposed nearshore fish community of Hamilton Harbour:

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<th>Category</th>
<th>Littoral Biomass (kg/ha)</th>
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<tr>
<td>Piscivores (pike, bass)</td>
<td>40 - 60</td>
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<td>Specialists (Insectivores like pumpkinseeds and Yellow Perch)</td>
<td>70 - 100</td>
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<tr>
<td>Generalists (Omnivores like Carp and Brown Bullhead)</td>
<td>30 - 90</td>
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   The percent of fisheries biomass allocated to the three trophic groups was based on the effects of improved water quality in the Bay of Quinte and Severn Sound. The littoral fish biomass of 200-250 kg/ha was based on electrofishing data collected from Hamilton Harbour, Bay of Quinte and Severn Sound in 1990.
   g. Attain an Index of Biotic Integrity (IBI) of 55-60 for Hamilton Harbour.

Why Update the 2002 HH Wording?

Reasonable: This objective was updated in 2002 to include reference to an Index of Biotic Integrity (IBI). The objective for the composition of the HH fish community is specifically defined. The IBI integrates factors affecting the fish community and is a means to standardize the comparison of Hamilton Harbour with other areas in the Great Lakes. Bullets a – f in the 2002 version are all metrics included in the IBI calculation, so were redundant. Wording has been added to this delisting objective to include a period of monitoring to ensure sustainability of the fish community has been reached. HH objectives are consistent with both the OMNR HH Fisheries Management Plan and the Fish Community Objectives for Lake Ontario.

Achievable: This fish community structure and IBI are based on research from comparable Great Lakes sites and modified specifically for Hamilton Harbour. The HH RAP is not expected to be accountable for outside stresses on fish populations beyond our local control.

Measurable: Fisheries and Oceans Canada and the Ontario Ministry of Natural Resources conduct ongoing monitoring to measure these specific fishery targets.

What Was the Original Problem in Hamilton Harbour?

The fish community was dominated by invasive, pollution tolerant species; 60% of the Harbour wetlands had been filled to create Port and industrial land; and very few aquatic plants grew in the nearshore zone of the Harbour. Cootes Paradise and the mouth of the Grindstone Creek were dominated by carp.

Reasonable...Achievable...Measurable
BACKGROUND INFORMATION

When fish and wildlife management programs have identified degraded fish or wildlife populations due to a cause within the watershed. In addition, this use will be considered impaired when relevant, field-validated, fish or wildlife bioassays with appropriate quality assurance/quality controls confirm significant toxicity from water column or sediment contaminants.

IJC Delisting Guideline (1991):
When environmental conditions support healthy, self-sustaining communities of desired fish and wildlife at predetermined levels of abundance that would be expected from the amount and quality of suitable physical, chemical and biological habitat present. An effort must be made to ensure that fish and wildlife objectives for Areas of Concern are consistent with Great Lakes ecosystem objectives and Great Lakes Fishery Commission fish community goals. Further, in the absence of community structure data, this use will be considered restored when fish and wildlife bioassays confirm no significant toxicity from water column or sediment contaminants.

Other AOC Comparisons:
Other AOCs have tended towards more general targets for their fish communities, refer to their Fisheries Management Plan (St. Lawrence River AOC and Niagara River AOC), or compare to a suitable reference site (Jackfish Bay).

What Has Been Done?
Fish habitat has been added to six different sites around the harbour and improvements in water quality have seen the return of vegetation to the nearshore zone. Cootes Paradise restoration has been ongoing including the construction of a fishway/carp barrier. The mouth of the Grindstone Creek has included pike spawning ponds and wetland restoration.

How Are Things Today?
This figure shows the IBI (Index of Biotic Integrity) of the Harbour has improved from <30 in 1990 to ~40 in 2010. Over the years substantial data sets have been developed for the fish community and associated macrophyte and wetlands.

What Still Needs To Happen?
- Water quality improvements required to meet Beneficial Use viii (Eutrophication or undesirable algae) will account for a major portion of the fishery changes directly in the Harbour. The restoration of the Cootes Paradise Marsh and the mouth of the Grindstone Creek as defined in Beneficial Use xiv (Loss of Fish and Wildlife Habitat) will aid to restructure the fish community.
- Ontario Ministry of Natural Resources plans to stock walleye in Hamilton Harbour (2012).
- Over the longer term, the Hamilton Harbour and Watershed Fisheries Management Plan targets cold water fish (lake herring) in the harbour.

When Will The Status Change?
The fish community will take years to respond to improvements to water quality and improvements to the habitat, particularly the restoration of the Cootes Paradise Marsh and Grindstone Creek. The desired outcome will likely come to fruition in the decade after 2020. It will however be possible to track the trend in the fish community via the IBI scores every few years.

REFERENCES
Where Can I Learn More?


Most references can be provided by the HH RAP Office as a PDF upon request.

Most references can be provided by the HH RAP Office as a PDF upon request.
Hamilton Harbour Remedial Action Plan (HH RAP) Beneficial Uses

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DEGRADATION OF WILDLIFE POPULATIONS

APPROVED BY 2012 RAP STAKEHOLDER FORUM:

1. Beneficial Use iii status regarding wildlife populations remain “impaired”.

2. Beneficial Use iii delisting objective wording regarding wildlife populations be updated as follows:

   Beneficial Use iii (wildlife populations) will be considered not impaired when:

   1. Colonial waterbirds:
      The overall objective is to have a sustainable mixed community of colonial waterbirds. In general are aiming for an increase of the rarer species and a reduction in the number of over-abundant species. Management of colonial waterbirds and achieving specific populations of particular species requires an adaptive management approach be in place to ensure sustainable populations continue to the extent possible after delisting.

      Targets (Number of Nests):
      - Ring-billed Gulls < 10,000;
      - Herring Gulls 200-300+;
      - Double-crested Cormorants < 2,500;
      - Common Terns 300-600+;
      - Caspian Terns 400-600+;
      - Black-crowned Night Herons 100-200+

   2. Other wildlife including waterfowl:
      No target will be suggested for other species of birds or animals, but a target for habitat (BU xiv) has been suggested which will enhance wildlife populations generally. In addition, management of some species may be necessary as a result of habitat enhancement.

2002 HH RAP Delisting Objective:

1. Colonial waterbirds:
   The overall objective is to have a self sustaining mixed community of colonial waterbirds generally with an increase of the rarer species and a reduction in the number of ring-billed gulls which currently nest in the Harbour. These figures are subject to revision once these general levels have been reached. Management of colonial waterbirds is experimental and achieving specific populations of particular species is highly speculative.

   Suggested Interim Targets (Number of Pairs):
   - Ring-billed gulls (Larus delawarensis) = 5,000;
   - Herring gulls (Larus argentatus) = 350;
   - Double-crested cormorants (Phalacrocorax auritus) > 200;
   - Common terns (Sterna hirundo) > 600;
   - Caspian terns (Sterna caspia) > 200;
   - Black-crowned night herons (Nycticorax nycticorax) = 200

2. Other wildlife including waterfowl:
   No target will be suggested for other species of birds or animals, but a target for habitat has been suggested which will enhance wildlife populations generally. In addition, management of some species may be necessary as a result of habitat enhancement.

   That fish and wildlife bioassays confirm no significant toxicity from water column or sediment contaminants.

Why Update the 2002 HH Wording?

Reasonable:
Existing targets for colonial waterbird populations were interim targets. New habitat has been constructed in the Harbour and 10 years experience with the bird populations and habitat available allows the refinement of population targets. The reference to bioassay should be removed as there is sufficient community structure data to rely on for the colonial waterbirds (and fish populations).

Achievable:
The new targets are best estimates of populations and management practices on constructed habitat have been refined over the past 10 years. The management of colonial waterbirds and achieving specific populations of particular species will need to follow a long term adaptive management plan developed to ensure sustainable populations continue, to the extent possible, after delisting.

Measurable:
The IJC delisting criteria asks for “predetermined levels of abundance”, therefore HH RAP will continue to set desired population numbers/ranges as part of this BUI. A program of annual monitoring is ongoing.
What Was the Original Problem in Hamilton Harbour?
Habitat was contaminated and temporary; communities dominated by a few overabundant species; clean permanent and species appropriate habitat preservation, enhancement, and management was required.

When fish and wildlife management programs have identified degraded fish or wildlife populations due to a cause within the watershed. In addition, this use will be considered impaired when relevant, field-validated, fish or wildlife bioassays with appropriate quality assurance/quality controls confirm significant toxicity from water column or sediment contaminants.

IJC Delisting Guideline (1991):
When environmental conditions support healthy, self-sustaining communities of desired fish and wildlife at predetermined levels of abundance that would be expected from the amount and quality of suitable physical, chemical and biological habitat present. An effort must be made to ensure that fish and wildlife objectives for Areas of Concern are consistent with Great Lakes ecosystem objectives and Great Lakes Fishery Commission fish community goals. Further, in the absence of community structure data, this use will be considered restored when fish and wildlife bioassays confirm no significant toxicity from water column or sediment contaminants.

Other AOC Comparisons:
Detroit River AOC targets “self-sustaining and healthy communities of indicator wildlife species” with three listed examples. Wheatley Harbour AOC doesn’t specify any species, just there be “no evidence of impacts to wildlife populations”. Niagara River AOC and St. Lawrence River AOC list specific species, comparison to reference, but no targeted numbers.

What Has Been Done?
- Habitat built: NE Islands (1995-96), LaSalle shoals (1995-96); Windermere Basin (2010-12)
- Active management: NE Islands and Windermere Basin; cormorants, gulls and geese throughout Harbour

How Are Things Today?
- These charts show the population dynamics for the targeted colonial water-bird species with the red shaded area showing the recommended target or target range.

What Still Needs To Happen?
- Ongoing active management to reduce the numbers of ring-billed gulls and cormorants required at some locations.
- Ongoing active management to support common terns, Caspian terns, and herring gulls.
- Habitat being built for common terns and black-crowned night herons at the Windermere Basin marsh (2013).

When Will The Status Change?
- All colonial waterbird habitat will be completed by 2013 and management efforts will attempt to meet targets by 2020.

Where Can I Learn More?
HH RAP Technical Team. 2008. Memo: Recommending the Removal of Bioassays from Delisting Objective iii

Most references can be provided by the HH RAP Office as a PDF upon request.
Hamilton Harbour Remedial Action Plan (HH RAP) Beneficial Uses

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**FISH TUMOURS OR OTHER DEFORMITIES**

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**APPROVED BY 2012 RAP STAKEHOLDER FORUM:**

1. Beneficial Use iv status be updated to “requires further assessment”.
2. Beneficial Use iv delisting objective wording be updated as follows:
   
   Beneficial Use iv will be considered not impaired when incidence rates of fish tumours in brown bullheads, as an indicator species, do not statistically exceed rates at relevant reference site(s).

**2002 HH RAP Delisting Objective:**

When incidence rates of fish tumours or other deformities do not exceed rates at unimpacted control sites that are locally relevant and when survey data confirm the absence of neoplastic or preneoplastic liver tumours in bullheads or suckers.

**Why Update the 2002 Status?**

- Environment Canada reviewed fish tumour data from all Canadian AOCs (Completed 2010). Hamilton Harbour was the only AOC site of the six surveyed which had a statistically significant difference (p ≤ 0.05) from its reference. An analysis of the age of the fish used from HH revealed they were older than reference site fish which may have been a factor in the higher number of tumours. This led to the recommendation that another round of sampling be undertaken for HH to determine the validity of the statistical difference.
- Environment Canada has budgeted for this additional HH survey to occur between 2012 and 2015.

**Why Update the 2002 HH Wording?**

*Reasonable:* Scientists no longer recommend “preneoplastic lesions be used as an actual impairment criterion” due to uncertainties they all progress to tumours (Baumann 2010, p. 5).

*Achievable:* Current wording specifies an “absence of…tumours”. This is not biologically achievable as these can occur naturally, hence the comparison to a reference site.

*Measurable:* A protocol for measuring fish tumours and statistically comparing results to reference sites has been established for use in Canadian AOCs.

**BACKGROUND INFORMATION**

**What Was the Original Problem in Hamilton Harbour?**

HH was the only Canadian AOC originally to be listed as “having a brown bullhead population with external and liver tumor epizootics during studies carried out prior to the mid 1990s” (Baumann 2010, p. 2).

**IJC Listing Guideline (1991):**

When the incidence rates of fish tumours or other deformities exceed rates at unimpacted control sites or when survey data confirm the presence of neoplastic or preneoplastic liver tumours in bullheads or suckers.

**IJC Delisting Guideline (1991):**

When the incidence rates of fish tumors or other deformities do not exceed rates at unimpacted control sites and when survey data confirm the absence of neoplastic or preneoplastic liver tumors in bullheads or suckers.

**Other AOC Comparisons:**

Detroit River AOC, Ohio AOCs, and Michigan AOCs specifically look to brown bullheads, but Jackfish Bay AOC does not specify a species. None of these AOCs refer to “neoplastic liver tumours”, but most refer to “fish tumour” and “deformities”. Fish sampled by Ohio and Michigan are to be three years or older. Detroit River establishes a minimum of two sampling events spaced three years apart to delist.

*Reasonable...Achievable...Measurable*
**BACKGROUND INFORMATION**

**What Has Been Done?**
Projects are indirectly related to reducing fish tumours or other deformities.
- MISA program reduced inputs of chemicals into HH by industry and municipal WWTPs (Ongoing)
- Natural burying of historical sediments by “cleaner” fill from the watershed and point source contributions (Ongoing)
- RBG Fishway – long term visual monitoring of fish traversing the Fishway provides anecdotal evidence on frequency of visible tumours (Ongoing)

**How Are Things Today?**
Environment Canada reviewed fish tumour data from all Canadian AOCs (Completed 2010). Hamilton Harbour was the only AOC site of the six surveyed which had a statistically significant difference from its reference.

Baumann Report Highlights:
- Hamilton Harbour samples were collected in 2001, 2005 and 2007.
- Jordan Harbour was used as the reference site.
- For all three years data combined, HH had a 5.5% liver tumour incidence, but Jordan Harbour only had 1.6%. This difference was statistically significant (P = 0.013).
- HH fish were the oldest mean age of any AOC sampled with 2007 samples averaging 3 years older than 2005 samples. Potentially “a more age specific comparison of the Hamilton Harbour [tumour] data might not demonstrate such a divergence from the reference data set.” (Baumann 2010, p. 13)

**What Still Needs To Happen?**
- “An additional [HH] survey is recommended with sampling techniques or size cut-offs designed to simulate, as much as possible, the IC data base age structure” (Baumann 2010, p. 13). Environment Canada has budgeted for this additional HH survey to occur between 2012 and 2015.
- Randle Reef Sediment Remediation Project (in water work targeted for 2019 completion)
- ArcelorMittal Dofasco Boat Slip Sediment Remediation Project (targeted for 2015 completion)
- PCB source track-down for Windermere Arm (ongoing)

**When Will The Status Change?**
To be evaluated by the RAP Technical Team upon receipt of next HH survey results. If status reverts back to “impaired” based on that survey, anticipate a few years of recovery after the last sediment project is completed.

**REFERENCES**

Baumann, P. C. March 2010. Data Analysis and Fish Tumor BUI Assessment for the Lower Great Lakes and Interconnecting Waterways.

*Most references can be provided by the HH RAP Office as a PDF upon request*
2012 FACT SHEET

Hamilton Harbour Remedial Action Plan (HH RAP) Beneficial Uses

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**STATUS**

APPROVED BY 2012 RAP STAKEHOLDER FORUM:

1. Beneficial Use v status be updated to “requires further assessment”.
2. Beneficial Use v delisting objective wording be updated as follows:

   Beneficial Use v will be considered not impaired when the types and frequency of deformities and/or reproductive impairments associated with contaminant exposure are similar to those seen at a suitable reference site(s), and do not result in a population level effect as examined through sentinel species (e.g. snapping turtles and herring gulls).

2002 HH RAP Delisting Objective:

When the incidence rates of deformities or reproductive problems in sentinel wildlife species do not exceed background levels in control populations.

Why Update the 2002 Status and HH Wording?

**Reasonable:** The expectation for HH is to have healthy self sustaining native wildlife populations. Herring gulls and snapping turtles are high on the food web and their health should be indicative of the broader wildlife community.

**Achievable:** While further assessment of the condition of the sentinel species is required, wildlife deformities and reproductive impairments do not appear obvious at a population level. It is anticipated that remedial actions presently planned for toxic substances and the ongoing Province of Ontario program for municipal and industrial abatement (MISA) will limit exposure to toxics to meet this delisting objective.

**Measurable:** Environment Canada (EC) has an ongoing monitoring program for contaminants in herring gull eggs. This is an annual program initiated in the 1970s. Periodic monitoring of contaminants, reproduction and deformities in snapping turtles, a supplementary 2-year assessment of reproduction and deformities in Northern Leopard Frogs and a standardized assessment of deformities in Double-crested Cormorant nestlings by EC should provide the additional data necessary for final evaluation of the status.

2002 HH RAP Delisting Objective:

When the incidence rates of deformities or reproductive problems in sentinel wildlife species do not exceed background levels in control populations.

Why Update the 2002 Status and HH Wording?

**Reasonable:** The expectation for HH is to have healthy self sustaining native wildlife populations. Herring gulls and snapping turtles are high on the food web and their health should be indicative of the broader wildlife community.

**Achievable:** While further assessment of the condition of the sentinel species is required, wildlife deformities and reproductive impairments do not appear obvious at a population level. It is anticipated that remedial actions presently planned for toxic substances and the ongoing Province of Ontario program for municipal and industrial abatement (MISA) will limit exposure to toxics to meet this delisting objective.

**Measurable:** Environment Canada (EC) has an ongoing monitoring program for contaminants in herring gull eggs. This is an annual program initiated in the 1970s. Periodic monitoring of contaminants, reproduction and deformities in snapping turtles, a supplementary 2-year assessment of reproduction and deformities in Northern Leopard Frogs and a standardized assessment of deformities in Double-crested Cormorant nestlings by EC should provide the additional data necessary for final evaluation of the status.

**What Was the Original Problem in Hamilton Harbour?**

Gross visible deformities such as crossed bills were seen in colonial water-bird at colonies in HH. These were considered to be the result of historical industrial and municipal inputs to the Harbour and airborne contaminants falling within the watershed. Snapping turtles showed reproduction anomalies and high levels of PCBs.

**IJC Listing Guideline (1991):**

When wildlife survey data confirm the presence of deformities (e.g. crossbill syndrome) or other reproductive problems (e.g. eggshell thinning) in sentinel wildlife species.

**IJC Delisting Guideline (1991):**

When the incidence rates of deformities (e.g. crossbill syndrome) or reproductive problems (e.g. eggshell thinning) in sentinel wildlife species do not exceed background levels in inland control population.

**Other AOC Comparisons:**

Niagara River AOC lists examples of snapping turtles and herring gulls as sentinel species. Detroit River AOC and Niagara River AOC data are compared to reference sites. Michigan AOCs require a minimum of two successive monitoring cycles.

**Reasonable...Achievable...Measurable**
BACKGROUND INFORMATION

What Has Been Done?
The Province of Ontario program for municipal and industrial abatement (MISA) is likely the principal factor in the reduction of ongoing contaminants directly to Hamilton Harbour. Similar measures to prevent or diminish air borne contaminants getting into the watershed have been ongoing at an international level.

How Are Things Today?
There has been a 30 year decline in contaminant levels measured in herring gull eggs from Hamilton Harbour (see Figure). While concentrations of certain contaminants found in sentinel species are higher in Hamilton Harbour than some other AOCs, contaminant-induced effects do not appear to be limiting factors at the population level for colonial waterbirds in Hamilton Harbour (Hughes et al. 2010). Nevertheless, hatching success of snapping turtles was the second lowest measured in 14 sites across the lower Great Lakes. While there are no recent reports of gross deformities of colonial waterbirds in the Harbour, standardized surveys for deformities have not been conducted in over 20 years, possibly influencing the likelihood of detecting deformities. Planned surveys for deformities in cormorants and studies of reproduction and deformities in turtles and frogs in 2012/13 should clarify the situation.

What Still Needs To Happen?
- There is a need to develop and confirm reference sites for comparison to Hamilton Harbour, preferably within Lake Ontario.
- Ongoing studies by EC to measure contaminants and assess endpoints of reproduction and deformities in sentinel species need to continue to provide essential information for final assessment of BUI status.
- Remedial Actions for Randle Reef and the ArcelorMittal Dofasco Boat Slip need to be completed.
- PCB source track-down needs to continue in the Windermere Arm of the Harbour

When Will The Status Change?
- This will be determined when further assessment of this BUI is carried out.

REFERENCES


Most references can be provided by the HH RAP Office as a PDF upon request.
2012 FACT SHEET

Hamilton Harbour Remedial Action Plan (HH RAP) Beneficial Uses

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DEGRADATION OF BENTHOS

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APPROVED BY 2012 RAP STAKEHOLDER FORUM:

1. Beneficial Use vi status remain "impaired".

2. Beneficial Use vi delisting objective wording be updated as follows:

   Beneficial Use vi will be considered not impaired when remedial actions to address contaminated sediment have been implemented and follow-up monitoring demonstrates improved benthic community structure and a reduction in acute and chronic toxicity attributable to contaminants in Hamilton Harbour sediments relative to historical surveys.

   Progress should continue to be made towards these desired outcomes:

   1. Littoral Zone (depth < upper limit of maximum extent of anoxic conditions)
      - Benthic community structure (BCS) is not different from that of appropriate reference conditions and BCS is not correlated to sediment contaminant levels among sites.
      - Acute and chronic sediment toxicity attributable to contaminants in sediments not different from appropriate reference conditions.

   2. Profundal Zone (depth > upper limit of maximum extent of anoxic conditions)
      - BCS is not correlated to sediment contaminant levels among sites.
      - Acute and chronic sediment toxicity attributable to contaminants in sediments not different from appropriate reference conditions.

2002 HH RAP Delisting Objective:

Using the BEAST (BEnthic Assessment of SedimenT) Methodology:

1. Littoral Zone (depth < upper limit of maximum extent of anoxic conditions)
   - Benthic community structure (BCS) not different from that of appropriate reference sites in the Great Lakes (i.e., Hamilton Harbour sites determined as "equivalent to reference conditions" by BEAST methodology) and BCS not correlated to sediment contaminant levels among sites.
   - Absence of acute or chronic sediment toxicity attributable to contaminants in sediments.

2. Profundal Zone (depth > upper limit of maximum extent of anoxic conditions)
   - BCS not correlated to sediment contaminant levels among sites.
   - Absence of acute or chronic sediment toxicity attributable to contaminants in sediments.

Why Update the 2002 HH Wording?

Reasonable: The primary goal of this Beneficial Use is to improve the benthic community numbers and diversity in comparison to historical records by completing sediment management plans for severely contaminated areas. The ultimate goal is to have populations across the whole Harbour similar to reference conditions which need to reflect HH’s urban/industrial setting.

Achievable: Anticipate years of natural recovery after the last sediment project is completed before the desired outcomes are reached; however, the urban/industrial setting of HH will likely always show a stressed benthic community structure.

Measurable: BEAST is only one technique which can be used to evaluate benthos, so specific reference has been removed to focus on the endpoint, not the methodology used. EC scientists currently use a modified BEAST methodology which includes the division into littoral (shallow) and profundal (deep) zones to account for anoxia. External reference conditions representative of HH's urban/industrial setting will be challenging to find, so internal HH sites may potentially need to be used.

What Was the Original Problem in Hamilton Harbour?

The benthic communities in 1964 and 1984 were dominated by pollution-tolerant worms, but with improvements in the abundance and community composition over those 20 years (HHRAP 1992, p.85). Stress on the benthos was caused by toxic chemicals in the sediment and extended periods of low to no oxygen.

Other AOC Comparisons:

St. Clair River AOC, Detroit River AOC, Jackfish Bay AOC, St. Lawrence River AOC, and Niagara River AOC compare their site to reference site(s), but none directly refer to BEAST. A distinction between criteria for “dynamics of benthic populations” (i.e. field measurements) and “body burden of benthic populations” (laboratory tests) appears frequently.

Reasonable...Achievable...Measurable
BACKGROUND INFORMATION

When the benthic macroinvertebrate community structure significantly diverges from unimpacted control sites of comparable physical and chemical characteristics. In addition, this use will be considered impaired when toxicity (as defined by relevant, field-validated, bioassays with appropriate quality assurance/quality controls) of sediment associated contaminants at a site is significantly higher than controls.

IJC Delisting Guideline (1991):
When the benthic macroinvertebrate community structure does not significantly diverge from unimpacted control sites of comparable physical and chemical characteristics. Further, in the absence of community structure data, this use will be considered restored when toxicity of sediment-associated contaminants is not significantly higher than controls.

What Has Been Done?
- There have been no direct projects targeted at changing the sediment characteristics. Various projects have been undertaken to reduce toxic substances and phosphorus input to HH.
- BEAST assessments have been completed at different scales in HH. A full survey was completed in 2000 and a partial survey in 2002. Surveys focused on the Randle Reef Remediation were completed in 2005, 2006, and 2007.

How Are Things Today?
- BEAST is recommended as part of biological sediment guidelines adopted by COA (2007).
- From a 2000 BEAST survey, there is strong evidence of benthic community impairment at 27 of 44 sites with strong evidence of toxicity at 21 sites and in general, there is a tendency towards lower taxon diversity (Milani and Grapentine 2006). However, available Great Lakes reference sites are not well matched to HH sites due to site-specific conditions (low-energy bay), multiple stressors (seasonal anoxia at depth >7m), and confounding factors (physical disturbance from ships). Therefore, reference conditions may need to be modelled.

What Still Needs To Happen?
- A BEAST survey focused on the Randle Reef Remediation sites is planned for 2013.
- Complete ongoing trackdown of the source of PCBs in Strathearne Slip and determine any management.
- Continue exploring causes for the “severely toxic” sites in Windermere Arm.
- Planned upgrades to the Woodward and Skyway WWTPs will reduce nutrient and sediment loadings.
- Complete in water work for the Randle Reef Sediment Remediation Project (targeted for 2019).
- Redo BEAST surveys after Randle Reef Remediation is completed (1 year and 5 years post remediation).

When Will The Status Change?
- A re-evaluation should be made when all scientifically feasible and economically reasonable actions have been implemented.
- Anticipate years of natural recovery after sediment projects are completed before the desired outcomes are reached.

REFERENCES

Most references can be provided by the HH RAP Office as a PDF upon request.
Hamilton Harbour Remedial Action Plan (HH RAP) Beneficial Uses

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APPROVED BY 2012 RAP STAKEHOLDER FORUM:
1. Beneficial Use vii update be deferred until more information is available.

2002 HH RAP Delisting Objective
When contaminants in sediments do not exceed biological and chemical standards, criteria, or guidelines such that there are no restrictions on disposal activities associated with navigational dredging.

Why Defer the Update?
- Environment Canada is currently having an external review of this Beneficial Use prepared on behalf of all Canadian AOCs.
- After seeing and discussing a preliminary draft of the external review, Canadian AOCs are now asking for clear direction from the federal and provincial governments.
- This direction is not expected before the end of the current Hamilton Harbour RAP Stakeholder Forum process in June 2012.

BACKGROUND INFORMATION

When contaminants in sediments exceed standards, criteria, or guidelines such that there are restrictions on dredging or disposal activities.

IJC Delisting Guideline (1991):
When contaminants in sediments do not exceed standards, criteria, or guidelines such that there are restrictions on dredging or disposal activities.
ARP STAKEHOLDER FORUM:

1. Beneficial Use viii status remain “impaired”.

2. Beneficial Use viii delisting objective wording be updated as follows:

   Beneficial Use viii will be considered not impaired when there are no persistent adverse water quality conditions attributable to cultural eutrophication for a period of three consecutive years. Listed are the anticipated environmental conditions for Hamilton Harbour (Table A), Cootes Paradise and Grindstone Creek area (Table B), and the annual average net loading targets required by major Harbour point sources to achieve those conditions (Table C).

**TABLE A: Environmental Conditions – Hamilton Harbour**

<table>
<thead>
<tr>
<th></th>
<th>Final Goals</th>
<th>Compliance Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phosphorus</td>
<td>≤ 20 μg/L</td>
<td>15 of 17 epilimnetic integrated samples analyzed weekly* at the centre station from June to September are at or better than the targeted goal</td>
</tr>
<tr>
<td>Chlorophyll a</td>
<td>≤ 10 μg/L</td>
<td></td>
</tr>
<tr>
<td>Concentration</td>
<td>≥ 2.5 m</td>
<td>* Although weekly sampling is recommended at only one location, there will be periodic sampling of a larger number of locations Harbour-wide to confirm representativeness of the centre station.</td>
</tr>
<tr>
<td>Un-ionized Ammonia</td>
<td>≤ 0.02 mg/L</td>
<td>Biweekly epilimnetic integrated samples from ice-out to the end of May, and weekly epilimnetic integrated samples in June at the centre station do not exceed the targeted goal</td>
</tr>
<tr>
<td>Minimum Dissolved Oxygen</td>
<td>≥ 6 ppm; but ≥ 3 ppm during allowable exceedence period</td>
<td>During June to September inclusive, the water column at centre station should have a minimum 4 metre thick layer of water with a temperature &lt;20°C and a DO &gt;3 mg/L. Compliance with this goal is to occur in at least 15 of 17 profiles measured weekly, and during any exceedence episode, the water column at centre station should still have a minimum 2 metre thick layer of water with a temperature &lt;20°C and a DO &gt;3 mg/L.</td>
</tr>
</tbody>
</table>

**TABLE B: Environmental Conditions – Cootes Paradise and Grindstone Marsh Area**

<table>
<thead>
<tr>
<th></th>
<th>Cootes Paradise</th>
<th>Grindstone Marsh Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phosphorus</td>
<td>60-70 μg/L,*</td>
<td>60-70 μg/L,*</td>
</tr>
<tr>
<td>Chlorophyll a</td>
<td>20 μg/L,*</td>
<td>20 μg/L,*</td>
</tr>
<tr>
<td>Concentration</td>
<td>1.5 m*</td>
<td>1 m*</td>
</tr>
<tr>
<td>Un-ionized Ammonia</td>
<td>&lt; 0.02 mg/L</td>
<td>&lt; 0.02 mg/L</td>
</tr>
<tr>
<td>Minimum Dissolved Oxygen</td>
<td>&gt; 5 ppm*</td>
<td>&gt; 5 ppm*</td>
</tr>
<tr>
<td>Submergent/ emergent aquatic plant area</td>
<td>240 ha*</td>
<td>50 ha*</td>
</tr>
<tr>
<td>Suspended solids</td>
<td>25 ppm*</td>
<td>25 ppm*</td>
</tr>
</tbody>
</table>

**TABLE C: Net Loading Targets – Annual Average (kg/day)**

<table>
<thead>
<tr>
<th></th>
<th>Phosphorus</th>
<th>Ammonia</th>
<th>Suspended Solids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Woodward WWTP</td>
<td>74</td>
<td>1000</td>
<td>1488</td>
</tr>
<tr>
<td>Skyway WWTP</td>
<td>17</td>
<td>115</td>
<td>280</td>
</tr>
<tr>
<td>King WWTP (Dundas)</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>CSOs</td>
<td>8</td>
<td>48</td>
<td>329</td>
</tr>
<tr>
<td>Streams **</td>
<td>TBD</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Industry (combined)</td>
<td>-</td>
<td>270</td>
<td></td>
</tr>
<tr>
<td>U. S. Steel Canada (Stelco)</td>
<td>-</td>
<td>-</td>
<td>1500</td>
</tr>
<tr>
<td>ArcelorMittal Dofasco</td>
<td>-</td>
<td>-</td>
<td>1500</td>
</tr>
</tbody>
</table>

* Cootes Paradise Water Quality Technical Team is working to develop final goals.

** Stream loadings work ongoing by Water Quality Technical Team.
2002 HH RAP Delisting Objective:

That there are no persistent adverse water quality conditions for each of the components attributable to cultural eutrophication. The following net loading targets provide the specific objectives. Eutrophication goals and anticipated conditions in Hamilton Harbour, Cootes Paradise, and the Grindstone Creek area.

<table>
<thead>
<tr>
<th>TABLE 1: Net Loading Targets (Kg/d)</th>
<th>Phosphorous</th>
<th>Ammonia</th>
<th>Suspended Solids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial</td>
<td>Final</td>
<td>Initial</td>
<td>Final</td>
</tr>
<tr>
<td>Woodward WWTP</td>
<td>140</td>
<td>60</td>
<td>2270</td>
</tr>
<tr>
<td>Skyway WWTP</td>
<td>30</td>
<td>12</td>
<td>470</td>
</tr>
<tr>
<td>King WWTP (Dundas)</td>
<td>5</td>
<td>22</td>
<td>5</td>
</tr>
<tr>
<td>Main WWTP (Waterdown)</td>
<td>1</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>CSOs</td>
<td>70</td>
<td>5</td>
<td>180</td>
</tr>
<tr>
<td>Streams *</td>
<td>90</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>Industry (combined)</td>
<td>400</td>
<td>270</td>
<td></td>
</tr>
<tr>
<td>Dofasco</td>
<td>3500</td>
<td>1500</td>
<td></td>
</tr>
</tbody>
</table>

* Stream loadings are extremely variable from year-to-year. The percentage of reduction is based on the estimated effect of best management practice.

<table>
<thead>
<tr>
<th>TABLE 2: Environmental Conditions</th>
<th>Hamilton Harbour</th>
<th>Cootes Paradise</th>
<th>Grindstone Creek Area</th>
<th>Beaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phosphorus concentration (ug/L)</td>
<td>34</td>
<td>17</td>
<td>60 - 70</td>
<td>60 - 70</td>
</tr>
<tr>
<td>Un-ionized Ammonia conc. (mg/L)</td>
<td>&lt; 0.02</td>
<td>&lt; 0.02</td>
<td>&lt; 0.02</td>
<td>&lt; 0.02</td>
</tr>
<tr>
<td>Chlorophyll a conc. (ug/L)</td>
<td>15-20</td>
<td>5-10</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Secchi Disk Trans. (m)</td>
<td>2</td>
<td>3</td>
<td>1.5</td>
<td>1</td>
</tr>
<tr>
<td>Min. DO conc. (ppm)</td>
<td>&gt; 1</td>
<td>&gt; 4</td>
<td>&gt; 5</td>
<td>&gt; 5</td>
</tr>
<tr>
<td>Submergent/emergent aquatic plant area (ha)</td>
<td>105</td>
<td>170</td>
<td>240</td>
<td>50</td>
</tr>
<tr>
<td>Suspended solids (ppm)</td>
<td></td>
<td>25</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Bacteria (E. coli organisms/100 ml water)</td>
<td></td>
<td></td>
<td></td>
<td>&lt; 100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TABLE 3: Criteria for Determining Compliance with RAP Goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>GOAL</td>
</tr>
<tr>
<td>Compliance with environmental conditions with respect to Phosphorus, Secchi depth and chlorophyll a</td>
</tr>
<tr>
<td>Compliance with environmental conditions with respect to unionized ammonia</td>
</tr>
<tr>
<td>Compliance with environmental conditions with respect to dissolved oxygen</td>
</tr>
<tr>
<td>Compliance with environmental conditions with respect to E. coli</td>
</tr>
</tbody>
</table>

* Although weekly sampling is recommended at only one location, there will be periodic sampling of a large number of locations harbour-wide to confirm representativeness of the centre station.

Why Update the 2002 HH Wording?

Reasonable:
- The original Writing Team and Stakeholders recommended a review of their final projections once initial water quality targets had been met.
- Targets correspond to the requirements of the fish community as part of an ecosystem approach with the fish community acting as a surrogate for conditions required for fish, wildlife, and people.

Achievable:
- Based on best available technology water quality targets have been adjusted for the Skyway and Woodward WWTPs which are the most significant single source loads to the Harbour. These targets are the present design criteria for upgrades at these WWTPs.
- State of the art modelling has been utilized to project Harbour water quality conditions based on inputs from the watershed, urban areas, and wastewater treatment plants.
- Natural variability in the system is now accounted for in the compliance criteria by allowing 10% exceedence of the maximum values.

Measurable:
- Sampling techniques have been improved to sample more of the water column, providing a truer picture of the conditions.
- The sampling season has been extended to account for high public use of HH in September.
**What Was the Original Problem in Hamilton Harbour?**

Phosphorus and ammonia concentrations exceeded the requirements for reasonable algae growth in HH. Algae presented an aesthetic problem with reduced water clarity and fouling the shore. Ammonia and decomposing algae created a high oxygen demand which caused anoxic areas during the summer. This reduced fish habitat and interfered with the normal food chain.

**IJC Listing Guideline (1991):**

When there are persistent water quality problems (e.g. dissolved oxygen depletion of bottom waters, nuisance algal blooms or accumulation, decreased water clarity, etc.) attributed to cultural eutrophication.

**IJC Delisting Guideline (1991):**

When there are no persistent water quality problems (e.g. dissolved oxygen depletion of bottom waters, nuisance algal blooms or accumulation decreased water clarity, etc.) attributed to cultural eutrophication.

**Other AOC Comparisons:**

Detroit River AOC refers to mesotrophic conditions, Wheatley Harbour AOC compares to a local reference condition, and St. Lawrence River AOC has a mean annual TP concentration of 20 µg/L. Ohio AOCs are to meet a set dissolved oxygen criteria and no nuisance growths of algae.

**What Has Been Done?**

- City of Hamilton is managing combined sewer overflows (CSO) to reduce amount of untreated sewage entering HH. Primary treatment capacity has been increased at Woodward WWTP.
- Halton’s Skyway WWTP successfully utilized plant optimization to improve effluent for a number of years.
- ArcelorMittal Dofasco and U. S. Steel Canada (formerly Stelco) dramatically improved their discharges to HH in the early 1990s through the MISA program.

**How Are Things Today?**

- The Harbour responds to reductions in phosphorus loading (50% P loading reduction has been made since 1980s).
- Recent water quality modelling of the Harbour integrates phosphorus and ecosystem conditions and suggests the updated loading targets should lead to meeting the updated (2012) environmental goals identified for the Harbour.

**What Still Needs To Happen?**

- Complete tertiary treatment upgrades to Halton’s Skyway WWTP.
- Initiate tertiary treatment upgrades of Woodward WWTP to increase capacity and reduce phosphorus loading.
- Implement Real Time Control to improve usage of the CSO system.

**When Will The Status Change?**

- HH has a relatively short residence time so some degree of water quality improvement should be realized quickly following implementation of management actions. A lag in further water quality improvements however, could potentially occur due to release of phosphorus from historically deposited sediments. In addition, ecosystem components linked to the phosphorus goals and targets, such as the number and diversity of aquatic plants, may take longer to respond due to cascading impacts from water quality improvements.

---

**REFERENCES**


*Most references can be provided by the HH RAP Office as a PDF upon request*
BUI viii: 2002 and 2012 Comparison Tables

Environmental Conditions – Harbour

<table>
<thead>
<tr>
<th></th>
<th>2002 Update</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Initial Goals</td>
<td>Final Goals</td>
</tr>
<tr>
<td>Phosphorus concentration</td>
<td>34 μg/L</td>
<td>17 μg/L</td>
</tr>
<tr>
<td>Chlorophyll a concentration</td>
<td>15-20 μg/L</td>
<td>5-10 μg/L</td>
</tr>
<tr>
<td>Secchi disc transparency</td>
<td>2 m</td>
<td>3 m</td>
</tr>
<tr>
<td>Compliance Criteria</td>
<td>13 out of 13 samples analysed weekly at the centre station from June to August are at or better than the targeted level.</td>
<td></td>
</tr>
<tr>
<td>Compliance Criteria</td>
<td>Weekly samples from March to June at the centre station are not to exceed 0.02.</td>
<td></td>
</tr>
<tr>
<td>Compliance Criteria</td>
<td>Weekly samples at 1 metre from bottom at centre station, from July to September are at or better than the targeted level.</td>
<td></td>
</tr>
</tbody>
</table>

**Compliance Criteria**
- Phosphorus concentration: ≤ 20 μg/L
- Chlorophyll a concentration: ≤ 10 μg/L
- Secchi disc transparency: ≥ 2.5 m

**Un-ionized Ammonia concentration**
- ≤ 0.02 mg/L

**Compliance Criteria**
- Weekly samples from March to June at the centre station do not exceed 0.02.
- Biweekly epilimnetic integrated samples from ice-out to the end of May, and weekly epilimnetic integrated samples in June at the centre station do not exceed the targeted goal.

**Minimum Dissolved Oxygen concentration**
- > 6 ppm; but ≥ 3 ppm during allowable exceedence period

**Compliance Criteria**
- Weekly samples at 1 metre from bottom at centre station, from July to September are at or better than the targeted level.
- During June to September inclusive, the water column at centre station should have a minimum 4 metre thick layer of water with a temperature <20°C and a DO >6 mg/L. Compliance with this goal is to occur in at least 15 of 17 profiles measured weekly, and during any exceedence episode, the water column at centre station should still have a minimum 2 metre thick layer of water with a temperature <20°C and a DO >3 mg/L.

**Submerged/ emergent aquatic plant area**
- 105 ha
- 170 ha

This is now dealt with entirely in BU xiv (FW Habitat)

Environmental Conditions – Cootes Paradise and Grindstone Marsh Area

<table>
<thead>
<tr>
<th></th>
<th>2002 Initial Goals</th>
<th>2012 Final Goals</th>
<th>2002 Initial Goals</th>
<th>2012 Final Goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phosphorus concentration</td>
<td>60-70 μg/L</td>
<td>To be determined (TBD)</td>
<td>60-70 μg/L</td>
<td>TBD</td>
</tr>
<tr>
<td>Chlorophyll a concentration</td>
<td>20 μg/L</td>
<td>TBD</td>
<td>20 μg/L</td>
<td>TBD</td>
</tr>
<tr>
<td>Secchi disc transparency</td>
<td>1.5 m</td>
<td>TBD</td>
<td>1 m</td>
<td>TBD</td>
</tr>
<tr>
<td>Un-ionized Ammonia concentration</td>
<td>&lt; 0.02 mg/L</td>
<td>&lt; 0.02 mg/L</td>
<td>&lt; 0.02 mg/L</td>
<td>&lt; 0.02 mg/L</td>
</tr>
<tr>
<td>Minimum Dissolved Oxygen concentration</td>
<td>&gt; 5 ppm</td>
<td>TBD</td>
<td>&gt; 5 ppm</td>
<td>TBD</td>
</tr>
<tr>
<td>Submerged/ emergent aquatic plant area</td>
<td>240 ha</td>
<td>TBD</td>
<td>200 ha</td>
<td>40 ha</td>
</tr>
<tr>
<td>Suspended solids</td>
<td>25 ppm</td>
<td>TBD</td>
<td>25 ppm</td>
<td>TBD</td>
</tr>
</tbody>
</table>

Environmental Conditions – Beaches

<table>
<thead>
<tr>
<th></th>
<th>2002 Initial Goals</th>
<th>2012 Final Goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacteria</td>
<td>&lt; 100 E.coli organisms/100 mL water</td>
<td>These are now dealt with entirely in BU x (Beaches)</td>
</tr>
<tr>
<td>Compliance Criteria</td>
<td>Daily samples meet target on every day that is 48 hours after a rain event.</td>
<td></td>
</tr>
<tr>
<td>Secchi disc transparency</td>
<td>1.2 m</td>
<td></td>
</tr>
</tbody>
</table>

Net Loading Targets – Annual Average (kg/day)

<table>
<thead>
<tr>
<th></th>
<th>Phosphorus</th>
<th>Ammonia</th>
<th>Suspended Solids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Woodward WWTP</td>
<td>140</td>
<td>60</td>
<td>74</td>
</tr>
<tr>
<td>Skyway WWTP</td>
<td>30</td>
<td>12</td>
<td>17</td>
</tr>
<tr>
<td>King WWTP (Dundas)</td>
<td>5</td>
<td>TBD a</td>
<td>22</td>
</tr>
<tr>
<td>Main WWTP (Waterdown)</td>
<td>1</td>
<td>n/a</td>
<td>5</td>
</tr>
<tr>
<td>CSOs ^b</td>
<td>70</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>Streams ^b</td>
<td>90</td>
<td>65</td>
<td>TBD ^a</td>
</tr>
<tr>
<td>U. S. Steel Canada (Stelco)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ArcelorMittal Dofasco</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a) Dundas WWTP and Stream targets will likely need to be lowered as part of ongoing analysis of improvements to Cootes Paradise.
b) Stream loadings are extremely variable from year-to-year. The percentage of reduction is based on the estimated effect of best management practice.
### Hamilton Harbour Remedial Action Plan (HH RAP) Beneficial Uses

<table>
<thead>
<tr>
<th>i</th>
<th>ii</th>
<th>iii</th>
<th>iv</th>
<th>v</th>
<th>vi</th>
<th>vii</th>
<th>viii</th>
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<th>x</th>
<th>xi</th>
<th>xii</th>
<th>xiii</th>
<th>xiv</th>
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<tbody>
<tr>
<td>STATUS</td>
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</table>

**RESTRICTIONS ON DRINKING WATER CONSUMPTION**

<table>
<thead>
<tr>
<th>2002 Status</th>
<th>2012 Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impaired</td>
<td>Impaired</td>
</tr>
<tr>
<td>Requires Further Assessment</td>
<td>Requires Further Assessment</td>
</tr>
<tr>
<td>Not Impaired</td>
<td>Not Impaired</td>
</tr>
</tbody>
</table>

**APPROVED BY 2012 RAP STAKEHOLDER FORUM:**

1. Beneficial Use ix status remain “not impaired”.
2. Beneficial Use ix delisting objective wording will remain the same.
3. No further assessment of Beneficial Use ix will be necessary prior to the Stage 3 Report.

**2002 HH RAP Delisting Objective:**
That Hamilton Harbour water outflow to Lake Ontario not give rise to water quality restrictions on the water intakes for Hamilton and Halton.

**Why Keep the 2002 Status and HH Wording?**

**Reasonable:** Regardless of Hamilton Harbour not having its own drinking water intakes, it is reasonable that Hamilton Harbour outflows should not negatively impact local Lake Ontario intakes.

**Achievable:** Hamilton Harbour has always achieved a “not impaired” status for this BUI.

**Measurable:** Water quality parameters are measured at both water intakes. Water currents leaving the Burlington Ship Canal have been measured and modeled.

### BACKGROUND INFORMATION

**What Was the Original Problem in Hamilton Harbour?**
This BUI has never been applicable to the HH RAP. There are no drinking water intakes in Hamilton Harbour despite it meeting “objectives for a potable water supply” (HHRAP 1992, p. 26).

**IJC Listing Guideline (1991):**
When treated drinking water supplies are impacted to the extent that: 1) densities of disease-causing organisms or concentrations of hazardous or toxic chemicals or radioactive substances exceed human health standards, objectives or guidelines; 2) taste and odour problems are present; or 3) treatment needed to make raw water suitable for drinking is beyond the standard treatment used in comparable portions of the Great Lakes which are not degraded (i.e. settling, coagulation, disinfection).

**How Are Things Today?**
- This BUI has never been applicable to the HH RAP as there are no drinking water intakes in Hamilton Harbour.
- The treatment processes Hamilton and Halton use to make raw water suitable for drinking are similar to the standard treatment used in comparable portions of the Great Lakes.
- Local water treatment plants deal with seasonal taste and odour issues and periods of increased turbidity; however, these are not linked to HH outflow.
- EC modeled the hypothetical impact of moving Skyway WWTP effluent into Lake Ontario (Miners et al 2002). Even combined with Woodward WWTP flows, the two drinking water intakes were not impacted.
- Halton-Hamilton Source Protection Committee has considered the potential affects of Hamilton Harbour water on Hamilton and Halton drinking water intakes during a spill scenario. Additional work is planned in 2012/13 to assess if there is a threat. This work is beyond the reach of this BUI which is focused on persistent day-to-day conditions.

**Where Can I Learn More?**
- Halton-Hamilton Source Protection Committee www.protectingwater.ca

*Most references can be provided by the HH RAP Office as a PDF upon request.*

---

**Reasonable...Achievable...Measurable**

June 2012
### BEACH CLOSINGS AND WATER CONTACT SPORTS

<table>
<thead>
<tr>
<th>2002 Status</th>
<th>2012 Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impaired</td>
<td>Impaired</td>
</tr>
<tr>
<td>Requires Further Assessment</td>
<td>Requires Further Assessment</td>
</tr>
<tr>
<td>Not Impaired</td>
<td>Not Impaired</td>
</tr>
</tbody>
</table>

**STATUS**

### APPROVED BY 2012 RAP STAKEHOLDER FORUM:

1. Beneficial Use x status remain “impaired”.
2. Beneficial Use x delisting objective wording be updated as follows:
   - Beneficial Use x will be considered not impaired when Hamilton Harbour public beaches (Bayfront Park and Pier 4 Park) meet the provincial beach management protocol 80% or more of the swimming season for a minimum of three consecutive years.

### 2002 HH RAP Delisting Objective:

1. That Hamilton Harbour effluent to Lake Ontario not give rise to conditions which would cause restrictions on open Lake water contact sports.
2. That water quality conditions in the west-end and in the north-half of the Harbour, be such as to permit opening of beaches and which would cause no significant restriction on water contact sports.

### Why Update the 2002 HH Wording?

**Reasonable:** A public beach is a community resource and it should be open a significant amount of time. A beach safe for swimming 80% of the time is reasonable as it allows for postings due to short, special circumstances. The standard to qualify for the internationally renowned Blue Flag program is for beaches to be open at least 80% of the time.

**Achievable:** Lake Ontario beaches have been safe for swimming more than 80% of the time in 12 of the past 13 years. Pier 4 Beach was safe for swimming more than 80% of the time in 2009 and 2011.

**Measurable:** City of Hamilton’s Public Health Department measures E. coli in the water at both beaches. The Public Health Department is working with Environment Canada to better identify and characterize cyanobacteria blooms in order to post the beaches appropriately.

### What Was the Original Problem in Hamilton Harbour?

Swimming was prohibited by a by-law of the Hamilton Harbour Commissioners due to health concerns about E. coli from raw sewage in the water.

### IJC Listing Guideline (1991):

When waters, which are commonly used for total-body contact or partial-body contact recreation, exceed standards, objectives, or guidelines for such use.

### IJC Delisting Guideline (1991):

When waters, which are commonly used for total-body contact or partial body-contact recreation, do not exceed standards, objectives, or guidelines for such use.

### Other AOC Comparisons:

St. Clair River AOC, St. Lawrence River AOC, and Niagara River AOC specifically refer to E. coli at beaches and use “no more than 20% of the geometric means exceeding the PWQO”. St. Lawrence River AOC is the only one referring to body contact.

---

*Reasonable...Achievable...Measurable*  
June 2012
BACKGROUND INFORMATION

**What Has Been Done?**
- Combined sewer overflow (CSO) tanks were built in West Hamilton to prevent raw sewage from entering HH.
- The by-law was lifted in 1995 so Bayfront Park Beach and Pier 4 Park Beach could be opened for public swimming.
- Pier 4 Beach pilot program (buoys, fencing, beach grooming, shrubbery, bird scaring) has been in effect since 2005. Some of these management techniques were used at Bayfront Park Beach beginning in 2010.

**How Are Things Today?**
- EC has shown HH beach *E. coli* readings are primarily due to bird droppings not human fecal matter (Edge + Hill 2007). This is a shift from the presumption sewage was continuing to be the culprit.
- This figure provided by the City of Hamilton shows an increase in safe beach days at Pier 4 Park Beach after pilot program began, whereas Bayfront Park Beach continued to struggle. Lake Ontario beaches have been safe for swimming in 12 of the past 13 years.
- A 1998 study did show a higher than negligible lifetime risk from exposure to PAH at Pier 4 Park Beach; however, this risk could be managed if swimmers took a bath or shower with soap within 24 hours after a swim (Hussain 1998).

**What Still Needs To Happen?**
- The City of Hamilton should implement bird management and surface water run-off management changes and practices at Bayfront Park Beach. Vegetation and landscape changes should be main focus of these efforts.
- It is recommended that the City of Hamilton consider improving the exchange of Bayfront Park Beach swimming area waters with the water of the main body of Hamilton Harbour in order to improve water quality at the shoreline. This recommendation should include changes to the shoreline at both ends of Bayfront Park Beach and consideration of novel methods to facilitate the exchange of swimming area waters with the main body of Hamilton Harbour.
- The bird management practices at Pier 4 Park Beach need to continue. Surface water run-off from nearby paved surfaces should be diverted away from Pier 4 Beach.

**When Will The Status Change?**
- Renewed efforts at Bayfront Park Beach are planned for completion in the next few years.

**REFERENCES**

Where Can I Learn More?
City of Hamilton website [http://www.hamilton.ca/HealthandSocialServices/PublicHealth/SafeWater/Beaches.htm](http://www.hamilton.ca/HealthandSocialServices/PublicHealth/SafeWater/Beaches.htm)
Blue Flag Canada [http://environmentaldefence.ca/campaigns/blue-flag-canada](http://environmentaldefence.ca/campaigns/blue-flag-canada)


*Most references can be provided by the HH RAP Office as a PDF upon request*
Hamilton Harbour Remedial Action Plan (HH RAP) Beneficial Uses

<table>
<thead>
<tr>
<th>DEGRADATION OF AESTHETICS</th>
<th>2002 Status</th>
<th>2012 Status</th>
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<tbody>
<tr>
<td></td>
<td>Impaired</td>
<td>Requires Further Assessment</td>
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</tbody>
</table>

APPROVED BY 2012 RAP STAKEHOLDER FORUM:

1. Beneficial Use xi status remain “impaired”.
2. Beneficial Use xi delisting objective wording be updated as follows:
   
   Beneficial Use xi will be considered restored when the waters are free of any substance due to human activity which produces a persistent objectionable deposit, unnatural colour or turbidity, or unnatural odour for a period of three consecutive years.
3. The RAP Technical Team be directed to evaluate Beneficial Use xi through both a semi quantitative monitoring program and qualitative stakeholder user input.

2002 HH RAP Delisting Objective:

When the waters are free of any substance which produces a persistent objectionable deposit, unnatural colour or turbidity, or unnatural odour (e.g. oil slick, surface scum, algae).

Why Update the 2002 HH Wording?

**Reasonable:** Citizens observing and recreating in HH should have the reasonable expectation that it will not be objectionable to look at or smell. IJC intention was to target issues created by human activity, not natural activity.

**Achievable:** Reductions of nutrient levels should achieve reduce occurrences of nuisance algae, but climate change weather could increase the frequency of large, area intense storms.

**Measurable:** By its very nature this BU is subjective, but there are four general parameters that can be monitored: clarity (turbidity), colour, odour, and debris. Secchi disc depth quantifies clarity and observational records for the other parameters can be made at the same time as Secchi disc depths are collected. A defined time frame is needed to clarify when a change in status can be made. A monitoring plan and public perception will both need to be used as measurements.

BACKGROUND INFORMATION

What Was the Original Problem in Hamilton Harbour?

This was listed as impaired in the 1992 Stage 2 Report with the causes of impairment listed as occasional oil sheens, algal blooms, objectionable turbidity, floating scum, debris, and putrid material (HHRAP 1992, p. 28). “Algae” added into the delisting objective wording during the 2002 Stage 2 Update.


When any substance in water produces a persistent objectionable deposit, unnatural color or turbidity, or unnatural odor (e.g. oil slick, surface scum).

IJC Delisting Guideline (1991):

When the waters are devoid of any substance which produces a persistent objectionable deposit, unnatural color or turbidity, or unnatural odor (e.g. oil slick, surface scum).

Other AOC Comparisons:

St. Clair River AOC, Detroit River AOC, Jackfish Bay AOC, and Toronto AOC wordings are similar to HHRAP. St. Clair River AOC, Ohio, and Michigan qualify sources as anthropogenic/human activity. Ohio and Michigan refer to excessive algae growth due to nutrients. Michigan requires two years, but St. Clair River AOC recently dropped the two years to avoid a single event causing an issue. Some AOCs rely on lack of public complaints as proof of delisting.

Reasonable...Achievable...Measurable
BACKGROUND INFORMATION

What Has Been Done?
- City of Hamilton is managing combined sewer overflows (CSO) to reduce amount of untreated sewage entering HH. Primary treatment capacity has been increased at Woodward WWTP.
- Upgrades to Halton’s Skyway WWTP are ongoing.
- Spill regulations and industrial pollution prevention plans have been implemented provincially.
- Yellow Fish RoadTM teaches “Only Rain Down the Drain”, helping to prevent oil and other materials entering streams.

How Are Things Today?
- Cyanobacteria blooms are both an aesthetic and health concern (toxins) with blooms lasting weeks.
- Oil sheens reported by scientists working in Strathearn Slip.
- Black tar-like “blobs” have been reported floating on the surface near Randle Reef.
- Localized debris in shoreline corners occasionally removed by business operators reliant on recreation/tourism.
- Average Secchi disc depths are generally around 2.5 m, but minimum values still are as shallow as 1 m.

What Still Needs To Happen?
- Investigation into ways to prevent/limit cyanobacteria blooms. This issue goes beyond the Hamilton Harbour RAP.
- Initiate tertiary treatment upgrades of Woodward WWTP to increase capacity and reduce phosphorus loading.
- Complete Randle Reef Sediment Remediation project.
- Continue improvements in the watershed, including stormwater management programs and stewardship.
- Continue public education programs.
- A monitoring protocol needs to be developed and implemented. Toronto AOC is starting a pilot program to evaluate aesthetics in 2012 which may be transferable to HH.

When Will The Status Change?
- Key words are persistent and unnatural. Looking for no reports of persistent, unnatural issues for three consecutive years. The time frame for status change is consistent with the eutrophication BUI (viii) as reductions in algae are integral to both BUIs.

REFERENCES

Most references can be provided by the HH RAP Office as a PDF upon request.
### 2012 FACT SHEET

#### Hamilton Harbour Remedial Action Plan (HH RAP) Beneficial Uses

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<thead>
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#### STATUS

**APPROVED BY 2012 RAP STAKEHOLDER FORUM:**

1. Beneficial Use xii status remain “not impaired”.
2. Beneficial Use xii delisting objective wording will remain the same.
3. No further assessment of Beneficial Use xii will be necessary prior to the Stage 3 Report.

#### 2002 HH RAP Delisting Objective:

When there are no significant additional costs required to treat water prior to use for industrial purposes (i.e. intended for commercial or industrial applications and non-contact food processing). Cost associated with zebra mussels or other invasive organisms are excepted. An added cost related to withdrawal of water from the Harbour to agriculture is not appropriate as this is not a use directly applicable to Hamilton Harbour.

#### Why Keep the 2002 Status and HH Wording?

**Reasonable:** Industry shouldn’t have to pay significantly more to use HH water. Zebra mussels are a Great Lakes basin wide problem so should be excluded. There is no agriculture using water directly from HH.

**Achievable:** Neither ArcelorMittal Dofasco nor U. S. Steel Canada report current additional costs beyond those required for normal operation; therefore this is achievable.

**Measurable:** Informal surveys allow HH users to self-determine if costs are beyond those required for normal operation.

#### BACKGROUND INFORMATION

**What Was the Original Problem in Hamilton Harbour?**

This BUI was not listed as impaired in the 1992 Stage 2 Report since “industry considers this source of water to be adequate or good compared with other areas in the Great Lakes” (HHRAP 1992, p. 28-9).

**IJC Listing Guideline (1991):**

When there are additional costs required to treat the water prior to use for agricultural purposes (i.e. including, but not limited to, livestock watering, irrigation and crop-spraying) or industrial purposes (i.e. intended for commercial or industrial applications and noncontact food processing).

**IJC Delisting Guideline (1991):**

When there are no additional costs required to treat the water prior to use for agricultural purposes (i.e. including, but not limited to, livestock watering, irrigation and crop-spraying) and industrial purposes (i.e. intended for commercial or industrial applications and noncontact food processing).

**How Are Things Today?**

- Industries report having to add mild bleach to intake water to control growth of algae on heat exchangers and condensers; however, this is routine operation (BARC 2005). Reductions in nutrient levels in Harbour water generally reduce algae levels.
- Industries report increased chloride levels in the spring which leads to increased rates of corrosion and need for more frequent exchange (BARC 2005); however, winter road salting is not an issue unique to lands surrounding HH, but restricted HH circulation due to geography shows the effect more acutely.
- Neither ArcelorMittal Dofasco nor U. S. Steel Canada report current additional costs as beyond those required for normal operation.

### REFERENCES

**Where Can I Learn More?**


Most references can be provided by the HH RAP Office as a PDF upon request.

*Reasonable...Achievable...Measurable*
Hamilton Harbour RAP Beneficial Use Impairment (BUI)

<table>
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<th>DEGRADATION OF PHYTOPLANKTON &amp; ZOOPLANKTON POPULATIONS</th>
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<td>2002 Status i</td>
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<tr>
<td>2012 Status ii</td>
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</table>

APPROVED BY 2012 RAP STAKEHOLDER FORUM:
1. Beneficial Use xiii status remain “requires further assessment”.
2. Beneficial Use xiii update be deferred until more information is available.

2002 HH RAP Delisting Objective:
When phytoplankton and zooplankton community structure does not significantly diverge from unimpacted control sites of comparable physical and chemical characteristics. Further in the absence of community structure data, this use will be considered restored when phytoplankton and zooplankton bioassays confirm no significant toxicity in ambient waters.

What Was the Original Problem in Hamilton Harbour?
The concern across many AOCs was various effluents entering the water, particularly phosphorous from sewage treatment plants and industrial contaminants, were creating chemically driven, unhealthy populations. Hamilton Harbour phytoplankton and zooplankton communities were described as being reflective of a eutrophic system due to their high numbers and their high level of activity. Studies of the toxicity of HH water to phytoplankton and zooplankton indicated no unusual toxicity, but the situation was under review.

When phytoplankton or zooplankton community structure significantly diverges from unimpacted control sites of comparable physical and chemical characteristics. In addition, this use will be considered impaired when relevant, field-validated, phytoplankton or zooplankton bioassays (e.g. Ceriodaphnia; algal fractionation bioassays) with appropriate quality assurance/quality controls confirm toxicity in ambient waters.

IJC Delisting Guideline (1991):
When phytoplankton and zooplankton community structure does not significantly diverge from unimpacted control sites of comparable physical and chemical characteristics. Further, in the absence of community structure data, this use will be considered restored when phytoplankton and zooplankton bioassays confirm no significant toxicity in ambient waters.

Other AOC Comparisons:
The Bay of Quinte AOC has adopted a labour intensive (and expensive) method of long term (30+ years) biweekly monitoring of phytoplankton and zooplankton communities including taxonomy, biomass and production. The Detroit River AOC wants a composition and abundance reflective of oligotrophic/mesotrophic conditions. Michigan AOCs defer to their eutrophication/algae BUI criteria as a surrogate for a phytoplankton/zooplankton BUI.

Many Canadian AOCs are asking for clear direction from the federal and provincial governments on how best to proceed forward with this Beneficial Use. This direction will not be available before the end of the current HH RAP Stakeholder Forum process in June 2012.

Reasonable...Achievable...Measurable

June 2012
2012 FACT SHEET

BACKGROUND INFORMATION

What Has Been Done?
- Various projects aiming to move the Harbour from a eutrophic state towards a mesotrophic state (WWTP upgrades, CSO containment, improved industrial discharges, watershed stewardship, etc.)

How Are Things Today?
- OMOE has sampled Hamilton Harbour as part of their Great Lakes Index-Reference Station Monitoring Program which cycles every three years, three times/year. Phytoplankton and zooplankton data are part of this data set; however, there has been no money to analyze the samples until now.
- DFO’s Great Lakes Laboratory for Fisheries and Aquatic Sciences has conducted biweekly surveys of phytoplankton, zooplankton, microbial and benthic communities at 2 index stations from 2002 – 2009 with comprehensive spatial surveys in 2006.

What Still Needs To Happen?
- In 2011, EC arranged for the counting and identification of the seasonal OMOE phytoplankton and zooplankton samples. DFO will interpret this data once the counting and identification are completed.
- DFO will resume biweekly sampling of microbial and planktonic communities in 2012 and follow up in 2014.
- From 2012-2015, DFO will be combining data from a number of Lake Ontario sites to develop a reference condition data set for a mesotrophic embayment. This data set is needed as there isn’t one ideal reference site for HH to use for comparison. New sites will be identified and sampled to augment OMOE and DFO data sets.

When Will The Status Change?
- A status change from “requires further assessment” is expected around 2015 after an evaluation of all lines of evidence by the HH RAP Technical Team.

Where Can I Learn More?


Most references can be provided by the HH RAP Office as a PDF upon request.

REFERENCES

Reasonable...Achievable...Measurable

June 2012
2012 FACT SHEET

Hamilton Harbour Remedial Action Plan (HH RAP) Beneficial Uses

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**LOSS OF FISH AND WILDLIFE HABITAT**

<table>
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<th>2002 Status</th>
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<tr>
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</table>

**APPROVED BY 2012 RAP STAKEHOLDER FORUM:**

1. Beneficial Use xiv status remain “impaired”.
2. Beneficial Use xiv delisting objective wording be updated as follows:

   - Beneficial Use xiv will be considered not impaired when:
     1. Emergent and submersed aquatic plants measure ≥ 500 hectares (230 ha in Hamilton Harbour + Windermere Basin and 270 ha in Cootes Paradise + Grindstone Creek Marshes).
     2. Improved littoral shore (0-5 m depth) measures ≥ 15 kilometres.
     3. Wildlife habitat measures ≥ 300 hectares.
     4. Colonial nesting waterbird island habitat measures ≥ 1.5 hectares.
     5. The quality and quantity of fish and wildlife habitat in Hamilton Harbour (including Windermere Basin, Cootes Paradise, and Grindstone Creek Marshes) improves to support the fish and wildlife populations identified in Beneficial Use iii.

**2002 HH RAP Delisting Objective:**

1. Provide 500 ha of emergent and submersed aquatic plants in Hamilton Harbour, Cootes Paradise, Grindstone Creek delta, and Grindstone Creek marshes in accordance with the Fish and Wildlife Habitat Restoration Project (360 ha FWHRP sites + 140 ha littoral zone).
2. Provide 15 km of littoral shore.
3. Provide 300 ha of wildlife habitat.
4. Provide 3 ha of colonial nesting bird habitat.

**Why Update the 2002 HH Wording?**

Reasonable: Updates based on local experience to refine targets to provide more specificity and to incorporate habitat quality. The recommended decrease in new habitat for colonial nesting waterbirds reflects the change to specifying island habitat.

Achievable: The vast majority of the habitat has already either been improved or is part of ongoing programs and projects to enhance and sustain fish and wildlife habitat.

Measurable: Various HHRAP partners carry out monitoring and modelling that allow for quantity and quality measurements of habitat.

**What Was the Original Problem in Hamilton Harbour?**

- Wetlands in Cootes Paradise and the mouth of the Grindstone Creek and the littoral shore of HH were severely degraded. 60% of wetland habitat in HH had been lost to filling for industry and the port. HH had lost most of its underwater reefs and shoals used by fish for spawning and nursery habitat. Colonial water-birds resident in HH were on port lands that were contaminated and slated for development.

- Contaminated sediment and low oxygen conditions in the hypolimnion of HH limited both the diversity and abundance of benthic organisms and resident fish and prevented coldwater fish species of Lake Ontario from using historically important coldwater habitat in Hamilton Harbour.

**IJC Listing Guideline (1991):**

When fish and wildlife management goals have not been met as a result of loss of fish and wildlife habitat due to a perturbation in the physical, chemical, or biological integrity of the Boundary Waters, including wetlands.

**IJC Delisting Guideline (1991):**

When the amount and quality of physical, chemical, and biological habitat required to meet fish and wildlife management goals have been achieved and protected.

**Other AOC Comparisons:**

This tends to be the most detailed of the Beneficial Uses for other AOCs with many specifically outlining a certain quantity and quality of hectares of habitat desired.
**What Has Been Done?**

- Programs to control carp, improve inflowing water quality, and decrease turbidity in order to return aquatic vegetation to the Cootes Paradise Marsh are ongoing. Similar programs are in place for the Grindstone Marsh system. Within HH, fish habitat has been constructed along the western shoreline and Bayfront Park, LaSalle Park and the north-eastern shoreline.
- A shoal was recently constructed in the north-east corner of HH to provide spawning habitat for existing littoral spawners (e.g. Walleye, Smallmouth Bass) and to encourage extirpated ones to return to HH (Lake Herring, Lake Whitefish).
- Colonial water-bird islands have been constructed north of the Canada Centre for Inland Waters. Wetland habitat is presently being constructed in Windermere Basin along with islands for common terns.

**How Are Things Today?**

<table>
<thead>
<tr>
<th></th>
<th>Hamilton Harbour</th>
<th>Windermere Basin</th>
<th>Cootes Paradise Marsh</th>
<th>Grindstone Creek Marshes</th>
<th>TOTAL (enhanced/delisting)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aquatic vegetation (ha)</td>
<td>239</td>
<td>15</td>
<td>58</td>
<td>20</td>
<td>332 ha / 500 ha</td>
</tr>
<tr>
<td>Littoral edge (km)</td>
<td>8.7</td>
<td>2.3</td>
<td>2.3</td>
<td>2.1</td>
<td>15.4 km / 15 km</td>
</tr>
<tr>
<td>Wildlife habitat (ha)</td>
<td>32</td>
<td>30</td>
<td>58</td>
<td>20</td>
<td>140 ha / 300 ha</td>
</tr>
<tr>
<td>Colonial nesting bird island habitat (ha)</td>
<td>1.3</td>
<td>0.2</td>
<td>-</td>
<td>-</td>
<td>1.5 ha / 3.0 ha</td>
</tr>
</tbody>
</table>

| Current Surplus or Deficit | -168 ha | +0.4 km | -160 ha | -1.5 ha |

**What Still Needs To Happen?**

- Continued restoring and sustaining of aquatic vegetation to the entire Cootes Paradise and Grindstone Creek Marshes.
- Restoration of the marshlands creates the prime ingredient required for improving the quantity and quality of wildlife habitat.
- Increase the dissolved oxygen in the hypolimnion to provide a 4 m deep layer of oxygenated water > 6ppm as described in BU viii. Planned tertiary improvements at the WWTPs will substantially reduce phosphorus and ammonia loadings to the Harbour which in turn should increase dissolved oxygen levels.
- Additional improvement to aquatic habitat will result from remedial actions related to toxic contaminants.

**When Will The Status Change?**

- Water quality is presently a major limiting factor in improving the quality and quantity of aquatic plants. As improvements are made to WWTPs, urban runoff, and rural runoff the quantity and quality of submergent aquatic habitat will also improve. Sustainability is likely during the decade following 2020.

**Where Can I Learn More?**


Fish and Wildlife Habitat Restoration Project Annual Reports (series dates back to 1995)

Most references can be provided by the HH RAP Office as a PDF upon request