V. ATTAINABILITY OF REACHING DELISTING OBJECTIVES

V.1 Introduction

This chapter in this Stage 2 Update Report merges the chapters on "Attainability of Designated Uses" and "Delisting Criteria" found in the original Stage 2 Report, 1992. Costs for implementation are set out separately in the following chapter in this update. In reorganizing these chapters from the original report, updated delisting objectives are provided followed by a discussion of the attainability of meeting the delisting objectives.

In order to provide continuity between this update and the original report, the format and headings used in the original report are followed as closely as possible in the subsection entitled "Reaching Delisting Objectives". This update does, however, provide references to both the delisting objectives and the RAP updated recommendations identified as necessary to create the conditions required for delisting the Harbour. In many cases the delisting objectives are indirectly addressed by various remedial actions and consequently are listed under multiple headings in this subsection.

V.2 Delisting Objectives

The proposed Hamilton Harbour delisting objectives have been modified and updated to reflect current science with respect to measuring and attaining the environmental conditions that are deemed necessary to delist Hamilton Harbour as an Area of Concern in accordance with the Great Lakes Water Quality Agreement. The following Figure 69 makes those conditions explicit in both general and specific terms. In addition, Figure 70 identifies some of the monitoring to be carried out and the frequency of this monitoring to gauge progress towards reaching the delisting objectives.

The delisting objectives focus on conditions that can be corrected through local action. For example, a health advisory on fish in the Harbour that is no different than the health advisory for western Lake Ontario may indicate that the necessary actions go beyond the Harbour. This would require Lake-wide actions and hence would not be a reason to prevent the eventual delisting of Hamilton Harbour as an Area of Concern.

It is clearly understood that common sense will be needed in the application of these objectives. It may not be possible to fully restore some delisting components in the short term but a long-term program for restoration may be in place in order for natural improvements to occur over time. Examples of this would include whole harbour changes to the fish community and natural biodegrading of low level contamination within sediments throughout much of the Harbour. This would, of course, require trend monitoring showing that improvements are being made and analysis indicating the eventual outcomes if these trends continue. It is also likely that over time some delisting objectives may be revisited and revised, as was the case with this update. The RAP Stakeholders have recommended that the water quality targets presently identified for the Cootes Paradise Marsh be reviewed to ensure they will provide the conditions necessary for

marsh restoration. A review of these criteria will take place once additional studying of water quality and factors affecting the marsh's recovery are completed.

The following fourteen Beneficial Use Impairments are common to all Area of Concern; the corresponding Delisting Objectives are unique to Hamilton Harbour.

Figure 69. Updated Delisting Objectives

NO.	BENEFICIAL USE IMPAIRMENTS AND HAMILTON HARBOUR DELISTING OBJECTIVES
(i)	***Restriction on fish and wildlife consumption.*** That there be no restrictions on consumption of fish and wildlife from the Harbour attributable to local sources.
(ii)	***Tainting of fish and wildlife flavour.*** When survey results confirm no tainting of fish or wildlife flavour.
(iii)	***Degraded fish and wildlife populations.*** 1. 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.

NO.	BENEFICIAL USE IMPAIRMENTS AND HAMILTON HARBOUR DELISTING OBJECTIVES
(iii) cont'd.	f. Proposed nearshore fish community of Hamilton Harbour: Category — Littoral Biomass (kg/ha) Piscivores *(pike, bass)* 40 - 60 Specialists *(Insectivores like pumpkinseeds and yellow perch)* 70 - 100 Generalists *(Omnivores like carp and brown bullheads)* 30 - 90 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 2. 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 Common terns (Sterna hirundo) > 600 Herring gulls (Larus argentatus) 350 Caspian terns (Sterna caspi) > 200 Double-crested cormorants (Phalacrocorax auritus) 200 Black-crowned night herons (Nycticorax nycticorax) 200 3. 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.

NO.	BENEFICIAL USE IMPAIRMENTS AND HAMILTON HARBOUR DELISTING OBJECTIVES
(iv)	***Fish tumours or other deformities.*** 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.
(v)	***Bird or animal deformities or reproductive problems.*** When the incidence rates of deformities or reproductive problems in sentinel wildlife species do not exceed background levels in control populations.
(vi)	***Degradation of benthos.*** 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.

NO.	BENEFICIAL USE IMPAIRMENTS AND HAMILTON HARBOUR DELISTING OBJECTIVES
(vii)	***Restrictions on dredging activities.*** 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.
(viii)	***Eutrophication or undesirable algae.*** 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 1: Net Loading Targets (Kg/d)

	Phosphorous		Ammonia		Suspended Solids	
	Initial	Final	Initial	Final	Initial	Final
Woodward WWTP	140	60	2270	530	3750	900
Skyway WWTP	30	12	470	115	500	200
King WWTP (Dundas)	5		22		28	
Main WWTP (Waterdown)	1		5		5	
CSOs	70	5	160	20	1400	200
Streams *	90	65				
Industry (combined)			400	270		
Stelco					4000	1500
Dofasco					3500	1500

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

NO.	BENEFICIAL USE IMPAIRMENTS AND HAMILTON HARBOUR DELISTING OBJECTIVES

(viii) cont'd.

TABLE 2: Environmental Conditions

	Hamilton Harbour		Cootes Paradise	Grindstone Creek Area	Beaches
	Initial Goals	Final Goals	Initial Goals	Initial Goals	Initial Goals
Phosphorus concentration (ug/L)	34	17	60 - 70	60 - 70	
Un-ionized Ammonia conc. (mg/L)	< 0.02	< 0.02	< 0.02	< 0.02	
Chlorophyll a conc. (ug/L)	15-20	5-10	20	20	
Secchi Disk Trans. (m)	2	3	1.5	1	1.2
Min. DO con. (ppm)	> 1	> 4	> 5	> 5	
Submergent/emergent aquatic plant area (ha)	105	170	240	50	
Suspended solids (ppm)			25	25	
Bacteria (E. coli organisms/100 ml water)					< 100

(viii) cont'd.

TABLE 3: Criteria for Determining Compliance with RAP Goals

GOAL	COMPLIANCE FORMULA
Compliance with environmental conditions with respect to Phosphorus, Secchi depth and chlorophyll a	13 out of 13 samples analysed weekly* at the centre station from June to August are at or better than the targeted level.
Compliance with environmental conditions with respect to unionized ammonia	Weekly samples from March to June at the centre station are not to exceed 0.02.
Compliance with environmental conditions with respect to dissolved oxygen	Weekly samples at 1 metre from bottom at centre station, from July to September are at or better than the targeted level.
Compliance with environmental conditions with respect to E. coli	Daily samples meet target on every day that is 48 hours after a rain event.

* 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.

NO.	BENEFICIAL USE IMPAIRMENTS AND HAMILTON HARBOUR DELISTING OBJECTIVES
(ix)	***Restrictions on drinking water consumption or taste and odour problems.*** That Hamilton Harbour water outflow to Lake Ontario not give rise to water quality restrictions on the water intakes for Hamilton and Halton.
(x)	***Beach closings. (Water contact sports.)*** 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.
(xi)	***Degradation of aesthetics.*** 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).
(xii)	***Added cost to agriculture or industry.*** 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.

NO.	BENEFICIAL USE IMPAIRMENTS AND HAMILTON HARBOUR DELISTING OBJECTIVES
(xiii)	***Degradation of phytoplankton and zooplankton populations.*** 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.
(xiv)	***Loss of fish and wildlife habitat.*** 1. Provide 500 ha of emergent and submergent 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.

Figure 70. Monitoring Program for Hamilton Harbour Delisting Objectives

DELISTING OBJECTIVE		MONITORING PROGRAM	TIMING
i	Restriction on fish and wildlife consumption	OMOE and OMNR – Guide to Eating Ontario Sport Fish	2003 (biennially)
		DFO – Contaminant Trend Monitoring	2001 – 2002 then repeated triennially
ii	Tainting of fish and wildlife flavour	DFO – Submitting fish to Fish Inspection Agency	2003
iii	Degraded fish and wildlife populations	DFO – Hamilton Harbour Fish Community Survey	2002 (triennially)
iv	Fish tumours or other deformities	DFO – Tumour Survey	2006
v	Bird or animal deformities or reproductive problems	EC (CWS) – Herring Gull and Turtle Research	Ongoing
		RBG – Research	Ongoing
		McMaster University – Research	Ongoing
vi	Degradation of benthos	EC – BEAST Study	2000 – 2005
vii	Restrictions on dredging activities	EC – Contaminated Sediment Mapping	2000 – Ongoing
		HPA	Ongoing
viii	Eutrophication or undesirable algae	EC (NWRI) – Research	Ongoing
		OMOE – Monitoring Program	Three Year Cycle of Multiple Projects
		RBG – Project Paradise	Ongoing
ix	Restrictions on drinking water consumption or taste and odour problems	EC (NWRI) – Research on canal flows	Ongoing
		City of Hamilton	Ongoing
		Region of Halton	Ongoing
x	Beach closings	City of Hamilton	Annual
		EC (NWRI) – Research	2001 – 2002
xi	Degradation of aesthetics	City of Hamilton – WWTPs and CSOs	Ongoing
		Region of Halton – WWTP	Ongoing
		Industries – MISA	Ongoing
xii	Added cost to agriculture or industry	Dofasco and Stelco – Water Intake Monitoring	Ongoing
xiii	Degradation of phytoplankton and zooplankton populations	DFO – Contaminant Trend Monitoring	2001 – 2002 then repeated triennially
xiv	Loss of fish and wildlife habitat	DFO – Fish & Wildlife Habitat Restoration Project	Ongoing

V.3 Reaching Delisting Objectives

V.3.1 Physical Characteristics of the Harbour

The flow of streams entering Cootes Paradise and Hamilton Harbour, along with depth and flushing characteristics of various parts of the Harbour system can affect aquatic habitat in these areas. The influence of stream flow volumes and temperature affect most seriously the habitat in the streams themselves – an important element of Harbour habitat – as well as estuary zones. While only the Spencer Creek has reservoirs that affect low flows, the hydrology of all streams entering the Harbour are affected (as is the case with most Southern Ontario streams) by the original clearing of the land and more recent urbanization of individual watersheds. Spring flows from the watersheds and base flows, which depend on groundwater for the most part, will vary from year to year and hence affect changes to aquatic habitat and water quality within the streams and their Harbour estuaries. While some habitat restoration projects address this type of issue, not all of nature's variability can or should be controlled.

Much of the Harbour habitat has water levels controlled primarily by water levels in Lake Ontario, which in turn is regulated artificially in the St. Lawrence River. The Lake Ontario and St. Lawrence River Water Level Regulation Plan has attempted to smooth out the highs and lows both on an annual and long-term basis, which the Lake would normally undergo in a natural regime. Recent experience in the Cootes Paradise Marsh indicates this regulation regime has a significant influence on the regeneration and the mix of the aquatic vegetation within the marsh.

Watershed plans have been prepared for all of the major creeks flowing into the Harbour. These plans identify both habitat and water quality enhancements required within the watershed. Monitoring in the centre of the Harbour indicates that cleaner sediment is entering the Harbour and fewer contaminants are being found in the water column. The long-term effect of the streams will need to be monitored to determine the effectiveness of watershed remediation on the Harbour. Similarly, the input of nutrients and contaminants from sewers and combined sewer overflows will have to be monitored to assess the effectiveness of programs for storm water management on separated sewers and the elimination of overflows from combined sewers. Water quality in the western basin of the Harbour has substantially improved as a result of the installation of combined sewer overflow holding tanks constructed to date.

In many places in the Harbour there are quiescent embayments that may depend on major windstorms and related currents for their rejuvenation. Hence, there could be annual variability in water quality in these constricted areas in spite of remedial actions to improve general conditions in the Harbour.

The mixing of the Harbour water with Lake Ontario water is a larger manifestation of the impact of natural forces on water quality. The mixing of Harbour and Lake Ontario water will vary seasonally and, while definitive estimates have not been prepared, mixing rates are likely to be very different from one year to the next. This could cause pollution concentrations in the Harbour to vary from year to year even though the reduced loading remains constant.

As colder, high-oxygen water comes into the hypolimnion of the Harbour from Lake Ontario in the summer the dissolved oxygen in this layer of the Harbour is dependent, in part, on the natural

forces affecting this inflow. This inflow, in turn, is dependent on the surface water temperature differences between the Harbour and the Lake (which depends on solar heating, air temperature, and wind speed and direction) and seiche activity in the Lake and Harbour (which depends on extreme wind-driven storm events).

Hence, concentrations of contaminants in the Harbour water, and the dissolved oxygen in the summer hypolimnion will depend on both the remedial programs that reduce loadings of pollutants, and on the physical exchange and mixing processes. It is for these reasons that these physical processes require more intensive investigation at this time since no program yet exists to routinely assess the year to year variations that these physical processes affect.

V.3.2 Chemical Characteristics – Water

V.3.2.1 Trace Organics and Metals

Delisting objectives affected:

- (i) Restriction on fish and wildlife consumption
- (ii) Tainting of fish and wildlife flavour
- (iv) Fish tumours or other deformities
- (v) Bird or animal deformities or reproductive problems
- (vi) Degradation of benthos
- (xiii) Degradation of phytoplankton and zooplankton populations

The Ontario Ministry of the Environment's, Municipal and Industrial Strategy for Abatement (MISA) has been the key force behind reductions in loadings of toxic substances from point sources. In addition, contaminants can reach the Harbour from a variety of non-point sources particularly urban and agricultural runoff.

As set out in the Toxic Substances and Sediment Remediation Component of Chapter IV, Harbour water is now meeting Provincial Water Quality Objectives for metals. Levels of PAHs and PCBs associated with suspended sediment have also declined. (See Chapter IV, Section 3 for greater detail)

In the original Stage 2 Report, PCB levels of 6 to 75 times the standard of 1 ng/L were found in wastewater treatment plant effluent, in tributaries and in the Harbour. Even Lake Ontario was found to have concentrations of 4 ng/L in the area around the west end. It was determined, however, that the PCBs were weathered and not fresh sources. While there are specific recommendations in this Stage 2 Update Report to reduce toxic substances, it is clear that measures to address PCBs need to be implemented on a broader scale than Hamilton Harbour.

Beside PCBs, two other contaminants affecting the fish consumption guidelines in the Harbour are Mirex and mercury. In the Hamilton Harbour RAP 1998 Status Report, it was determined that "There is no source of Mirex in the Hamilton Harbour watershed. Sources are in Niagara Falls and Oswego, New York." Mercury was once discharged into the Harbour. Additional research is needed to determine current levels of mercury within the Harbour.

The following RAP recommendations should address these delisting objectives both directly and indirectly.

- TSSR – 1 Spill Reporting and Handling
- TSSR – 3 Goal of Zero Discharge of Trace Metals and Organics
- TSSR – 4 Management Strategies for Contaminated Sediments
- TSSR – 5 Household Hazardous Waste Collection Services
- TSSR – 6 Reduction of Pesticide Use
- WQ – 3 Alternatives to Chlorination
- ULM – 5 Remediation of Sediment from Inappropriate Land Management

V.3.2.2 Dissolved Salts (Water Hardness)

The total dissolved salts content of Harbour waters has, for natural reasons, always exceeded the GLWQ objective of 200 mg/L. Undoubtedly, the addition of treated municipal wastewater increases the salt content of Harbour water, as does the use of salt to alleviate winter driving problems on area roads. These two uses are no different than urban centres generally, though the restricted circulation in the Harbour shows the effect of these loadings more acutely. Various actions have been taken by the watershed municipalities to reduce salting of roads and further measures are expected to be initiated by the federal government. Even so, these measures are partly obscured by the apparently natural high levels of salt in the waters of Red Hill Creek, a major tributary of the Harbour that drains through gypsum deposits.

While the lake-wide standard cannot apply in such a situation, and there are no known impacts on the beneficial uses of the Harbour, the matter requires clarification. There is no indication that dissolved salts in the Harbour are getting worse at this time although the average dissolved salts in Lake Ontario are gradually increasing year by year.

V.3.2.3 Nutrient Enrichment – Eutrophication

Delisting objectives affected:

- (viii) Eutrophication or undesirable algae
- (xi) Degradation of aesthetics
- (xii) Added cost to agriculture or industry

The majority of nutrient loading to the Harbour and Cootes Paradise comes from the wastewater treatment plants (WWTPs) and the combined sewer overflows (CSOs). The loading levels for phosphorus, ammonia and suspended solids established for the Harbour in this plan require the wastewater treatment plants to incorporate the very best treatment processes available to retrofit the plants. Significant improvements have been made by the Regional Municipality of Halton to the Skyway WWTP. The City of Hamilton is approximately one third of the way through its program to eliminate CSOs, has made recent upgrades to its WWTPs, and is in the process of refining its plan for continued upgrades to the Woodward WWTP and CSOs. This Stage 2

Report Update maintains the same loading targets for the Harbour even though the Cities of Hamilton and Burlington expect to experience growth and increase the capacity of their WWTPs.

Experience with upgrades and the response of the Harbour to those upgrades encouraged the stakeholder Water Quality Task Group to anticipate that the majority of the water quality objectives set for the Harbour can be met. The exception is the dissolved oxygen target for the Harbour of >4 ppm which may not be realistic for the hypolimnion. Presently, the planned upgrades are targeted in the RAP Stage 2 Report Update to be completed by 2015.

The stakeholders and general public have expressed the desire not to divert WWTP effluent to Lake Ontario except as a last resort. Therefore, it continues to be prudent to carefully monitor the changes to the Harbour as upgrades to the wastewater treatment systems are made in order to gauge the effectiveness of the strategy set out in this plan.

The following RAP recommendations should address these delisting objectives both directly and indirectly.

- WQ – 1a Key Water Quality Goals
- WQ – 1b Wastewater Treatment Plant Effluent Targets
- WQ – 1c Combined Sewer Overflows
- WQ – 1d Monitoring Net Loading Trends of WWTPs
- WQ - 1e Monitoring of Harbour Water Conditions
- WQ – 2 WWTP Loadings Effect on Cootes Paradise and Grindstone Creek
- WQ – 4 Diversion of WWTP Effluent to Lake Ontario
- ULM – 3 Erosion and Sediment Controls
- ULM – 4 Top Soil or Site Alteration By-Law
- ULM – 10 Watershed Studies
- ULM – 11 Stormwater Management Plans

V.3.3 Chemical Characteristics – Sediment

Delisting objectives affected:

- (vi) Degradation of benthos
- (vii) Restrictions on dredging activities

The Harbour has served as a settling basin for particulates from urban and rural runoff and effluent discharges from industry and municipal WWTPs. At the same time it has received organic matter from excessive algal growth. Added to this mix are industrial spills and leaching of contaminants from older landfill sites.

The organic particles use up oxygen as they decompose and toxic hot spots of contaminated sediment can act as dispersion points from which contaminants may spread to other parts of the Harbour. Considerable effort has been ongoing during the past ten years to define contaminant hot spots and determine remedial actions. At the same time, banning of some substances (e.g. lead in gasoline) and the MISA program has addressed the principal sources of sediment

contamination. The RAP Stakeholders in this update are recommending investigating the potential sources of contaminants within the sewer system, and older landfill sites. Techniques for removing, burying, treating *in situ* and containing contaminated sediments have been examined.

Similar to the original Stage 2 Report, contaminated sediments have been defined under three categories, severely toxic (hot spots), intermediate toxicity (not identified for immediate remediation, but in many cases still above acute toxicity levels) and low toxicity (west Harbour conditions which do not seem to be significantly lethal to *in situ* biota). The major hot spots are associated with polycyclic aromatic hydrocarbons (PAHs); at the time of writing this update it is anticipated that a project will be undertaken to contain the largest of the hot spots at Randle Reef and include the ability to confine in the same project site the vast majority of the other hot spot sediments and sediment from areas of intermediate toxicity. If successful, it is possible for major progress to be made within this area of the RAP by 2005 –2007.

Another ongoing location where contaminated sediments accumulate in the Harbour is Windermere Basin at the outlet of Red Hill Creek. It was originally dredged in 1989 and 1990. In 2001, its ownership was transferred to the City of Hamilton and re-dredging is scheduled for 2002 or 2003. The sediment trap may require dredging again in the future if contaminated material continues to accumulate, however, the sources of contaminants to the basin are potentially from the City's Woodward WWTP, sewer system and older municipal landfill sites found adjacent to the valley of the Red Hill Creek. There is an obvious incentive for the City to be vigilant in tracking down and eliminating sources of contamination.

The following RAP recommendations should address these delisting objectives both directly and indirectly.

- TSSR – 1 Spill Reporting and Handling
- TSSR – 3 Goal of Zero Discharge of Trace Metals and Organics
- TSSR – 4 Management Strategies for Contaminated Sediments
- TSSR – 5 Household Hazardous Waste Collection Services
- TSSR – 6 Reduction of Pesticide Use
- WQ – 3 Alternatives to Chlorination
- ULM – 3 Erosion and Sediment Controls
- ULM – 4 Top Soil or Site Alteration By-Law
- ULM – 5 Remediation of Sediment from Inappropriate Land Management
- ULM – 11 Stormwater Management Plans
- EPI – 1 Personal Impact Education Programs

V.3.4 Biological Characteristics

Delisting objectives affected:

- (i) Restrictions on fish and wildlife consumption
- (ii) Tainting of fish and wildlife flavour
- (iii) Degraded fish and wildlife populations

- (iv) Fish tumours or other deformities
- (v) Bird or animal deformities or reproductive problems
- (xiv) Loss of fish and wildlife habitat

Targets have been set in the delisting objectives to indicate habitat requirements, desirable biological diversity, and community structure for fish and colonial nesting bird populations in a restored harbour with its associated wetlands. An Index of Biotic Integrity (IBI) has been added to the delisting objectives, in this update, as a means to put a numerical value to these various integrated components in order to better measure changes in the species composition and diversity of the fish community.

Certain health standards and toxic chemical objectives are applicable to fish and wildlife in the area. Each of these factors may partly depend on circumstances outside the control of the local RAP community. The contaminant burdens in the fish and birds in the Harbour and Lake Ontario as a whole have declined. It should be noted that many fish spend time in both the Harbour and Lake Ontario. Thus, it is expected that the measures or conditions that have led to the decline of contaminant burdens in fish and birds in Lake Ontario as a whole, combined with further effluent controls in the Harbour itself, would result in declining contaminant burdens in the biota of Hamilton Harbour. Both sets of measures will be required to ensure further substantial reductions of contaminant burdens. This will be particularly true of migratory fish and the birds that feed on fish. A new issue that is now being studied by the RAP is the potential of endocrine disrupting compounds and pharmaceuticals to affect fish and wildlife populations. Again, this problem is not unique to Hamilton Harbour, but the Harbour and Cootes Paradise may be particularly vulnerable to these effects because of the high proportion of treated sewage that enters the Harbour and Cootes Paradise Marsh and their use by fish and wildlife as a nursery area.

Tumours (or hyperplasia) found in fish are one measure of population health that is being given considerable attention. Some of these tumours are caused by parasites and viruses and seem to occur at many sites in the Great Lakes irrespective of chemical contamination. However, remedial measures carried out to reduce exposure to known carcinogens will bring about changes in such things as chemically caused liver tumours. Fisheries and Oceans Canada (DFO) have carried out fish tumour studies and will repeat these at ten year intervals to determine the trends occurring. Original research in the Harbour by DFO indicated a link between tumours and PAHs. It is hoped that actions to control PAH sources in the Harbour will show a positive result in reducing liver and epithelial tumours. In addition, DFO has initiated a contaminant trend study of the Harbour fish community with a focus on tracking contaminants within the aquatic community most representative of the Harbour. Environment Canada's (EC) Canadian Wildlife Service has a long period of record for herring gulls located in the Harbour. Both DFO's and EC's contaminant trend monitoring will be used by the RAP to gauge progress against delisting objectives.

It should be noted that efforts to reduce eutrophication with resulting potential improvements in oxygen conditions within the hypolimnion may, according to some experts, result in higher contamination burdens in fish – at least for a while – until conditions in the bottom sediments improve to the point where fish food organisms in the sediments have lower contaminant content. At the present time these organisms are protected from fish predation during the summer months by the overlying low oxygen conditions.

The fishery in the Harbour is dominated by plankton feeding fish and benthic feeding fish with few top predators. From this perspective the Harbour fish community is typical of many stressed warm water ecosystems. At the outset of the RAP in 1990, the IBI for the whole Harbour was estimated to be 18. By 1997, it had risen to 28, a positive trend. The target IBI is 55 – 60. This is a result of general improvements in water clarity allowing more aquatic plant growth and the enhancement of fish habitat at numerous sites around the Harbour and in the Cootes Paradise Marsh. The Harbour, however, like most other embayments on the Great Lakes, has been impacted by a number of introduced species. Some, such as the Pacific salmon and rainbow trout, were introduced intentionally to encourage the recreational fishery. Others such as the sea lamprey, carp and most recently the zebra mussel and round goby, were accidentally introduced to the Great Lakes.

The combination effects of habitat destruction, toxic chemicals, and eutrophication have impacted indigenous fish and wildlife communities and created opportunities for successful colonization of non-native species. The health and diversity of the Harbour's fish and wildlife community will result from the overall improvements in water, sediment and habitat quality and the interaction of indigenous species with those that are introduced within the Harbour ecosystem. The efforts to restore the fish and wildlife community to conform to the delisting objectives established are, by their very nature, experimental. While progress to date gives the RAP community optimism, final results are not assured.

The following RAP recommendations should address these delisting objectives both directly and indirectly. (It should be noted that fish and wildlife populations in the end assimilate all of the various remedial actions. Therefore, all remedial actions could be included in the following list. Those listed relate principally to those included under the fish and wildlife component of the RAP Stage 2 Update.)

- FW – 1 Fish and Wildlife Restoration Project
- FW – 2 Fish and Wildlife Habitat Restoration Project Steering Committee
- FW – 4 Ecosystems of Lower Reaches of Harbour Tributaries
- FW – 5 Nuisance Species Management
- FW – 6 Biological Effects due to Exposure of Contaminants
- FW – 7 Indicators of Wildlife Health
- FW – 8 Habitat Protection from Overuse by Public
- FW – 9 Restoration of Aquatic Vegetation in Cootes Paradise
- FW – 10 Carp Control in Cootes Paradise
- FW – 11 Restructuring of Fish Community
- FW – 12 "No net loss" of Fish Habitats
- FW – 13 Nesting Habitat Creation for Colonial Waterbirds
- TSSR – 2 Wildlife Management Strategy for Confined Disposal Facilities

V.3.5 Water Contact Recreation

Delisting objectives affected:

- (x) Beach closings (water contact sports)

Contamination by faecal coliform and E. Coli bacteria is a problem common to any area in the Great Lakes impacted by urban runoff. The beaches of Lake Ontario on the east side of the sand bar separating the Harbour from Lake Ontario may, on occasion, be found to have unacceptable bacteria counts – even though they are isolated from the direct discharges of wastewater treatment plants (WWTPs), combined sewer overflows (CSOs) and most urban runoff in the area. It is obvious that the Harbour has a greater potential to be more seriously affected by this problem with the discharge of WWTPs and CSOs.

Correspondingly, the disinfection of effluent from the WWTPs and the capture of CSOs have the potential to make dramatic improvements to the bacterial contamination condition of Hamilton Harbour. Recent monitoring of the Harbour shows that for most of the water recreation season harmful bacterial levels in the open waters of the Harbour are very low and meet provincial swimming water standards. With the construction of CSO tanks at the western end of the Harbour swimming beaches opened in 1992 for the first time in over forty years. More recently the number of days when beaches have been closed has been increasing. A study by Environment Canada indicates that the problem may not be with Harbour water polluting the beaches, but with beach uses (people, feeding of ducks, geese and gulls) generating local bacteria. This is not uncommon on active waterfronts and measures to correct this will have to be generated by the municipal park operators.

As the City of Hamilton continues with its program to control CSOs and to upgrade the WWTPs, particularly the Woodward Plant, fewer and fewer untreated discharges of bacterial contaminated effluent will enter the Harbour. This, in turn, will allow for the water recreational delisting objective to be achieved.

The following RAP recommendations should address these delisting objectives both directly and indirectly.

- WQ – 1a Key Water Quality Goals
- WQ – 1b Wastewater Treatment Plant Effluent Targets
- WQ – 1c Combined Sewer Overflows
- WQ - 1e Monitoring of Harbour Water Conditions
- ULM – 6 Control of Urban Storm Runoff
- ULM – 10 Watershed Studies
- ULM – 11 Stormwater Management Plans
- RM – 4 Bacteria Monitoring at Beaches

V.3.6 Navigation

Delisting objectives affected:

- (vii) Restrictions on dredging activities

Costs to navigation from pollution focus on the special requirements for disposal of contaminated dredgeate. The port berths and shipping channels are all located in industrial areas and include locations of combined sewer overflows. Meeting the delisting objective for navigation will require actions identified within the RAP addressing Toxic Substances and Sediment Remediation.

There is always likely to be a need for special controls on the disposal of contaminated sediment. To date the remedy has been to place contaminated soil from Harbour dredging in a Confined Disposal Facility (CDF). The Hamilton Port Authority (HPA), in its recently approved master plan, does not define any expansion of its existing, twenty-year, CDF capacity at East Port. In the future, the HPA will have to depend on cleaner sediment entering the Harbour in order to provide for disposal of ongoing dredging from berths and shipping channels. The HPA is, therefore, very dependant upon and tied to the actions of this RAP.

The following RAP recommendations should address this delisting objective both directly and indirectly.

- TSSR – 1 Spill Reporting and Handling
- TSSR – 3 Goal of Zero Discharge of Trace Metals and Organics
- TSSR – 4 Management Strategies for Contaminated Sediments
- TSSR – 5 Household Hazardous Waste Collection Services
- TSSR – 6 Reduction of Pesticide Use
- ULM – 3 Erosion and Sediment Controls
- ULM – 4 Top Soil or Site Alteration By-Law
- ULM – 5 Remediation of Sediment from Inappropriate Land Management
- ULM – 11 Stormwater Management Plans

V.3.7 Aesthetics

Delisting objectives affected:

- (xi) Degradation of aesthetics

The Harbour has been noticeably improved by the combined sewer overflow (CSO) tanks constructed to date, which serve the western basin. The CSO program is, however, only one-third complete at the time of writing this update and the impact of CSOs remaining to be remediated in Cootes Paradise is obvious to anyone canoeing the marsh. Once completed, the CSO program and wastewater treatment plant upgrades should resolve most aesthetic issues of concern to the community.

Nuisance algae can be a serious problem and potentially dangerous. In 2001, a substantial bloom of blue-green algae occurred producing microcystin, a toxin. Similarly, filamentous algae heavily impacted Cootes Paradise and Macassa Bay in 2001. The remedy for these algae outbreaks ultimately lies with the reduction in nutrient loading to the Harbour.

The Hamilton Harbour RAP community increased public access from less than 5% in 1990 to greater than 21% by 2000. This has resulted in more people visiting and engaging in recreation around the Harbour. As a result, the need to place an emphasis on aesthetics has increased. The positive result of this greater interest in the Harbour is the greater political support for the RAP and at the same time less tolerance of effluents that are physically seen by the general public. At the same time, the impact of this greater population using the waters edge has also the potential to foul the environment, if visitors leave behind refuse.

The following RAP recommendations should address this delisting objective both directly and indirectly. (It should be noted that aesthetics rely on many of the various remedial actions. Therefore, many remedial actions could be included in the following list. Those listed relate principally to those included under the Public Access and Aesthetics, and the Education and Public Information components of the RAP Stage 2 Update.)

- PAA – 1 Physical Access to the Harbour
- PAA – 2 Promotion of Natural Ecosystems Appreciation
- PAA – 3 Protection of Views and Vistas of the Harbour
- EPI – 1 Personal Impact Education Programs
- EPI – 2 Distribution of Information on Harbour and Watershed Conditions
- EPI – 5 Adoption Programs for Streams and the Waterfront