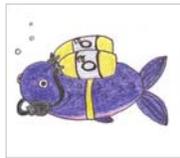


Hamilton Harbour Remedial Action Plan (HH RAP) Beneficial Uses

i	ii	iii	iv	v	vi	vii	viii	ix	x	xi	xii	xiii	xiv
---	----	-----	----	---	----	-----	------	----	---	----	-----	------	-----

**EUTROPHICATION OR UNDESIRABLE ALGAE**



**STATUS**

2002 Status	Impaired	Requires Further Assessment	Not Impaired
2012 Status	Impaired	Requires Further Assessment	Not Impaired

**APPROVED BY 2012 RAP STAKEHOLDER FORUM:**

- Beneficial Use viii status remain “impaired”.
- 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**

	Final Goals	Compliance Criteria
Phosphorus concentration	≤ 20 µg/L	15 of 17 epilimnetic integrated samples analyzed weekly* at the centre station from June to September are at or better than the targeted goal  * 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.
Chlorophyll a concentration	≤ 10 µg/L	
Secchi disc transparency	≥ 2.5 m	
Un-ionized Ammonia concentration	≤ 0.02 mg/L	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	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.

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

	Cootes Paradise	Grindstone Marsh Area
Phosphorus concentration	60-70 µg/L*	60-70 µg/L*
Chlorophyll a concentration	20 µg/L*	20 µg/L*
Secchi disc transparency	1.5 m*	1 m*
Un-ionized Ammonia concentration	< 0.02 mg/L	< 0.02 mg/L
Minimum Dissolved Oxygen concentration	> 5 ppm*	> 5 ppm*
Submergent/ emergent aquatic plant area	240 ha*	50 ha*
Suspended solids	25 ppm*	25 ppm*

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

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

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

\* 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 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.

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

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.

**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.

### Where Can I Learn More?

Gudimov, A., et al. 2011. Predicting the response of Hamilton Harbour to the nutrient loading reductions: A modelling analysis of the "ecological unknowns" Journal of Great Lakes Research. 37: 494-506.

WQ Tech Team. 2010. Hamilton Harbour RAP Water Quality Goals and Targets Interim Part 2 Review. Draft.

WQ Tech Team. 2007. Hamilton Harbour RAP Water Quality Goals and Targets Review. Part 1: Response to the City of Hamilton's Proposed Wastewater System Upgrades. Summary Report and Technical Appendix.

BARC. 2005. Toward Safe Harbours: Progress Toward Delisting – Water Quality

Painter, S., Hampson, L. and K. McCabe. 1990. Hamilton Harbour Water Clarity Response to Nutrient Abatement. NWRI Contribution No. 90-14.

*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**

	2002 Update		2012
	Initial Goals	Final Goals	Approved Final Goals
Phosphorus concentration	34 µg/L	17 µg/L	≤ 20 µg/L
Chlorophyll a concentration	15-20 µg/L	5-10 µg/L	≤ 10 µg/L
Secchi disc transparency	2 m	3 m	≥ 2.5 m
Compliance Criteria	13 out of 13 samples analysed weekly* at the centre station from June to August are at or better than the targeted level.		15 of 17 epilimnetic integrated samples analyzed weekly* at the centre station from June to September are at or better than the targeted goal  * 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.
Un-ionized Ammonia concentration	< 0.02 mg/L	< 0.02 mg/L	≤ 0.02 mg/L
Compliance Criteria	Weekly samples from March to June at the centre station are not to 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	> 1 ppm	> 4 ppm	≥ 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.
Submergent/ emergent aquatic plant area	105 ha	170 ha	<i>This is now dealt with entirely in BU xiv (FW Habitat)</i>

**Environmental Conditions – Cootes Paradise and Grindstone Marsh Area**

	Cootes Paradise		Grindstone Marsh Area	
	2002 Initial Goals	2012 Final Goals	2002 Initial Goals	2012 Final Goals
Phosphorus concentration	60-70 µg/L	To be determined (TBD)	60-70 µg/L	TBD
Chlorophyll a concentration	20 µg/L	TBD	20 µg/L	TBD
Secchi disc transparency	1.5 m	TBD	1 m	TBD
Un-ionized Ammonia concentration	< 0.02 mg/L	< 0.02 mg/L	< 0.02 mg/L	< 0.02 mg/L
Minimum Dissolved Oxygen concentration	> 5 ppm	TBD	> 5 ppm	TBD
Submergent/ emergent aquatic plant area	240 ha	230 ha	50 ha	40 ha
Suspended solids	25 ppm	TBD	25 ppm	TBD

**Environmental Conditions – Beaches**

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

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

	Phosphorus			Ammonia			Suspended Solids		
	2002		2012	2002		2012	2002		2012
	Initial	Final	Final	Initial	Final	Final	Initial	Final	Final
Woodward WWTP	140	60	74	2270	530	1000	3750	900	1488
Skyway WWTP	30	12	17	470	115	115	500	200	280
King WWTP (Dundas)	5		TBD <sup>a</sup>	22		TBD <sup>a</sup>	28		TBD <sup>a</sup>
Main WWTP (Waterdown)	1		n/a	5		n/a	5		n/a
CSOs	70	5	8	160	20	48	1400	200	329
Streams <sup>b</sup>	90	65	TBD <sup>a</sup>						
Industry (combined)				400	270	270			
U. S. Steel Canada (Stelco)							4000	1500	1500
ArcelorMittal Dofasco							3500	1500	1500

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.