TORONTO & REGION
REMEDIAL ACTION PLAN

Method to Assess Beneficial Use Impairment (BUI) Degradation of Aesthetics (Toronto)

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Background

A method for assessing the 'Degradation of Aesthetics' Beneficial Use Impairment (BUI) is required for the Toronto and Region Area of Concern (AOC). The Toronto and Region consists of the Toronto waterfront and the six associated watersheds that influence lake quality: Etobicoke Creek, Mimico Creek, Humber River, Don River, Highland Creek, and Rouge River.

The framework for evaluating BUI criteria has been previously outlined.[1] The method of assessment for 'Degradation of Aesthetics' uses a Tier 3 'Weight of Evidence' (WOE) approach, which requires assessment endpoints (e.g., delisting criteria) as well as measurement endpoints (e.g., environmental endpoints and action endpoints.) See *Appendix B: Weight of Evidence Approach (Toronto RAP)* for more information. The method to assess environmental endpoints is outlined in this document.

Stakeholder input from Environment Canada, City of Toronto, Ministry of the Environment, Toronto and Regional Conservation Authority (Water Quality Testing, and Waterfront Group) and Toronto Port Authority informed the development of this document.

This document will form the basis for a one-year pilot phase. Input/feedback from the stakeholders will be evaluated during and after the pilot phase and, if required, the method of assessment updated.

Delisting Criteria

As identified in the Remedial Action Plan in 1994, the BUI delisting criteria - or assessment endpoint - is as follows:

2g. Pleasing Aesthetic Quality	Waters are free of any substance that produces a persistent objectionable deposit, unnatural colour or turbidity or unnatural odour (for instance, oil slick or surface scum)

The intent is to identify substances that produce a persistent, typically man-made and non-natural, deposit on the waterfront or along our watercourses that is objectionable and appears in sufficient amounts to interfere with, or impair, the aesthetic quality and use by the public.

Goals and Objectives

Develop a degradation of aesthetics method of assessment that:

- Can be easily implemented by a variety of trained stakeholders within the RAP area
- Adapts to electronic collection methods (long-term)
- Builds on existing data collection methods where possible
- Uses qualitative and quantitative data collection protocols
- Uses statistical data analysis where appropriate
- References third party research and other AOC strategies
- Delivers a phased approach: one-year pilot with input/feedback collected and protocol modified as needed

[1] 'Toronto RAP: Background, Rationale and Framework for BUI Criteria Review and Update. March 2011'. Available at: http://www.torontorap.ca/dotAsset/101980.pdf

- Meets or exceeds existing Toronto RAP requirements

Environmental Endpoints

To assess Environmental Endpoints, it is proposed to leverage the work from the Rouge River, Detroit, MI AOC[2] , St. Clair River AOC[3] and others[4] to develop an Aesthetic Quality Index (AQI). At each site, collected observational data for four (4) endpoints are assigned scores based on the observed condition which are then used to calculate an AQI for each site. By combining the AQI of each site (AQI_{site}), an overall AQI (AQI_{AOC}) for the Toronto AOC is determined. Over time, trends in the AQI for the individual sites and AOC can be tracked. (See *Appendix C: Calculating the AQI* for additional information.)

Environmental Endpoint	Descriptor	Score
Clarity	Clear	10
	Cloudy	7
	Opaque	0
Colour	Clear	10
	Green	7
	Yellow/Amber	6
	Brown	5
	Grey	2
	Black	0
Odour	None	10
	Musty	6
	Petroleum *(transitory)*	5
	Sewage	2
	Petroleum *(spill)*	0
	Anaerobic	0
Debris	None	10
	Natural *(unusual accumulation)*	8
	Oil film *(non-natural)*	3
	Trash *(large amount)*	2
	Foam *(non-natural)*	2
	Sewage	0

NOTE: Technicians will collect the data and complete the data collection form; the RAP team coordinator will evaluate the data and assign the descriptor (if needed) and score. In addition, as part of the pilot phase, the scores will be evaluated and changes may be made as required.

[2] Heidtke, T, Tauriainen, E. 'An Aesthetic Quality Index for the Rouge River. Available at: http://www.rougeriver.com/pdfs/sampling/weftec96-03.pdf
[3] St. Clair River Aesthetics Report 2010 DRAFT.Available upon request.
[4] Lake Erie Lakewide Management Plan (LaMP) Technical Report No. 15: Degradation of Aesthetics. Available at: http://www.epa.gov/lakeerie/buia/lamp15.pdf

Definitions

Clarity (Unnatural turbidity): The clarity of the water is also affected by the location. For example, some opaqueness or cloudiness may be attributed to the natural condition of the waterway (e.g., natural turbidity that may occur after rain events) which can be identified when evaluating the weather conditions over the previous 48 hours.

Colour (Unnatural colour): The colour of the water may vary from location to location, depending on the natural colour of the area. Often the water has a natural background colour that is not directly attributable to pollution or unnatural organic growth, such as brownish water that is a result of dissolved organic material. Also, the colour of the sky and bottom material influences the colour. [5]

Odour (Objectionable odour): Odours, identified by a trained technician, may be from a range of sources including oil and grease, and raw sewage from combined sewer overflows and/or failing septic systems. Odours from petroleum sources are sub-divided into transitory (e.g., fleeting or ephemeral) or arising from a spill; if a spill is observed, the technician will call the Spill Action Centre hotline immediately. **NOTE**: Odours from decay of natural materials (e.g., from algae, plant growth, isolated dead fish and zebra mussels) are excluded.

Debris (Objectionable deposit): This refers to man-made or non-natural materials that are objectionable, offensive or constitute an unusual accumulation. Although this parameter is subjective, small amounts of isolated and non-recurring debris (e.g., plastic bags) may be acceptable. In some cases, the debris may be man-made but have become part of the natural environment over the years (such as concrete slabs).

The level of trash is intended to reflect a qualitative 'first impression' of the sampling site. A site with a **Trash *(large amount)*** rating would indicate a site where trash is one of the first things noticed in the sampling area. These are areas where trash is harmful to aquatic life (e.g., toxic substances, items that could cause entanglement, etc.) or a threat to human life (e.g., medical waste, diapers, human or pet waste, etc.) or there is evidence of illegal dumping.[6]

[5] For additional information on colour and clarity, see 'A Field Guide to Aquatic Phenomena'. Available at: http://www.umaine.edu/waterresearch/fieldguide/Field%20guide.pdf and http://www.umaine.edu/waterresearch/fieldguide/color.htm

[6] 'A Rapid Trash Assessment Method Applied to Waters of the San Francisco Bay Region: Trash Measurement in Stream. Available at: http://www.waterboards.ca.gov/rwqcb2/docs/swampthrashreport.pdf

Exclusions:

Waterfowl: In some cases, native species such as Canada geese and cormorants can conflict with human use of the waterfront and watersheds and some may consider the impact of these species to adversely affect the aesthetics. However, by definition, these native species are not "substances" in water and have a more overarching impact.

Aquatic Plants: In some areas along the waterfront, there may be large quantities of rooted aquatic plants. Again, these are natural habitats used by certain organisms and are not "substances".

Algae: Undesirable algae will be addressed in the 'Eutrophication or Undesirable Algae' BUI and is not included of this BUI.

Natural Debris: In contrast with man-made debris and garbage, natural debris is typically wood, cattails, grasses, etc.) that is often deposited along the shorelines after high waters. The intent is to only record unusual accumulations of natural debris.

Natural Foams: Some naturally occurring compounds found in plants and algae in and around the watersheds and surface waters may have surfactant qualities resulting in the production of natural foams (Figure 1).[7,8,9]

Figure 1: Natural occurring foam along shoreline (ref. 8)

Natural Films and Sheens: Naturally decaying plant material can produce black residue, films or sheens on the surface of the water similar to the appearance of petroleum spilled in water (Figure 2). If the cause of the film or sheen is an oil spill, it will be present on the surface of flowing water, will not disperse when disturbed and will have a petroleum odour.[10]

Figure 2: Natural film caused from decaying vegetation (ref. 10)

[7] 'Foam: an Introduction'. Available at: http://www.lakepanachecampers.com/Foaming%20Water.pdf
[8] 'Foam on Surface Waters'. Available at: http://environment.gov.ab.ca/info/library/7663.pdf
[9] 'Piles of Foam? It's a natural phenomena! Available at: http://www.lakesuperiorstreams.org/understanding/foam.html
[10] 'Water Quality: Oil Spill or Decaying Vegetation'. Available at: http://www.cuwcd.com/operations/waterquality.htm

Data Collection - General

Evaluating aesthetics requires data collection in the field with in-house analysis involving quantitative and qualitative assessment of the water quality in the AOC. Because aesthetic judgments and values vary widely between individuals, only trained technicians will perform the data collection in the field. Wherever possible, technicians currently obtaining water samples or working around the watershed will be asked to augment their current data collection with data required for this delisting protocol. Trained technicians shall have the necessary training and experience to complete the data collection forms.[11]

Complaints by citizens on water clarity, colour, odour and debris will be handled through existing complaint channels (e.g., 311 run by the City of Toronto, Spills Action Centre hotline, etc.) and evaluated as available.

Equipment Required

- ☐ Data collection forms (see *Appendix A: Data Collection Form (for field use)*)
- ☐ Digital camera
- ☐ 500 ml PET bottle

Training will be provided for all technicians to ensure consistency of sample collection and form completion.

Method

The method outlined below is a guideline only. Minor modifications may be made by stakeholders as required for their particular location and regime.

Using a paper data collection form (one for each site)

1. When first arriving at the collection site, complete Part A of the data collection form. **NOTE**: It is important that any background information (e.g., rain event within past 48 hours) be identified.
2. Make a visual assessment of the area for debris. If there is debris that meets the definition or you are unsure if it meets the definition, take a picture of the area and indicate the possible source on the data collection form. Record the photo file name (e.g. IMG #) on the data collection form.
3. Take a sample of the water in the 500 ml clear bottle sufficient to permit evaluation of odour, clarity and colour.
4. Holding the bottle under your nose, safely waft to identify any odours. Record observations on the data collection form.
5. Hold the sample over the 'X' and take a photo. Record the IMG #. Check off the appropriate colour; if any question of the colour, leave blank and let the RAP Co-ordinator make the assessment.
6. With the lid firmly on the bottle, shake the sample and hold it front of the 'X' on the form. If the X is clearly visible, select **Clear**; if blurry, select **Cloudy**; if not visible, select **Opaque**. **NOTE**: Where Secchi data is available and collected as part of general methods, record that value also.

[11] A community-based study in 2001/2002 showed the importance of using trained technicians to reduce sample variation, improve geographic distribution and augment reporting of other variable. For more information, see http://www.trca.on.ca/dotAsset/26654.pdf.

7. Empty and rinse the water collection bottle at least twice to remove any remaining debris and solids.
8. Back at the office, download photos to the server and file the completed forms in a separate location. On a regular basis, the photos and supporting completed forms will be forwarded to the RAP Co-ordinator for review and analysis.

TIPS for completing the data collection form.

If there is any doubt about what is considered 'debris' or 'colour', take photos and flag for review by the RAP Co-ordinator in the NOTES box.

Record any previous weather events in the past 48 hours (e.g., heavy rains, high winds, etc.) as this can affect the data collected (e.g. natural turbidity).

Other Data Sources

Wherever possible, additional sources of data collection should be considered. This could include:

- Analysis of type (e.g., natural versus unnatural) and volume of debris collected by Toronto Port Authority from booms
- Analysis of type and volume of debris collected during beach grooming at City of Toronto beaches
- Analysis of type and volume of debris collected by the City-owned weed harvester. (**NOTE**: This may not be used every year)
- Historical TRCA water quality data
- Complaints made to City of Toronto (e.g. through 311 service) or Spills Action Centre

Monitoring Locations and Frequency

The intention is to leverage existing water collection/testing locations and associated agencies/stakeholders during the pilot phase. As noted below, there are ~ 100 monitoring locations to ensure sufficient data points for analysis during the pilot phase.

Data will be typically collected between March through to November.

Monitoring Program	Sampling Frequency (min./ location)	Lead Agency	Notes
Electrofishing sites (80 sites)	Monthly *(16 RAP sites)* Opportunistically *(other sites)*	TRCA	• ~ 270 in total but test ~ 80 sites/year • 16 RAP sites monitored monthly; remainder monitored opportunistically • Typically boat-only access sites along the waterfront
Water Quality (30-40 sites)	Monthly	TRCA	• ~30-40 sites tested monthly along watershed • Although collected year round, will only focus on seasonal data
Beaches (11)	TBC	City of Toronto Police Services	• 11 beaches in total • Part of Blue Flag testing protocol
Index stations (3)	Tri-annually	Ministry of the Environment	• Variety of water quality data collected 3 times a year (spring, summer, fall) every 3 years (e.g. 2006, 2009, 2012)
Regional Watershed Monitoring Network sites (Non-Water Quality Sites)	Opportunistically	TRCA	• Data collected when at sampling sites

Figure 3: Water Quality Monitoring Site Map

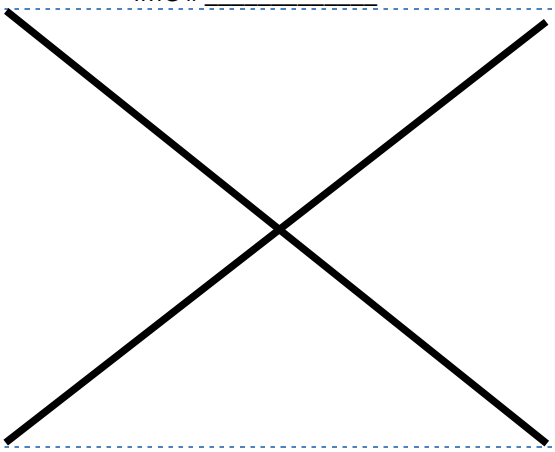
Appendix A: Data Collection Form (for field use)

Part A: Site Information

Technician Name		Agency	
Location/Waterbody name		Site GPS coordinates	E _____ N _____
Date (dd/mm/yyyy)		Time	
Waterbody type	☐ Open coast / beach ☐ Embayment	☐ Pond ☐ Wetland ☐ Stream/river (headwater)	☐ Stream/river (middle channel) ☐ Stream/river (lower channel) ☐ Other _____
Current (circle)	Still	Slow	Medium Fast
Current weather	Cloud Cover	Precipitation	Approx. Temp
Weather (past 48 hrs.)	Cloud Cover	Precipitation	Approx. Temp
NOTES:			

Part B: Data Collection

			Add any observations or comments
Debris *(objectionable deposits)* IMG # _____	☐ None ☐ Oil film ☐ Sewage	☐ Natural ☐ Trash (lg) ☐ Other	
Odours *(objectionable odour)*	☐ None ☐ Sewage ☐ Petroleum (tr) ☐Petroleum (spill)	☐ Musty ☐ Anaerobic ☐ Other	

Colour *(unnatural colour)*	IMG # _____
☐ Clear	
☐ Green	
☐ Yellow/ Amber	
☐ Brown	
☐ Grey	
☐ Other	
Clarity *(unnatural turbidity)*	
☐ Clear	
☐ Cloudy	
☐ Opaque	
Secchi Disc Depth (m) *(if available)*	

***TIP**: Hold water sample in front of X and take photo.*

Reference Notes

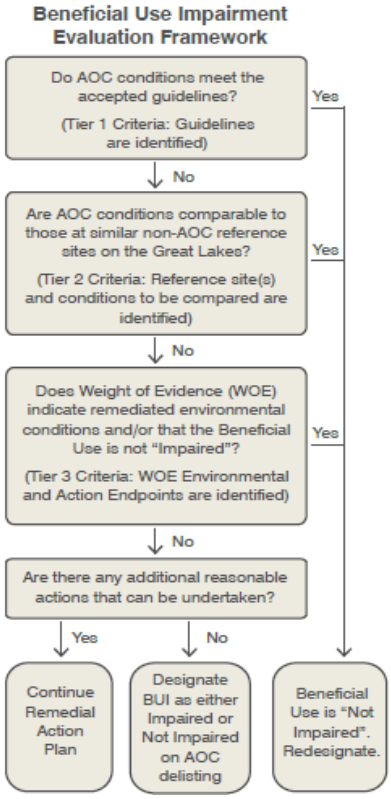
☐ Clear (e.g., blue) 	☐ Green 	☐ Yellow/ Amber 
☐ Brown 	☐ Grey 	☐ Other

Clarity *(Unnatural turbidity)* • Account for sampling location (e.g., streams mixing.) • Account for previous weather (e.g., rains.) • Account for seasonable effects (e.g., spring run-off.)	Colour *(Unnatural colour)* • May vary from location to location, depending on the natural colour of the area. • Account for natural background colour. • Account for effect of the colour of the sky.
Odour *(Objectionable odour)* • Exclude odours from decay of natural materials. • Notify Spills Action Centre if appropriate.	Debris *(Objectionable deposit)* • Small amounts of isolated and non-recurring debris (e.g., plastic bags) may be acceptable. • For large amounts, record observations. • Exclude waterfowl impact, aquatic plants, algae and natural debris. • Exclude natural foams and sheens.

Appendix B: Weight of Evidence Approach (Toronto RAP)

Toronto RAP has outlined a three tier criteria evaluation framework, as shown below.

- Tier 1 criteria: AOC conditions compared against established guideline(s)
- Tier 2 criteria: AOC conditions compared against Great Lakes non-AOC conditions
- Tier 3 criteria: Weight of Evidence on a BUI by BUI basis. Incorporate existing actions and environmental outcomes into the WOE measurement endpoints and update the environment/action endpoints as appropriate.



For 'Pleasing Aesthetic Quality', the WOE approach will be considered as there is currently no accepted 3rd party guideline or methodology. In fact, other AOCs are interested in the Toronto RAP approach to this BUI and it is anticipated that input from other AOC teams will also inform subsequent iterations of the methodology.

As defined in the Toronto RAP guide[12], there are two different types of measurement endpoints: Environmental and Action.

> Environmental endpoints are the criteria and desired trend used to evaluate empirical environmental data that directly impact the BUI 'Degradation of Aesthetics'. To assess progress, each one is assigned a **Relevance, Reliability, Outcome** and **Trend**.
>
> Action endpoints are the critical elements of an action or project that directly impact the BUI 'Degradation of Aesthetics'. To assess progress, each one is assigned a **Weight** and **Outcome**

[12] 'Toronto RAP: Background, Rationale and Framework for BUI Criteria Review and Update. March 2011'

(see evaluation matrices below), as well as the **Endpoint** which identifies how to measure success (e.g., % complete, bylaw passed, program implemented, etc.)

Weight of Evidence is a way of expressing all of the factors - environmental indicators and actions completed - that will be taken into consideration when evaluating the status of a Beneficial Use Impairment. Specifically, the weight of evidence approach outlines:[13]

- What measurements and actions will be reported on;
- The standard (a criteria or threshold) against which the measurement or action will be compared;
- The relative importance that any given criteria or threshold is achieved;
- The current status of the measurement or action, as it compares to the stated criteria;
- The general trend of the condition/action being reported on; and
- The concurrence between outcome importance and its actual current condition

As outlined, the Weight of Evidence (WOE) framework requires:

- **Assessment Endpoint:** 'What is the acceptable state of the BUI?'
- **Measurement Endpoints:** 'What are the environmental and action endpoints to be met?'
  - Environmental Endpoints: 'What are the weighted criteria to compare against empirical environmental data? (e.g., percentage of yellow perch in the aquatic community)
  - Action Endpoints: 'Are there any outcomes or undertakings that are not evaluated from environmental condition data? (e.g., legislation, education programs, etc.)

NOTE: Measurement endpoints are assigned a score, outcome and reliability factor (environmental only.)

[13] http://torontorap.ca/dotAsset/101974.pdf

Appendix C: Calculating the AQI

This will be calculated by the RAP Co-ordinator and team only; it is included for interest only.

Using the table below, the water sample is evaluated on the four environmental endpoints: clarity, colour, odour and debris and assigned a score.

Environmental Endpoint	Descriptor	Score
Clarity	Clear Cloudy Opaque	10 7 0
Colour	Clear Green Yellow/Amber Brown Grey Black	10 7 6 5 2 0
Odour	None Musty Petroleum *(transitory)* Sewage Petroleum*(spill)* Anaerobic	10 6 5 2 0 0
Debris	None Natural *(unusual accumulation)* Oil film*(non-natural)* Trash*(large amount)* Foam*(non-natural)* Sewage	10 8 3 2 2 0

Collected data on the clarity, colour, odour and debris is analysed to determine the AQI using the following calculation:

$$AQI_{site} = \frac{[Clarity + Colour + Odour + Debris]}{4}$$

$$AQI_{AOC} = \frac{\text{the sum of all the } AQI_{site}}{\text{Total number of sites}}$$

Example

Data collected from site 22: Clarity = 10 Colour = 7 Odour = 6 Debris = 8

$AQI_{site\ 22} = [10 + 7 + 6 + 8] / 4 = 31/4 = 8$

AQI Range	Aesthetic Condition
AQI ≥ 9	Excellent
8 ≤ AQI > 9	Good
6 ≤ AQI > 8	Fair (minimum acceptable)
AQI < 6	Poor