

Jackfish Bay Area in Recovery Long-Term Monitoring Plan

Purpose:

The purpose of this plan is to identify long-term monitoring actions for Beneficial Use Impairments (BUIs) which require further assessment or remain impaired in the Jackfish Bay Area of Concern (AOC).

Acknowledgements:

The Jackfish Bay Area in Recovery long-term monitoring plan was prepared by the Jackfish Bay Remedial Action Plan (RAP) team with guidance and advice from technical experts in each agency. Members of the RAP team and their affiliations are listed below, as are some of the many technical experts who reviewed or provided assistance.

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Executive Summary

This long-term monitoring plan was developed to track recovery in Jackfish Bay and fulfills Canada and Ontario's commitment for a long-term monitoring plan for Jackfish Bay Area of Concern as outlined in the 2007 Canada Ontario Agreement Respecting the Great Lakes Basin Ecosystem (2007).

The purpose of this plan is to identify monitoring needs for Beneficial Use Impairments (BUIs) which require further assessment or remain impaired in the Jackfish Bay Area of Concern:

1. Restrictions on fish consumption,
2. Degradation of fish populations,
3. Body burdens of fish,
4. Loss of fish habitat, and
5. Dynamics of benthic populations including body burdens of benthic populations.

In preparing this plan, the agencies considered past and present data, current assessments and conclusions as well as recommendations from Lakehead University's *Area in Recovery Status Report 1 for Jackfish Bay* (2010) and the Jackfish Bay Public Area in Recovery Review Committee (PARRC).

To maximize efficiency and minimize duplication of efforts, the plan relies on a combination of existing programs and additional studies. Existing programs include the Sport Fish Contaminant Monitoring Program of the Ontario Ministry of the Environment and Environment Canada's Environmental Effects Monitoring Program. The RAP team will work with local communities to communicate monitoring results.

Introduction

The purpose of this plan is to identify monitoring needs for Beneficial Use Impairments (BUIs) which require further assessment or remain impaired in the Jackfish Bay Area of Concern (AOC) (Appendix 1). The Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem included a proposal to recognize the Jackfish Bay Area of Concern as an Area in Recovery as well as a commitment to develop a long-term monitoring plan for the Jackfish Bay Area of Concern (2007).

In support of these commitments, the Jackfish Bay Public Area in Recovery Review Committee (PARRC) was convened from the local community to provide input into the federal-provincial proposal to recognize the AOC as an Area in Recovery in 2008. The following year, Lakehead University, with input from Jackfish Bay technical and Remedial Action Plan (RAP) teams, began summarizing the work completed to date for the Jackfish Bay AOC and found that Jackfish Bay qualifies as an *Area in Recovery* (AiR) according to the definition provided by the Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem (2007). The PARRC endorsed Lakehead's finding along with the proposal to recognize Jackfish Bay as an Area in Recovery in April 2010.

The following recommendations from the PARRC were included in Lakehead's Area in Recovery Status Report 1 for Jackfish Bay AOC (2010) and are relevant to the long-term monitoring plan for Jackfish Bay AOC:

PARRC RECOMMENDATION #2: Committed Monitoring is Needed to Build from a Strong BUI Baseline – A phased monitoring framework should include contingency plans to address changes in monitoring programs, government funding for monitoring, and the ability to incorporate new information about impaired BUIs from secondary sources to avoid data gaps over the long-term. The use of the term Area of Monitored Recovery was more accurate for Jackfish Bay over the term Area in Recovery.

PARRC RECOMMENDATION #3: Differentiate Levels of Recovery – In some instances, it is uncertain whether ecosystem recovery is occurring as a result of mill upgrades to effluent quality versus prolonged periods of mill shutdown when effluent does not enter the AOC. As a result, monitoring should be designed to compile data to help differentiate the levels of ecosystem recovery that occurs when the mill is not operating versus ecosystem recovery that occurs when the mill is operating.

PARRC RECOMMENDATION #5: Further Assessment of Blackbird Creek – There is a need to complete further study of Blackbird Creek to better characterize the potential for historic contaminants to affect the AOC. The COA Sediment Management Decision-Making Framework should be applied specifically to the Blackbird Creek system.

The following are among the principles and criteria that were proposed for an AOC entering the natural recovery mode in a submission to the Canada-Ontario Agreement RAP Steering Committee (1998). These were reiterated by the PARRC when they endorsed the Area in Recovery Recognition and accepted Lakehead University's *Area in Recovery Status Report 1 for Jackfish Bay* (2010).

- Monitoring and surveillance commitments are a requirement of entering the Area in Recovery status, to continue to assess progress towards achievement of delisting targets. This commitment should provide a method of determining the state of natural recovery, whether the recovery can be accelerated based on new science and technology, and measuring the achievement of delisting criteria.
- There should be commitment from the government to intervene if recovery rates are unacceptable and do not measure progress towards the delisting targets.
- A process is in place to respond to future development pressures and emerging technologies such that environmental recovery is sustainable and further intervention can take place if warranted.
- A mechanism is established to report systematically to the public the monitoring actions and results that are achieved during the Area in Recovery status, and to ensure that the public and the PARRC are satisfied with the current conditions of natural recovery.

For each Beneficial Use, the agencies and community have agreed on a target set of conditions to achieve in the Area of Concern. Once this target, or criteria, is met that Beneficial Use is no longer considered impaired. Once all the delisting criteria are met, the AOC can be removed from the list of Great Lakes Areas of Concern. These targets are commonly referred to as “delisting criteria.” Lakehead University’s Area in Recovery Status Report (2010) assessed the conditions in Jackfish Bay AOC against the delisting criteria and determined that of the eight beneficial uses originally identified in Jackfish Bay, four are still impaired. Lakehead found that another three require further assessment before a determination can be made. A further four BUIs were found to be “not impaired” (see Table 1).

Table 1: Status of Beneficial Use Impairments and Long-Term Monitoring Indicators

A summary of the status of the Beneficial Use Impairments as reported in Lakehead University's *Area in Recovery Status Report 1 for Jackfish Bay* (2010). Indicators or "performance measures" are specified for BUIs that remain "impaired" or "require further assessment." The long-term monitoring plan will use these indicators to track recovery in the AOC.

Beneficial Use Impairment	Stage 1 Status 1991	Stage 2 Status 1998	Area in Recovery Status Report 2010	Indicator for Long Term Monitoring
Restriction on fish consumption	Requires Further Assessment	Impaired	Requires Further Assessment	Concentration of dioxins and furans in fish fillet tissue
Degradation of fish and wildlife populations				
a. fish population	Impaired	Impaired	Impaired	Community composition and abundance
b. fish body burden	Impaired	Impaired	Requires Further Assessment	Concentration of dioxins/furans in small and young-of-the-year fish; EEM fish survey indicators of reproduction, condition, growth, and survival
c. wildlife population	Requires Further Assessment	Requires Further Assessment	Not Impaired	NA
d. wildlife body burden	Requires Further Assessment	Requires Further Assessment	Not Impaired	NA
Fish tumours or deformities	Impaired	Impaired	Not Impaired	NA
Bird or animal deformities or reproductive problems	Requires Further Assessment	Requires Further Assessment	Not Impaired	NA
Degradation of benthos				
a. population	Impaired	Impaired	Impaired	Community composition and abundance; acute and chronic toxicity of sediment
b. body burden	Impaired	Impaired	Impaired	invertebrate tissue concentrations of dioxins and furans
Degradation of aesthetics*	Impaired	Impaired	Requires Further Assessment	NA
Loss of fish and wildlife habitat	Impaired	Impaired	Impaired	Substrate quality; benthic community structure

* The degradation of aesthetics BUI was not assessed in the Area in Recovery report (2010).

Restrictions on Fish Consumption

Lead agency

Ontario Ministry of the Environment (MOE)

Background

Since the 1970's, the Ministry of the Environment has been tracking contaminants in fish from various locations throughout Ontario. There are about 2000 locations that have been sampled for contaminants in sport fish. The primary goal of this program is to advise Ontarians on safe consumption of sport fish via biennial publication of the "Guide to Eating Ontario Sport Fish." Since some sport fish have a large home range, the contaminant levels found in fish collected inside Jackfish Bay may not be entirely due to conditions in the Area of Concern. This makes it difficult to separate localized effects of the mill effluent in Jackfish Bay from conditions affecting sport fish on a lake wide scale. Nevertheless, the measurements reflect the levels of exposure to contaminants through the consumption of sport fish caught within the AOC.

Indicator

1. Concentrations of contaminants, primarily dioxins/furans, in skinless boneless fillets of sport fish - namely lake trout, whitefish and white sucker.

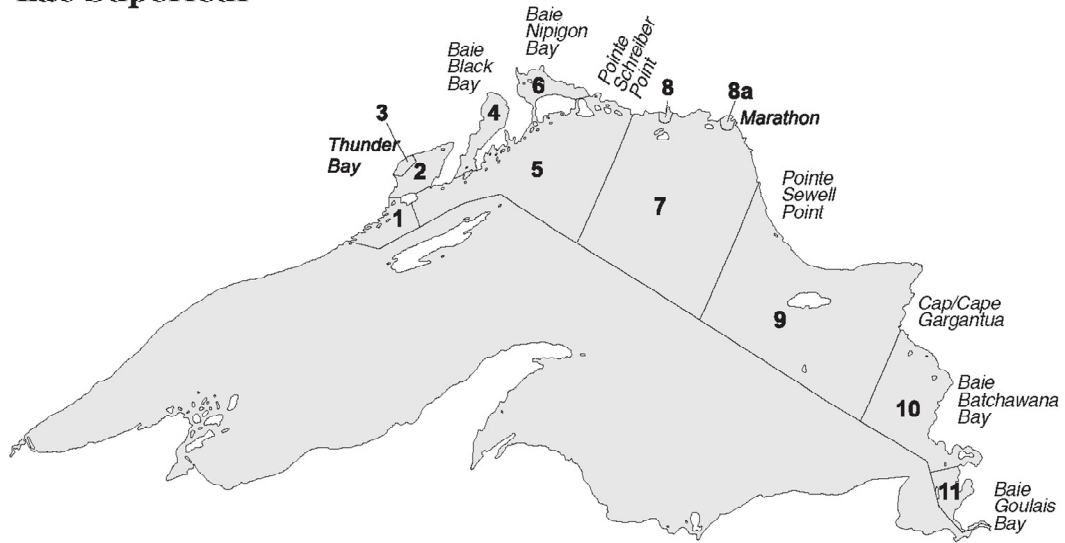
Monitoring action

Continue to monitor and compare contaminants in sport fish collected from both Jackfish Bay and appropriate reference sites, such as the open water area from Schreiber Point to Sewell Point (Block 7 in the Guide to Eating Ontario Sport Fish), using the existing MOE Sport Fish Contaminant Monitoring Program (Figure 1). Block 7 is considered to be a suitable reference site because it covers an open water area of Lake Superior that excludes Areas of Concern and other significant point sources of contamination.

In consideration of the monitoring frequency for sport fish, research indicates that the levels in Lake Superior are changing slowly and can be adequately assessed by a five-year monitoring cycle. The MOE recommends a sampling program that coincides with the binational Coordinated Science and Monitoring Initiative. The next monitoring initiative for Lake Superior will occur in 2011.

Figure 1: Ontario Ministry of the Environment 2009-2010 Guide to Eating Ontario Sport Fish Lake Superior Block Map

**Lake Superior
Lac Supérieur**



Source: Ministry of the Environment, 2009

Degradation of Fish Populations

Lead agency:

Ontario Ministry of Natural Resources (MNR)

Background:

The MNR has primarily monitored the status of commercial fish species using commercial harvest and effort data, combined with commercial catch sampling. More recently, the MNR has adopted an annual standardized fishery independent survey with coverage across the Ontario waters of the lake. The purpose of this survey is to establish a fishery independent trend through time relative abundance index in Lake Superior. The survey will provide information on the offshore fish community, with an emphasis on commercially important species.

In the spring of 2009, the MNR initiated a fish Community Index Netting program to assess relative abundance and population characteristics of the fish community. Sites within and adjacent to the Jackfish Bay AOC are included in the survey.

Indicator:

1. Fish community composition and abundance.

Monitoring actions:

A community index netting program will be used to establish a trend through time data set on the abundance and diversity of the fish community in Jackfish Bay. The survey will occur every two years or less frequently as the situation requires. Results from the AOC index netting will be compared to reference sites as well as tracked for changes over time.

Body Burdens of Fish

Lead agency:

Ontario Ministry of the Environment (MOE)

Background:

The intent of this Beneficial Use Impairment is to provide an indicator of the contaminant levels in fish that could pose a health risk to larger animals. The monitoring program will focus on small fish (5 – 8 centimeters) and young-of-the-year (YOY) forage fish, such as common shiner, because these fish have small home ranges in comparison to older fish.

At the same time, Environment Canada's Environmental Effects Monitoring program (EEM) will continue to evaluate the effects of effluents on fish and fish habitat to assess the adequacy of regulations on a site-specific basis. Information from the EEM program, along with social, economic, and technological information, can be used to assess the effectiveness of pollution prevention and control measures to indicate where there is a local, regional or national need for enhanced protection.

EEM was included as a component of the Pulp and Paper Effluent Regulations because of uncertainty that uniform discharge standards would protect all receiving environments. EEM studies are intended to identify effects from pulp and paper effluent, not evaluate cumulative effects resulting from other sources. EEM has provided the science-based feedback loop to assess the effectiveness of the national discharge limits in protecting the fisheries resource. Canada is unique in requiring pulp and paper mills to conduct an EEM program under regulation at a national scale to determine if regulations provide adequate protection for all receiving environments.

Indicators:

1. Concentrations of contaminants, primarily dioxins/furans, in composite samples of small fish and young-of-the-year forage fish.
2. The EEM fish survey statistically compares indicators of reproduction, condition, growth, and survival of fish exposed to effluent with the same indicators in unexposed fish collected from a reference area.

Monitoring actions:

1. Monitor and compare contaminants in small fish, such as white sucker, and young-of-the-year forage fish, such as common shiner, collected from both Jackfish Bay AOC and an appropriate reference site. As small fish and young-of-the-year forage fish are unlikely to be found in the open water reference sites used for the sport fish analysis, an alternative reference site will be selected. The MOE is considering a smaller inland lake that is not impacted by a point source of dioxins/furans, such as Lake Nipigon. This will help ensure that the sample collection from the reference site is large enough to enable a comparison to Jackfish Bay. In order to optimize the use of resources, sampling and analysis for body burdens will be planned in conjunction with the sport fish assessment. This entails a sampling frequency of once every five years that coincides with the binational Coordinated Science and Monitoring Initiative.

2. This will help ensure that the sample collection from the reference site is large enough to enable a comparison to Jackfish Bay. In order to accommodate costly dioxin measurements and the need for monitoring data on contaminant levels in fish, the MOE recommends a five year sampling frequency that coincides with the binational Coordinated Science and Monitoring Initiative. The next monitoring initiative for Lake Superior will occur in 2011.
3. Environment Canada's Environmental Effects Monitoring program is carried out in three-year cycles and consists of a biological monitoring study and sub lethal toxicity testing of effluent, including supporting information to aid with the interpretation of the monitoring results. Recent changes to the regulations introduced tiered monitoring, which reduces the frequency of biological testing to every six years where mills show no effects and increases efforts where more significant effects are observed. Potential effects of effluent on fish are assessed by comparing fish exposed to effluent with unexposed fish. Effects on the use of fisheries resources are assessed through measurements of dioxins and furans in fish tissue.

Loss of Fish Habitat

Lead agency:

Environment Canada

Background:

Habitat requirements typically change for each stage in a fish's life cycle; from egg to adult. If the various life cycle requirements are not met due to loss of habitat, fish numbers decline, and over time the entire population may be affected. It is therefore important that we protect the habitat that provides fish with clean water, spawning and rearing grounds, an adequate food supply and clear migration routes.

The health of benthic invertebrate communities is a good indicator of the health of fish habitat. Important information about existing fish habitat can also be determined by identifying and mapping the characteristics of the lakebed. These combined methods will provide information regarding the existing fish habitat as well as the health of that habitat.

Indicators:

1. Statistical differences in four core indicators between exposure and reference areas are used to quantify effects on the benthic invertebrate community. The indicators are: number of invertebrates, number of taxa (community diversity), evenness of organism distribution among the taxa, and similarity to reference site in community structure.
2. Classification and assessment of lake bottom substrates to determine the amount of available fish habitat for each life stage.

Monitoring actions:

Undertake a survey to classify and map the submerged substrate in Jackfish Bay, Lake Superior. The objective is to develop substrate and bathymetry maps to identify and classify fish habitat within the AOC. Quality assessment of the substrate will involve examining components of cobble and gravel areas for sediment and/or organic material. Where possible, the presence of aquatic plants and marshes will be noted so that wetland ecosystem classification (Hall-Armstrong *et al.* 1996) may be related to the findings of the community index netting results for the Jackfish Bay AOC.

Once fish habitat has been classified in the AOC, benthic community structure will be used as an indicator of the relative health of fish habitat in the AOC. Environment Canada's Environmental Effects Monitoring program is carried out in three-year cycles and consists of a biological monitoring study and sub-lethal toxicity testing of effluent, including supporting information to aid with the interpretation of the monitoring results. Recent changes to the regulations introduced tiered monitoring, which reduces the frequency of biological testing to every six years where mills show no effects and increases efforts where more significant effects are observed. Effects on fish habitat are assessed through comparing benthic invertebrate communities from areas exposed and unexposed to effluent.

Benthic invertebrate community structure will continue to be assessed in the Jackfish Bay AOC including Blackbird Creek and Moberly Lake whether the mill is operating or not. This monitoring will be carried out in approximate five year intervals.

Degradation of Benthos (including body burdens)

Lead agency:

Environment Canada

Background:

Previous assessments of sediment quality in the Jackfish Bay Area of Concern revealed that conditions in Moberly Bay (the western arm of Jackfish Bay) indicated a polluted environment, characterized by elevated sediment contaminant concentrations, toxicity and the absence of pollution sensitive benthos (Milani and Grapentine 2007; 2009). Assessments of water, sediment and benthic conditions in Blackbird Creek and Moberly Lake have been infrequent and less regular than monitoring of Jackfish Bay itself. However, data from the 1990s and from 2008 shows some elevated sediment chemistry as well as low levels of dissolved oxygen. Observation shows that foam and surfactants continue to affect parts of the creek and lake while the mill is operating.

Indicators:

1. Benthic community composition and abundance.
2. Sediment chemistry.
3. Sediment toxicity to benthos.
4. Benthic tissue concentration of dioxins and furans.

Monitoring actions:

To evaluate benthic conditions in the Jackfish Bay Area of Concern (AOC) and whether they continue to improve over time, four lines of evidence will be monitored: 1) benthic invertebrate communities, 2) sediment contaminant concentrations, 3) toxicity, and 4) benthic invertebrate contaminant tissue concentrations. These conditions will be assessed for spatial differences between contaminated and reference sediments, and temporal differences between sampling periods. A similar assessment was conducted by Environment Canada in 2003 and 2008 and will be repeated approximately every five years or as study results dictate. Benthic community, along with water and sediment chemistry will continue to be monitored in Blackbird Creek and Moberly Lake on a similar cycle.

References

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Appendix 1: Map of Jackfish Bay Area of Concern

