EXECUTIVE SUMMARY

The St. Clair River flows 64 km from Lake Huron south to Lake St. Clair and forms the border between the state of Michigan (U.S.A.) and province of Ontario (Canada). The St. Clair River Remedial Action Plan (RAP) report identified three areas within the St. Clair River, Zones 1, 2 and 3, as "priority" areas for further study due to benthic community alteration and contaminated sediment. The RAP identified mercury and several chlorinated organic compounds as the main contaminants of concern. Portions of Zone 1 were remediated through efforts completed in 2004. In 2007, the Canadian RAP Implementation Committee (CRIC) identified the need to apply the Canada-Ontario Decision-Making Framework for the Assessment of Great Lakes Contaminated Sediment (COA Framework) within Zones 2 and 3, an 8.3-kilometer (km) reach of the middle St. Clair River, hereafter referred to as the Area of Investigation (AOI). ENVIRON was hired to perform this assessment.

The COA Framework uses an ecosystem approach to sediment assessment to evaluate potential effects on sediment-dwelling and aquatic organisms, as well as potential for contaminants to biomagnify in the food chain, in order to form a rational basis for making sediment management decisions. ENVIRON evaluated four lines of evidence (LOEs): 1) risk from biomagnification of mercury and octachlorostyrene, 2) sediment chemistry, 3) benthic invertebrate community structure, and 4) sediment toxicity. Key findings and recommendations of this report are described below.

Risk from Biomagnification

To assess the risk from biomagnification LOE, ENVIRON conducted a streamlined analysis based on ecological risk assessment principles and practices, with the goal of refining the current understanding of the risk from the biomagnification LOE. Specifically, risk from biomagnification was evaluated by: 1) selecting ecological receptors of interest (ROIs); 2) calculating target concentrations of mercury and octachlorostyrene in aquatic organisms that are protective of each ROI; and 3) comparing current chemical concentrations in aquatic organisms to the target concentrations that are protective of each ROI.

Risk to Fish

- Risks to fish were evaluated by "block" in the St. Clair River AOC. Blocks 1, 2, and 3 correspond to locations upstream of the AOI, within the AOI, and downstream of the AOI, respectively.

- Risks to fish were evaluated based on comparisons of mercury and octachlorostyrene fish tissue concentrations to literature-derived toxicity reference values (TRV). Under this assessment approach, severity of risk (e.g., negligible, intermediate, high) was evaluated as a function of proportion of samples exceeding the TRV, by species and location. Negligible risks were

predicted for young-of-year fish throughout the St. Clair River (i.e., 20% or fewer samples exceeded TRV), while intermediate to high risks (i.e., 21% to 50%, and 51% or more, respectively) were predicted for adult sportfish in Blocks 2 and 3, and negligible risks were predicted for adult sportfish in Block 1. Species-specific risks within the AOI (Block 2) indicate high risks for northern pike and redhorse sucker and intermediate risks for carp, freshwater drum, white sucker and yellow perch. Octachlorostyrene is not predicted to adversely affect fish in the St. Clair River.

- Key sources of uncertainty for fish relate to the use of literature-based TRVs, exposure assumptions, sampling design, and confounding factors. The LOEs suggest these uncertainties are not expected to affect overall conclusions or recommendations.

- Based on the findings of potential risk to fish, prioritized zones of sediment management to mitigate those risks are mapped in Figure ES-1.

Risk to Wildlife

- Mean and 95% upper confidence limit (UCL) concentrations of mercury and octachlorostyrene in the prey tissue are below the target concentrations protective of wildlife ROIs (i.e., double-crested cormorants, herring gulls, and raccoons). Thus, negligible risks are predicted for wildlife foraging within the AOI.

- Key sources of uncertainty for wildlife relate to the use of literature-based TRVs, differences in species sensitivity, and exposure assumptions. However, consistent use of conservative assumptions to compensate for uncertainty, as well as evaluation of avian risks based on both dose and measured egg concentrations, suggest that these uncertainties do not affect overall conclusions or recommendations presented in this report.

Sediment Chemistry

The sediment chemistry LOE involves comparing surface sediment chemistry data to Sediment Quality Guidelines (SQGs) and reference conditions. The objective of this LOE is to determine whether: 1) chemicals are present in surface sediment at concentrations greater than conservative screening levels; and/or 2) chemicals present in surface sediment could biomagnify and affect the health of biological communities at higher trophic levels.

0 100 Meters

0 50 Meters

0 100 Meters

Stag Island

Lake Huron
St. Clair
Lambton County
Macomb
St. Clair River
Lake St. Clair
Chatham-Kent Division

Priority Areas

High : 0.049 mg/kg MeHg

Low : 0.0079 mg/kg MeHg

No sample data in this scoured area due to insufficient sediment depth

Source of Orthophotography:
St. Clair Region Conservation Authority, 2006

N

0 500 1,000 Meters

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Prioritized Zones for Sediment Management

Figure ES-1

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- All surface sediment sampling stations in the AOI exceed the SQG-low and 61% exceed the SQG-high for total mercury. However, exceedances of the mercury SQG are not generally predictive of impairment of the benthic community in the AOI. Concentrations of octachlorostyrene in surface sediment from all sampling stations in the AOI are below the equilibrium partitioning SQG, indicating that adverse effects on benthic invertebrates from octachlorostyrene are unlikely.

- Key sources of uncertainty in application of this LOE relate to: 1) the presence and effect of chemicals in sediment that were not evaluated in this report; 2) past and future changes in the spatial distribution of chemicals in sediment; 3) interpolation of chemical concentrations in unsampled areas; and 4) limited ability of mercury SQGs to predict adverse effects in benthic invertebrates. Consideration of the other three LOEs prevents these uncertainties from significantly affecting the overall conclusions of this report.

Benthic Invertebrate Community Alteration

The objective of the benthos alteration LOE is to determine whether the benthic community structure in the AOI differs significantly from benthic community structure at appropriate reference sites. Milani et al. (2007) and Moran et al. (2005) evaluated the benthic community in the AOI. This report summarizes those findings, with particular attention given to defining the magnitude and spatial extent of any impairment observed.

- Neither Milani et al. (2007) nor Moran et al. (2005) reported impairment of the AOI's benthic community structure.

- Stations sampled by both authors represented the full range of total organic carbon (TOC) concentrations, grain size distribution and mercury concentrations in the AOI, indicating that the findings for the stations surveyed are spatially representative of the entire AOI.

- The primary source of uncertainty in this LOE relates to identification of appropriate reference stations. However, Milani et al.'s (2007) comparison of upstream versus downstream conditions supports the finding of no significant alteration in the benthic community within the AOI.

Sediment Toxicity

The objective of the sediment toxicity LOE was to determine whether survival, growth and/or reproduction of sediment-associated invertebrates and minnows are impaired in

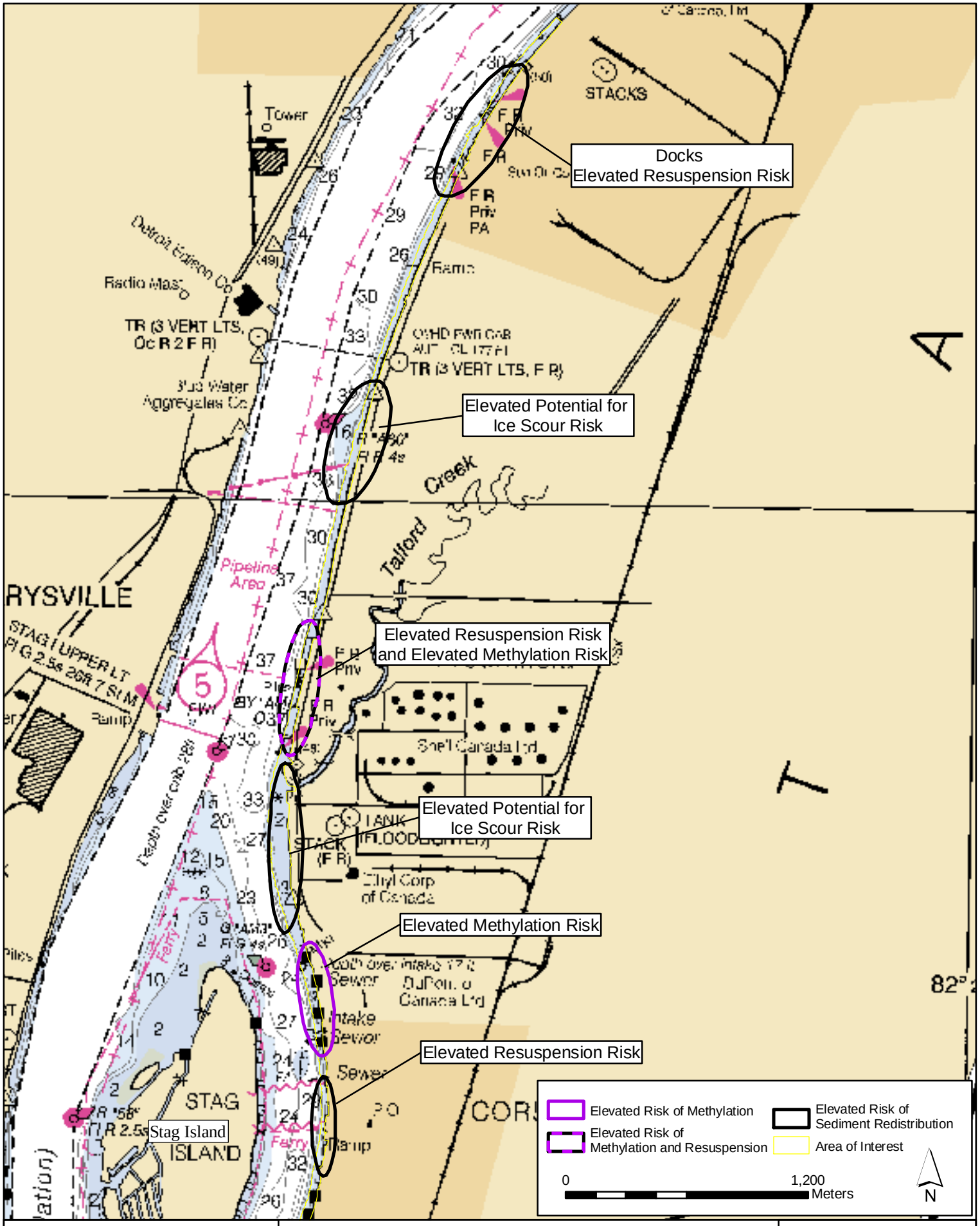
the St. Clair River AOI. Milani et al. (2007) and Moran et al. (2005) completed a number of toxicity tests using AOI sediment, yielding the following conclusions.

- Multiple toxicity tests on invertebrate survival, growth, and reproduction provide no clear indication of strong toxicity or a relationship between toxicological responses and concentrations of total mercury or methylmercury in river sediments.
- Test conditions represented the full range of TOC concentrations, grain size distribution, and mercury concentrations in the AOI, indicating that the findings for the stations tested are spatially representative of the entire AOI.
- Uncertainty associated with the sediment toxicity LOE primarily relates to the cause of the limited toxicity observed. Given the low frequency and severity of the effects observed by Milani et al. (2007), causation was not investigated in detail. Moran et al. (2005) reported more severe and widespread toxicity in the AOI and at an apparently uncontaminated upstream reference location, possibly due to an episodic stressor not present during the Milani et al. (2007) sampling events.

Subsurface Risk

Given the presence of elevated concentrations of mercury in subsurface sediment in the AOI, risks associated with disturbance of subsurface sediment were evaluated, with following findings.

- Compared to surface sediment, subsurface sediment has higher and more widespread distribution of total mercury. Maximum concentrations of total mercury in subsurface sediment are nearly five-fold higher than maximum concentrations in surface chemistry.
- The main causes of any potential disturbance to subsurface sediment are expected to be vessel traffic and ice scour. If vessel traffic or ice scour causes sediment erosion, the redistribution of mercury-impacted sediment may result in elevated in situ methylation potential in those locations where materials are redeposited.
- Methylation potential may be enhanced in the vicinity of dock or pier structures, or in locations where organic enrichment increases the activity of methylating bacteria near the sediment-water interface. Figure ES-2 maps the spatial distribution of potential subsurface sediment risks, as well as the factors contributing to those risks.



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Areas of Elevated Sediment Redistribution
and/or Methylation Risk
St. Clair River Area of Interest

Figure
ES-2

Conclusions

- Based on the COA Framework, when the biomagnification LOE indicates impairment, and the benthos alteration and sediment toxicity LOEs indicate no impairment—as is the case for the St. Clair River AOI—further assessment of the risk from biomagnification is required, regardless of the outcome of the sediment chemistry LOE (i.e., Scenarios 5 and 9), unless, however, there is sufficient site-specific evidence available from fish advisories and other research to consider that biomagnification at a site is significant. Thus, in the case of the St. Clair River AOI, integration of the four LOEs is primarily driven by the risk from biomagnification LOE.

- Zones for sediment management were prioritized based on risk to fish, the one ROI for which significant risk from biomagnification was predicted (Figure ES-1). The most important zones for sediment management to address risks to fish are immediately upstream and downstream of the scoured area.

- Zones with potential subsurface sediment risk are more extensive than those based on risk from biomagnification (Figure ES-2). Further investigation is recommended to characterize chemical stability, ice scour, and methylation potential within focused reaches of the AOI, particularly downstream of the scoured area. Specific testing recommendations include: 1) erodibility testing through flume-based analysis and numerical modeling; 2) ice accumulation mapping; and 3) fine spatial scale analysis of mercury and methylmercury distributions in sediment and porewater.