



St. Clair River Watershed Plan

December, 2009

AOC Area 1-A



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Chapter 1

Introduction and Background

1.1 Introduction

The 1995 St. Clair River Stage 2 – Recommended Plan identified that contaminants from non-point sources may be contributed to five of nine beneficial use impairments. Six major non-point sources of contaminants were identified and they included:

- Urban storm runoff
- Rural storm runoff
- Waste sites without leachate and runoff collection
- Malfunctioning septic systems
- Generation and disposal of household hazardous waste

In order to reduce contaminant loadings, the Stage 2 Plan recommended that the preparation of Watershed/Subwatershed Management Plans be drafted which focus on actions necessary to improve water quality and fish and wildlife habitat.

In the interim, a St. Clair River RAP Progress Report (2003) was prepared by Environment Canada. The report found significant progress in the implementation of municipal and industrial point source corrective measures. Remedial actions pertaining to waste sites and malfunctioning septic systems have also been undertaken. While many of the actions allowed a movement toward delisting of the St. Clair River as an Area of Concern (AOC), information gaps existed and solutions to removing impairments needed to be determined. In particular, habitat continues to be lost despite restoration and enhancement actions taken by land stewardship initiatives, non-profit groups and other organizations. The progress report recognized that an effort had to be made to quantify the current habitat status for each subwatershed. This included inventorying existing terrestrial habitat and non-point source pollution projects. Non-point source pollution projects are also referred to as Best Management Projects. With an emphasis on recommendations to address non-point source pollution, a Watershed Plan outline was supported. With a better understanding of local conditions in each subwatershed, development of a clear and practical remedial action program to restore and delist the AOC can be possible.

1.2 Purpose

The purpose of the Watershed Plan was to identify specific environmental conditions within the 14 subwatersheds with an emphasis on non-point source pollution actions. The plan was to update the 2003 Progress report where relevant.

1.3 AOC General Description

The 1991 Stage 1 “Problem Definition” defined the Area of Concern as the St. Clair River proper. The boundaries extended from the Blue Water Bridge to the southern tip of Seaway Island, west to St. John’s Marsh and east to include the north shore of Mitchell’s Bay on Lake St. Clair. This area encompasses Walpole Island First Nation Territory.



In 1995, the Stage 2 – Recommended Plan expanded the scope of the Remedial Action Plan to encompass the immediate drainage basin (Area 1-A) of the St. Clair River and include the immediate watershed area including the tributary creeks (Talford, Baby, Bowens, Clay, Marshy, etc.) in Ontario. **See Map 1: AOC Base Map.**

This Watershed Plan examines the environmental conditions with the 14 subwatersheds identified formally as St. Clair River AOC Area 1-A.

1.4 Goals and Objectives

1.4.1 St. Clair River RAP Goals

In 1995, the specific water use goals and objectives to direct action were developed. A series of goals were defined and adapted. They are listed below. The intent was to implement the actions and eventually delist the individual Beneficial Use Impairments (BUIs).

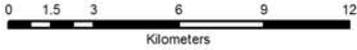
- 1. Restriction on Fish and Wildlife Consumption**
Eliminate the need for restrictions on human consumption of fish and wildlife for reasons of health.
- 2. Tainting of fish and wildlife flavour-recommended for re-designation as “not impaired”**
Eliminate the reporting of fish tainting reported.
- 3. Degradation of fish and wildlife populations**
Attain and maintain healthy, diverse and self-sustaining biological communities and habitats. Ensure no net loss of fish and wildlife habitat and reclaim, rehabilitate and enhance habitat where possible.
- 4. Fish tumours or other deformities**
Ensure the fish population does not exhibit fish tumours or other deformities.
- 5. Bird (or other animal) deformities or reproduction problems**
Ensure bird (or other animal) population does not exhibit deformities or reproduction problems.
- 6. Degradation of benthos**
Ensure the benthic community structure and contaminant body burdens are not negatively impacted.
- 7. Restrictions on dredging activities**
Eliminate restrictions on dredging activities due to contaminant levels.
- 8. Restrictions on drinking water consumption, or taste and odour problems**
Eliminate the need to close water treatment plant intakes due to chemical spills.
- 9. Beach closings and water contact sports**
Eliminate beach closings due to bacterial levels.
- 10. Degradation of aesthetics**
Eliminate reportings of oily surface films, spills and combined sewer overflow (CSO) events.
- 11. Added costs to agriculture or industry**
Eliminate water treatment plant closures or associated interruptions in water supply to industrial and agricultural users.
- 12. Loss of Fish and Wildlife Habitat**
Eliminate the loss of fish and wildlife and habitat and restore habitat necessary to maintain healthy, diverse and self-sustaining biological communities.

The objectives necessary to obtain the above listed goals are outlined in the Beneficial Use Report Card. The Report Card provides a description of the impairment and objectives necessary to restore environmental conditions in a summary form.

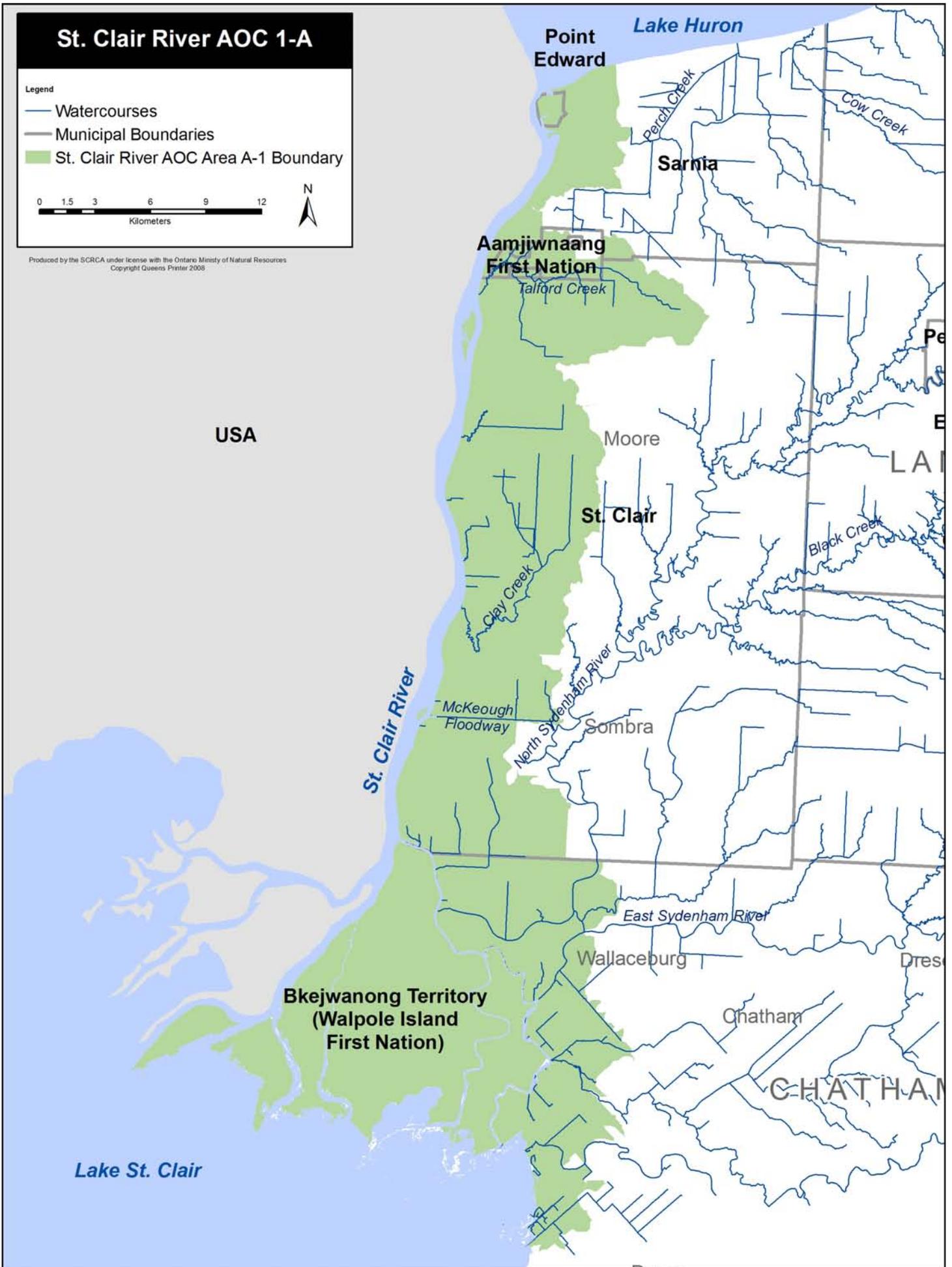
St. Clair River AOC 1-A

Legend

- Watercourses
- Municipal Boundaries
- St. Clair River AOC Area A-1 Boundary



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Map 1: AOC Base Map



Table 1: St. Clair River Area of Concern Beneficial Use Impairments Report Card

Beneficial Use Impairment	Stage 2 Status in 1995	Current Status 2007	Description of impairment	Past and planned actions to restore environmental conditions
Restrictions on fish and wildlife consumption	Impaired (for fish)	Impaired (for fish)	The Guide to Eating Ontario Sport Fish (OMOE) and the Michigan Fish Advisory (MDEQ) indicate that consumption restrictions remain in place for various fish species due to mercury, polychlorinated biphenyls (PCBs), mirex/ photomirex, and pesticides.	Decreasing trend in environmental concentrations of certain chlorinated organic compounds in water (1986-2000) reported by Environment Canada's Head and Mouth survey, and the removal of contaminated sediment by Dow Chemical Canada Inc. (1994) should contribute to improved health and quality of wild fish, as well as current efforts on contaminated sediments in Zones 2&3 and past and ongoing improvements to industrial discharge quality.
Tainting of fish and wildlife flavour	Requires further Assessment	Requires further Assessment	In 1995 a controlled subjective olfactory sensory evaluation of walleye caught from the St. Clair River was conducted and revealed that no identifiable tainting was detected by a panel of BPAC members and public. It was recommended that the status of this BUI be changed from "requires further assessment" to "not impaired". This change was to be based on confirmation by an extensive angler survey in late 1997 which revealed that just under half of St. Clair fish consumers (291) had concerns about the fish they caught. Of these, 4% reported fish tainting and provided specific descriptions such as "didn't smell/taste right" and odours and flavours like "oil", "crude", "petrochemicals" and "gasoline" (Dawson, 2000). Given that these reports were derived from experiences in the early to mid 1990s, and the study did not include Walpole Island First Nation residents this BUI was identified as still "requiring further assessment".	An angler survey was conducted in the spring of 2007 to look at the fish tainting issue. It indicated that, based on the results of this study and the results of two previous studies examining fish quality, tainting of smell and taste appear not to be a major concern amongst St. Clair River anglers. The weight of evidence accumulated to date leads us to conclude that tainting of fish and wildlife is not impaired. This recommendation has been endorsed by the Canadian RAP Implementation Committee (CRIC) and will be taken to the next BPAC meeting for endorsement.
Degradation of fish and wildlife populations	Not Impaired	Not Impaired	Contaminant concentrations in snapping turtles, terns and mink remain above RAP contaminant yardstick values (numerical environmental objectives), however, no impacts to populations observed.	None Required



Beneficial Use Impairment	Stage 2 Status in 1995	Current Status 2007	Description of impairment	Past and planned actions to restore environmental conditions
Fish tumours or other deformities	Requires further Assessment	Requires further Assessment	Liver samples from 63 fish representing 17 species from different trophic levels were evaluated using histopathologic criteria by the University of Guelph (Hayes, 2002). No neoplasms were found in any of the liver samples examined. One carp assessed from the Sarnia Bay station had several altered foci of the type observed in some fish species from locations where liver cancers occur. Thus, there is a possibility that these lesions might have been generated by exposure to mutagenic insult. Many of the fish may have been too young to develop neoplasms. Further assessment on older fish was recommended (Hayes, 2002).	Awaiting a report on the 2006 fish collection and liver evaluation from EC-NWRI before undertaking a comprehensive review of the current status. Integrate previous studies with the 2006 results to determine if this BUI is impaired or not impaired.
Bird (or other animal) deformities or reproduction problems	Impaired	Requires further Assessment	When this was revisited in the 2005 Progress Report it was noted that the Stage 2 declaration of this Beneficial Use as being Impaired was based on chironomid mouth part anomalies with no evidence of other bird or other animal deformities and it was felt that this was being dealt with through the degradation of benthos BUI.	Integrate previous studies on birds, reptiles and mammals with the 2006/2007 EC-CWS amphibian results. Complete a comprehensive assessment of vertebrate classes to determine the status of this BUI.
Degradation of benthos	Impaired	Impaired	Benthic communities in the two priority zones remain impacted and significant relationships were found between contaminant body burdens (mercury (Hg), hexachlorobutadiene (HCBD), HCB, OCS, PCBs) in invertebrates (oligochaetes, chironomids and mayflies) and sediment contaminant concentrations, demonstrating the extent of bioaccumulation. Sediment mercury contamination also impacts tubificid (a type of worm found in sediments) population density.	Complete contaminated sediment assessment and undertake management actions as required. Undertake shoreline erosion/softening projects to improve St. Clair River shoreline habitat. Continue to work with industry on monitoring and ongoing improvements to discharge quality.



Beneficial Use Impairment	Stage 2 Status in 1995	Current Status 2007	Description of impairment	Past and planned actions to restore environmental conditions
Restrictions on dredging activities	Impaired	Impaired	High levels of contaminants in the sediments exceeding the PSQG including mercury, hexachlorobutadiene, hexachlorobenzene, Octachlorostyrene have been found along the Ontario shoreline. Most of the exceedences occur along the Sarnia industrial waterfront as far downstream as Stag Island.	To date, approximately 13,370 m ³ of bottom sediment historically contaminated with mercury have been removed from the highest priority area (Zone 1) offshore of Dow Chemical Canada Inc. The COA Contaminated Sediment Assessment Framework is currently being used to assess the impact of the sediment within Zones 2 & 3. Once this assessment is complete (2009), management actions (if required) will be developed for the sites.
Eutrophication or undesirable algae	Not Impaired	Not Impaired	The waters of the St. Clair river are mesotrophic and algae do not occur at nuisance levels.	None required.
Restrictions on drinking water consumption, or taste and odour problems	Impaired	Impaired	The Stage 2 document indicated that periodic closing of water treatment plants intakes in Ontario occurred as a result of chemical spills. While there were no MOE or MDEQ issued drinking water advisories or mandated water treatment shutdowns for several years prior to 2000, this BUI is still identified as impaired given the incidence of spills in 2003-2004.	Review and, if necessary, revise the delisting criteria for “restrictions on drinking water consumption or taste and odour problems”. The criteria based on a two year timeline for no water plant intake shutdowns can lead to ongoing re-designations between impaired and not impaired status. The Industrial Pollution Action Team (IPAT) examined causes of industrial spills to the St. Clair River and made recommendations on spill prevention measures for industries and others. Implementations of IPAT recommendations are ongoing. Ont. Regulation 224/07 “Spill Prevention and Contingency Plans” was put in place and defines the mandates for spill prevention and contingency plans and must be in place by September 2008.
Beach closings/ water contact sports	Impaired	Impaired	Signs warning of possible intermittent pollution are in place at four Ontario parks (Willow, Seager, Lambton, Cundick, Brander) until bacterial levels are below Ontario Ministry of Health guidelines. Combined sewer overflows, storm sewer outfall discharges and by-passes from the Sarnia WPCP still constitute major sources of pollution to the St. Clair River and contribute to beach postings.	The City of Sarnia is currently working to eliminate CSOs within the city. The City of Sarnia WPCP has completed an upgrade from primary to secondary treatment. The villages of Corunna and Courtright are currently undertaking an EA to upgrade their joint WPCP to secondary treatment. The communities of Frogpoint and Wilkesport have gone off septic systems and installed pipeline. Ongoing NPS work.



Beneficial Use Impairment	Stage 2 Status in 1995	Current Status 2007	Description of impairment	Past and planned actions to restore environmental conditions
Degradation of aesthetics	Impaired	Impaired	This BUI is impaired as a result of oily surface films, spills and combined sewer overflow (CSO) events.	Develop an appropriate methodology (e.g. questionnaire, contact MOE district office, Health Units, municipalities and the MNR to determine if there have been recent complaints) to evaluate degradation of aesthetics in the St. Clair River AOC, including all partners (U.S., Canadian and First Nations) in the development of study and the decision BUI status. Ont. Regulation 224/07 "Spill Prevention and Contingency Plans" was put in place and defines the mandates for spill prevention and contingency plans and must be in place by September 2008. The City of Sarnia is currently working to eliminate CSOs within the city.
Added costs to agriculture or industry	Impaired	Impaired	Because there had been no water treatment plant closures or associated interruptions in water supply to industrial users between 1994 and 1997, it was recommended that the status of this BUI be changed from "impaired" to "not impaired". This beneficial use impairment also requires current review based on recent chemical spills to the St. Clair River.	This BUI requires a full assessment to determine whether there are added costs through a survey of river water users.
Degradation of Phytoplankton and Zooplankton Populations	Not Impaired	Not Impaired	The species composition of phytoplankton and zooplankton reflect the oligotrophic to mesotrophic conditions of lower Lake Huron	None required.
Loss of Fish and Wildlife Habitat	Impaired	Impaired	Habitat has been lost due to filling, draining, dredging and bulkheading for industrial, urban, agricultural and navigational uses. Significant losses of wetlands have occurred particularly in the Walpole Island delta region.	Ongoing NPS and habitat projects within the AOC, (as per the Updated Habitat and NPS Rehabilitation Priority Sites). Undertake shoreline erosion/softening projects to improve St. Clair River shoreline habitat. Improve the biological connectivity within the AOC with a focus on Area 1-A.



1.4.2 St. Clair River RAP Work Plan

The 2007 Canadian Work Plan is a continuation of, and revision to, the Bi-national work plan of the 1995 St. Clair River Stage 2 – Recommended Plan. Four subcommittees studied and completed work plans for the following categories: Point Source, Habitat and Non-point Source Pollution, Monitoring and Research, and Sediment. These work plans propose actions that will lead to the rehabilitation of Beneficial Use Impairments (BUIs) of the St. Clair River that presently have a status of “Impaired”, or “Require Further Assessment”. A particular BUI may be re-designated to a status of “Not Impaired” when the delisting criteria are achieved. When all BUIs have been re-designated as “Not Impaired”, a recommendation and submission to the IJC can be made to delist the St. Clair River as an AOC. The prioritized actions identified in Section 5 are basically a reiteration of the actions and issues listed in the 2007 Work Plan with some modification based on the examination of site specific subwatershed characteristics and conditions.





2

Chapter 2

Watershed Characterization

2.1 Physical Characteristics

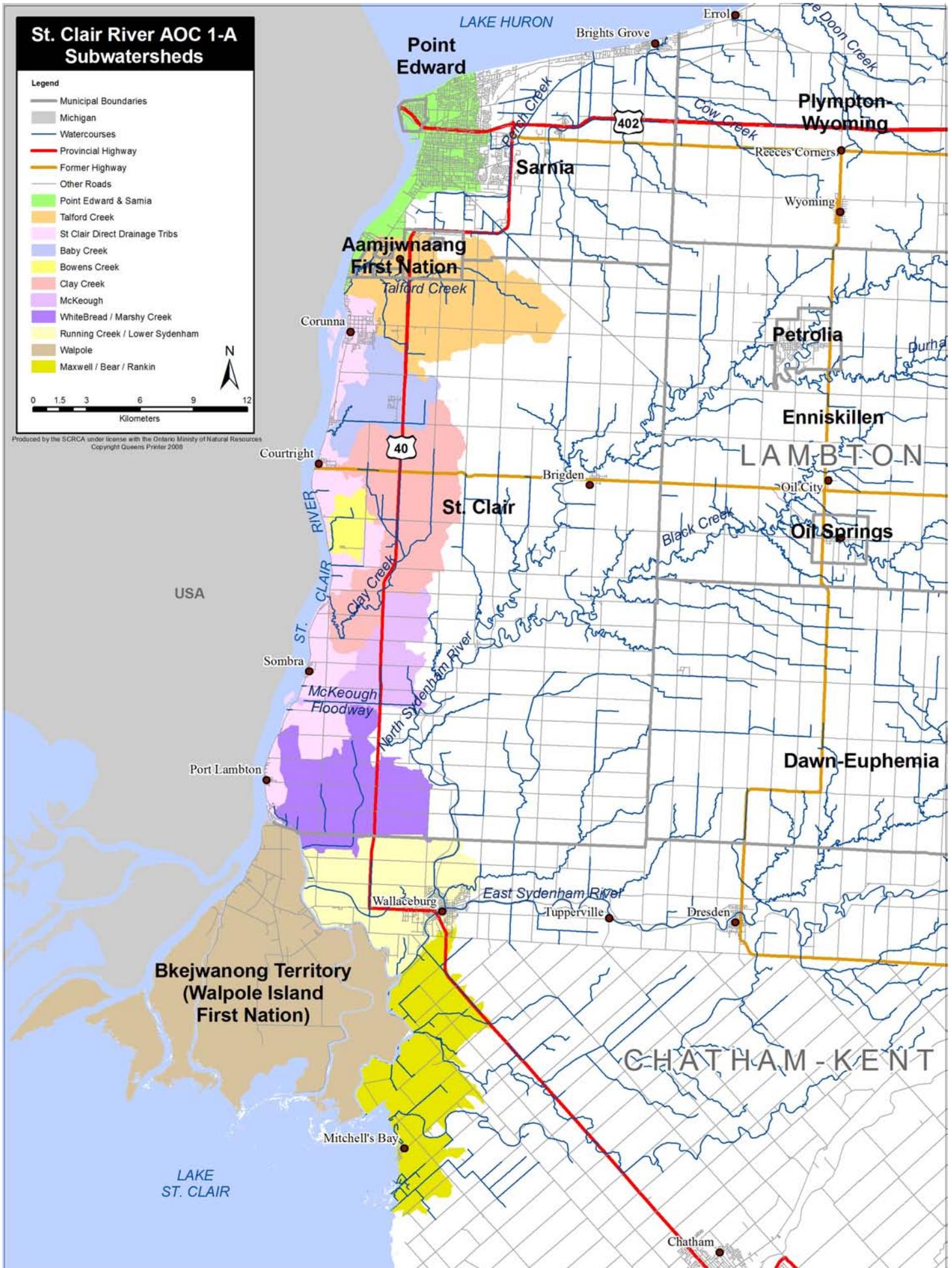
The AOC 1-A area is a compilation of Canadian subwatersheds which directly drain to the St. Clair River. The AOC area drains approximately 14% of western Lambton County and 4% of northwest Chatham-Kent. This proportional area amounts to approximately 433 km² of Lambton County and approximately 108 km² of Chatham-Kent. Walpole Island is situated within the delta of the St. Clair River. 147 km² of Walpole Island lands drain to the delta watercourse features. The AOC includes 60 km of shoreline along the St. Clair River, 25 km along the Chenal Ecarte and 7 km along Lake St. Clair. The St. Clair River is wholly situated within Lambton County with a small 1.8 km section along the Chenal Ecarte. The municipality of Chatham-Kent physically abuts the Chenal Ecarte for a distance of 23.2 km and Lake St. Clair for a distance of 7 km. Tributaries which ultimately discharge to the St. Clair River measure 285 km, while the total kilometres of tributaries that discharge to the Chenal Ecarte and Lake St. Clair measure 4,963 km. **See Map 1: AOC Base Map.**

Eleven subwatersheds have been identified and their hydrologic boundaries are provided on **Map 2: AOC Subwatersheds**. The lands can be described by bedrock, overburden, surficial geology, soils, physiography and topography. These properties all have significant impacts on groundwater hydrology and surface water drainage. The flow characteristics of the St. Clair River and the surrounding physical characteristics had a significant impact on the human settlement and development in the area. In return, human activities have had an effect on water quality and flow in the watershed.

Bedrock topography slopes to the west with the lowest or deepest bedrock surface elevations along the St. Clair River and Lake St. Clair. Millions of years ago when the bedrock was exposed, stream erosion played a major role in sculpting the bedrock topography of southern Ontario. Similar to our modern day river valleys, these ancient channels formed persistent topographic lows into which surface drainage was focused over long periods of time¹. A small scale bedrock valley is believed to exist from the Sarnia-Corunna area. This valley is parallel to the St. Clair River approximately 300 to 1,000 metres east of the river. The valley is 30 to 35 metres below surrounding bedrock and is generally 60 to 70 metres below ground. It is generally filled with sand and gravel deposits². The presence of Salina formations has led to the use of these caverns by petrochemical and processing industries for storage. Caverns are constructed in the salt formation(s) by a solution-mining process. The rock salt has extremely low permeability and porosity, making these ideal as storage mediums for industries.

¹ Eyles, N., Arnaud, E., Scheidegger, A.E., and Eyles, C.H. 1997. Bedrock jointing and geomorphology in southern Ontario, Canada; an example of tectonic pre-design: *Geomorphology*, 19, 17-34.

² INTERA Technologies Ltd., 1992 Hydrogeologic Study of the Fresh Water Aquifer and Deep Geologic Formations, Sarnia, Ontario



Map 2: AOC Subwatersheds



Soils and Topography

Much of the overburden covering the bedrock in the study area was the result of fine-grained material deposited at the bottom of ancient glacial lakes. The topography is relatively flat and the watersheds contain mostly clay and silt soils. Glacial lake meltwaters and changing lake levels created elevated sand ridges such as those found in the north Sarnia portion of the study area. However, the dominant physiographic feature of the AOC area consists of the Lambton Clay Plain and the Chatham Flats/Clay Plain.

Lambton Clay Plain – this till plain was deposited beneath the glaciers and is relatively flat, reworked till plain. The material was previously deposited and then over-ridden by a subsequent glacial event.

Chatham Flats/Clay Plain – this plain parallels the St. Clair River and Lake St. Clair shorelines and is characterized by deep lacustrine clay deposits with extreme flatness.

Soils

The soil maps produced for the watershed illustrate the soils generalized into five soil groups. The soil maps were developed from detailed county soil surveys and provide a brief description of the soil types. **See Map 3: Soils.**

Shorelines

St. Clair River Shoreline

The river is a relatively straight channel with hardened erosion control structures such as riprap and retaining walls lining most of the shoreline. There are some narrow beaches, vegetated slopes, and parks. The head of the St. Clair River has relatively high velocities, and is considered a pinch point due to the narrow configuration of the channel at the Lake Huron outlet. Historic photos indicate some infilling has occurred in the Point Edward/Sarnia area.

Lake St. Clair Shoreline

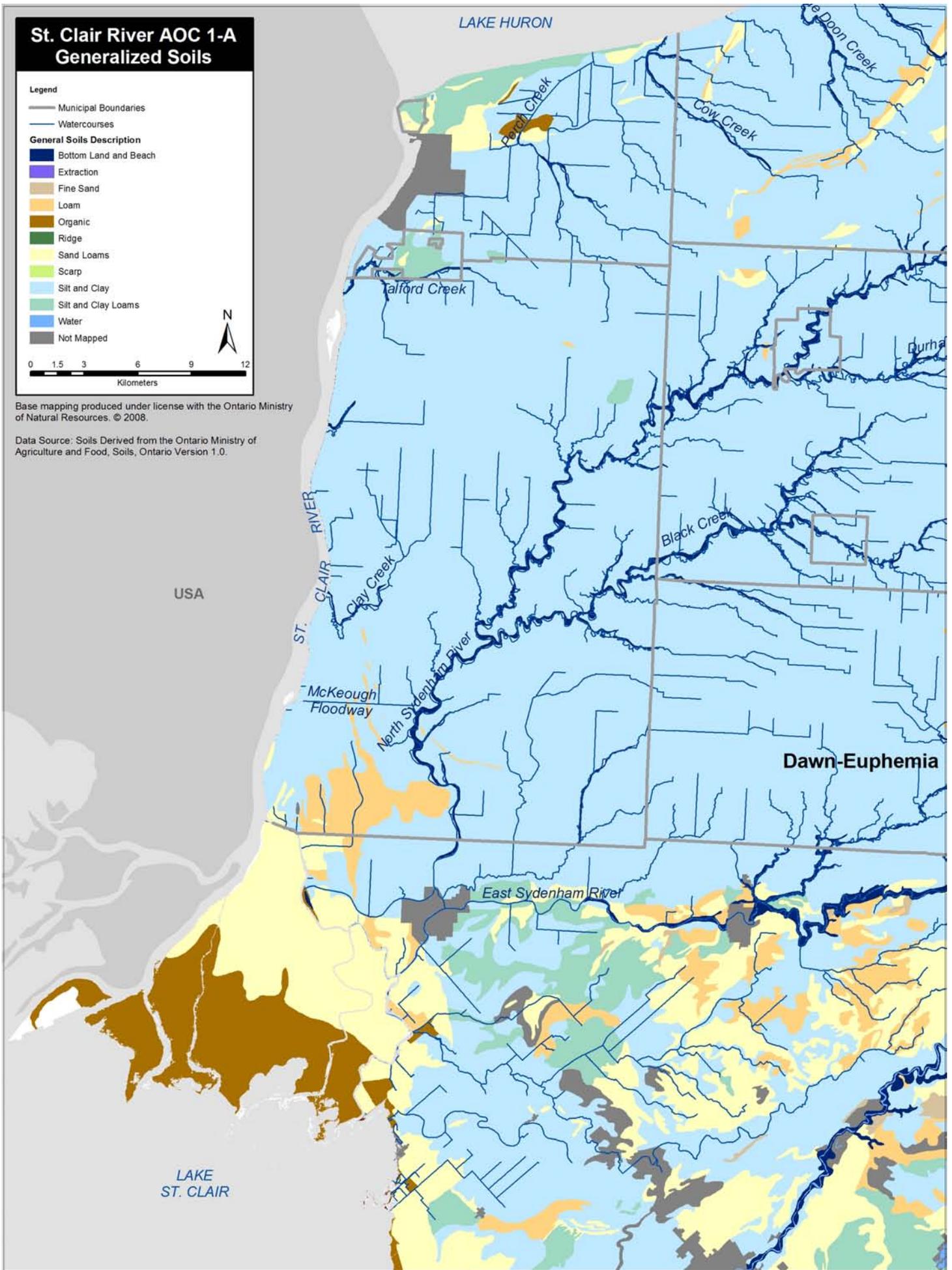
The shoreline varies from broad wetland to hardened retaining walls. Much of the area has been dyked inland from the lake to allow dewatering by pumping. The extensive pump works permits extensive cultivation in the low lying region.

Lake St. Clair Delta Shoreline

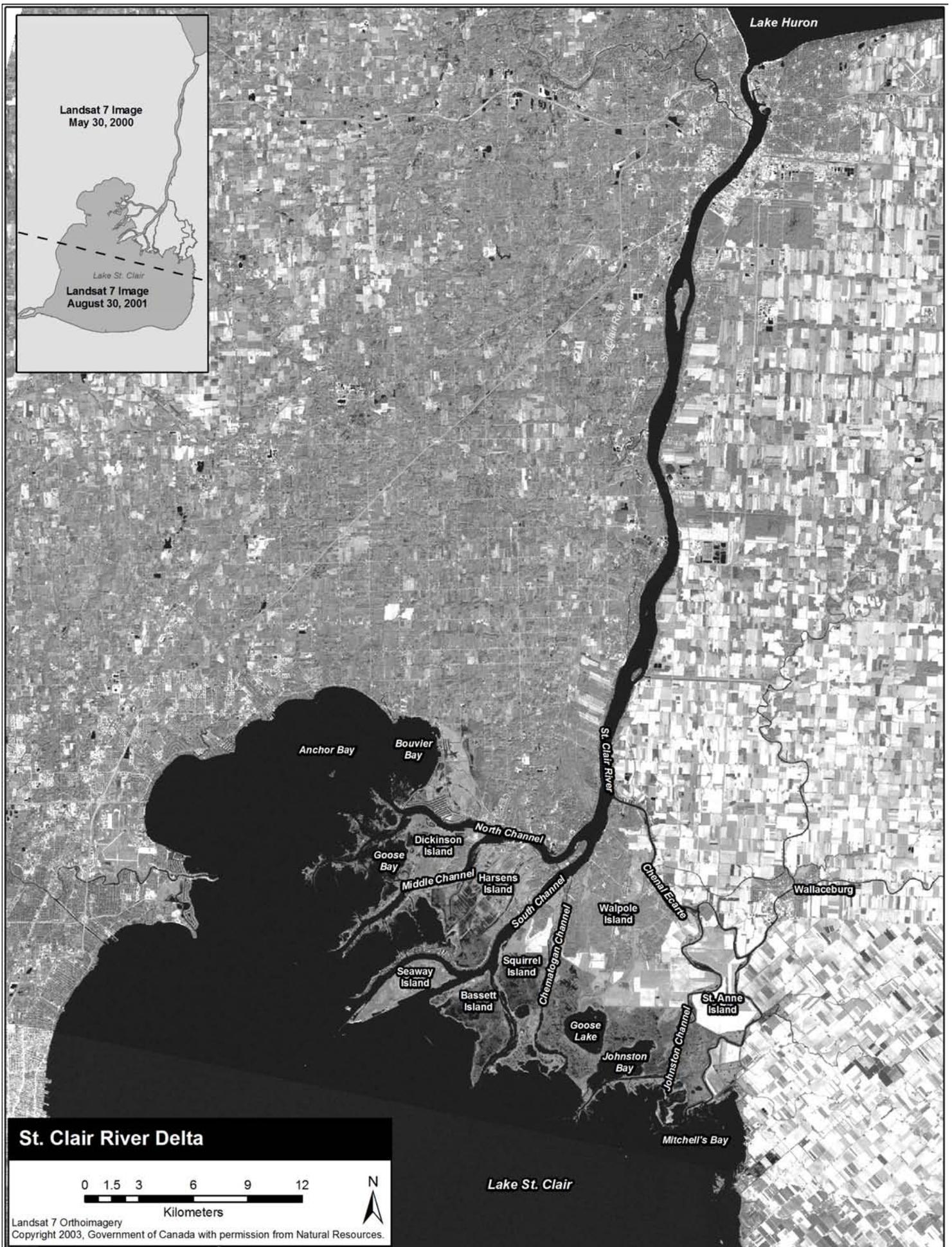
Before discharging to Lake St. Clair, the St. Clair River divides into several channels creating an extensive delta. The delta is made up of discrete islands; Walpole Island, the largest one, is accompanied by Squirrel Island and St. Anne Island with several other small islands divided artificially by canals. **See Map 4: St. Clair River Delta.** Walpole Island Shoreline is less hardened and consists of natural vegetated shorelines. Dependent on lake levels, wide beaches exist along the Walpole Island shoreline.

Terrestrial Ecology

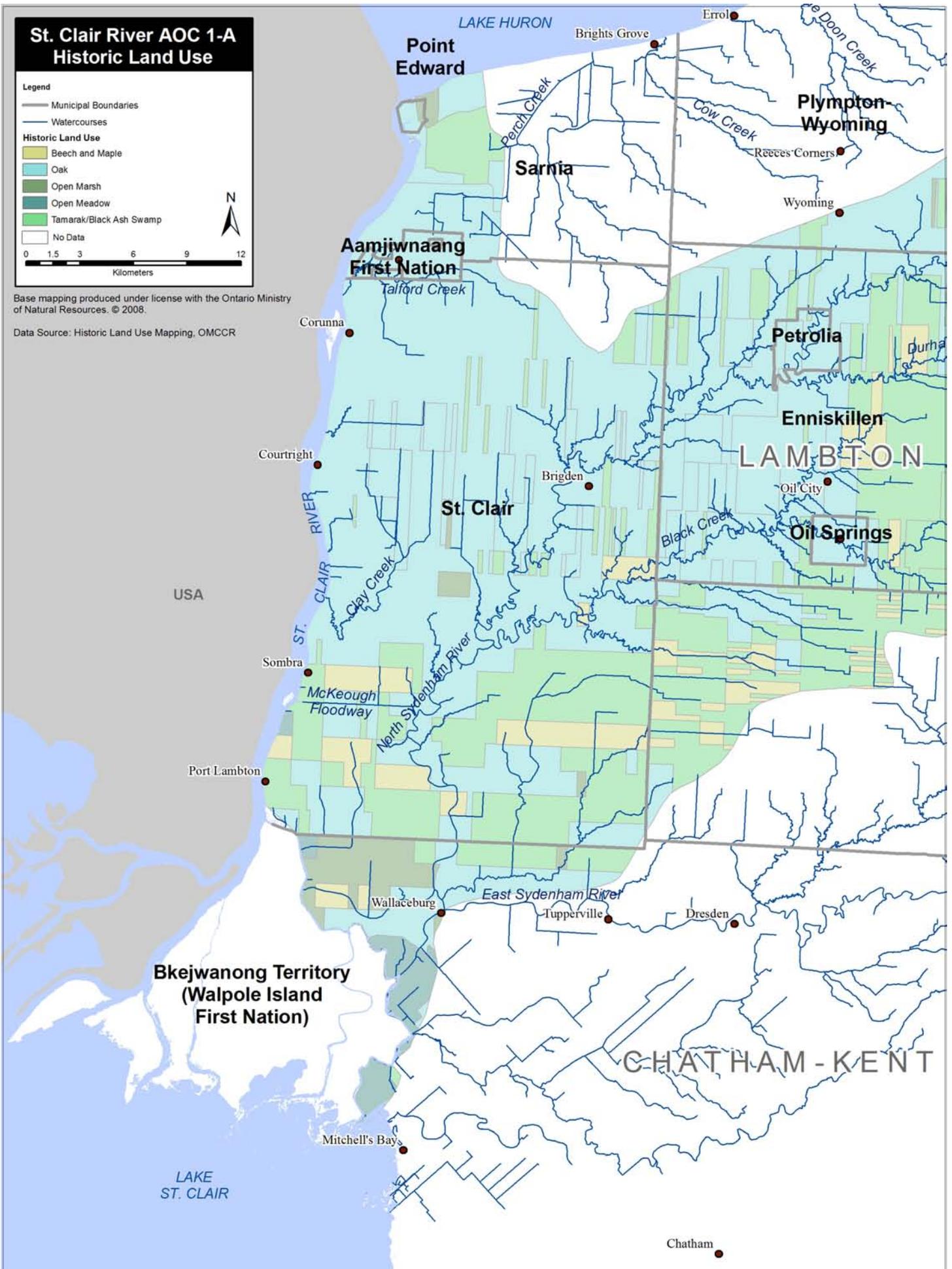
Historical surveyors' notes from the early 1800s have been compiled and analyzed for the St. Clair Region which provides a reasonable perspective on the land use changes over time. **Map 5: Historic Land Use** indicates the vegetative cover present prior to the area being populated by European settlers. With the exception of marshland in the Sarnia (old Lake Wawanosh area), wetlands were not predominant in the upper St. Clair River area. Forest dominated the landscape. However, in the lower St. Clair River and Lake St. Clair area, both wet woods and marsh wetlands as well as prairie meadows would have been more numerous than upland woods.



Map 3: AOC Soils



Map 4: St. Clair River Delta



Map 5: Historic Land Use



Wetlands

Protection of the remaining wetlands is extremely important for maintaining base flow to watercourses, water filtering functions, and natural heritage biodiversity. Wetlands also act as a carbon sink, filter the air and provide valuable social and educational resources. Environment Canada has provided guidelines indicating that greater than 6% of each major subwatershed should be in wetland habitat; or the original percentage of wetlands should be restored³. The table below indicates the area of Ministry of Natural Resources identified wetlands per subwatershed.

Table 2: % Wetland Cover Within Each Subwatershed

Subwatershed	Total wetland area (km ²)	Subwatershed area (km ²)	% wetland
Baby Creek	0	21.0097	0
Bowens Creek	0.592	6.6198	8.942868365
Clay Creek	2.406	56.6698	4.245647594
Whitebread/Marshy Creek	0.01	43.849	0.022805537
Maxwell Creek/Bear/Rankin	2.88	56.279405	5.11732489
McKeough	0.044	21.7352	0.202436601
Running Creek Lower Sydenham	0.307	49.3795	0.621715489
Sarnia/Pt. Edward	0.024	34.813787	0.068938205
St. Clair	0.709	47.793409	1.483468149
Talford Creek	0	57.168	0
Walpole Island	0	147.120635	0
Total	6.972	542.438236	1.285307623

Review of the historical surveyors' notes from the early 1800s revealed extensive wet meadows and open marshes stretched south from Wallaceburg into Geographic Dover Township. This was an extension of the existing St. Clair Marshes, situated along Lake St. Clair, as shown in the Maxwell/Bear/Rankin subwatershed map. **See Map 6: AOC Wetlands.**

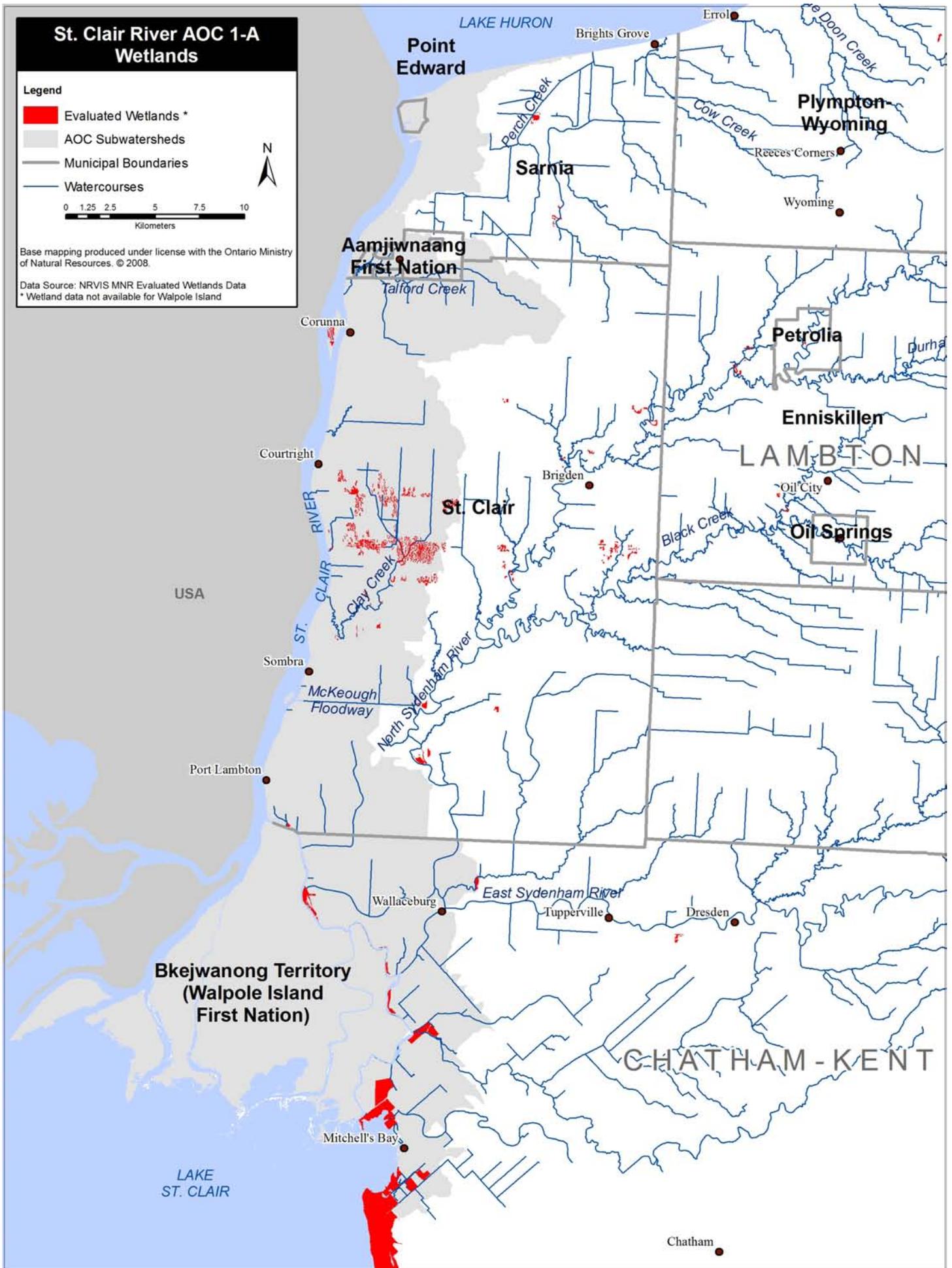
Widespread drainage works over the past 150 years have reduced the wetland cover to less than 1% in the entire St. Clair Region watershed. The diversity has also been affected, as the majority of the wetlands are those deciduous swamps existing in the remnant woodlands at the back of farms. Along Lake St. Clair, there are remnants of marsh and some marshlands have also been recreated with dykes and pump works. Currently, the largest MNR identified wetland complex is the Bickford Oak Woods wetland in St. Clair Township. This swamp or slough forest is 3.6 km². It is the largest wetland in the entire St. Clair Region watershed, not to mention Lake St. Clair and St. Clair River direct drainage watersheds referred to as AOC Area 1-A. Situated within 3 subwatersheds, it represents a core Natural Heritage feature within the AOC. **See Map 7: Wetland Cover.**

Riparian Zones

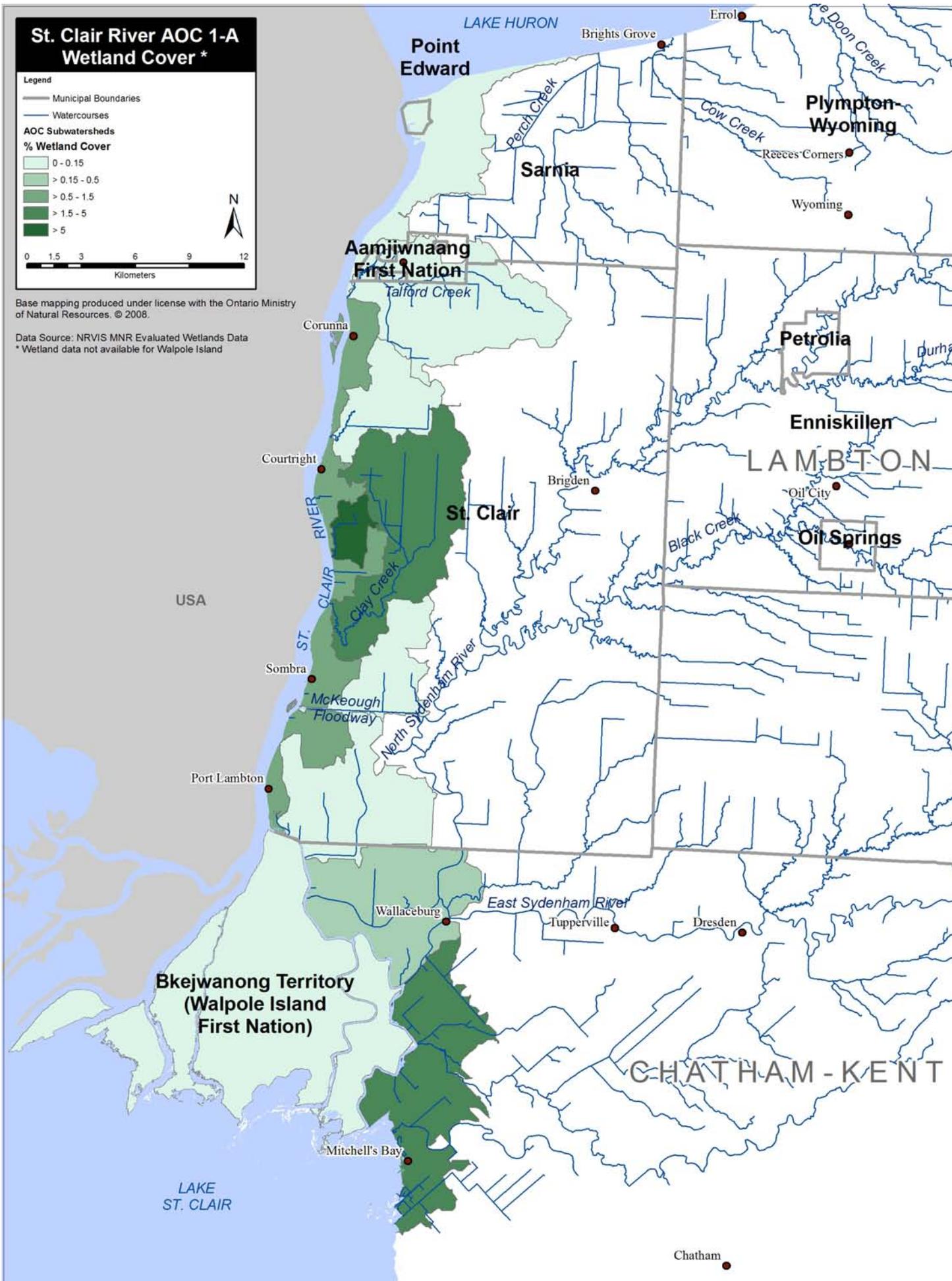
The area of land adjacent to the watercourse is often called the riparian zone or buffer zone. Natural or permanent vegetation adjacent to watercourses provides many benefits to the watercourse. The vegetation filters sediment and pollutants from surface runoff, shades and cools the water, provides shoreline habitat for fish, reduces bank erosion, and contributes organic matter such as woody debris and leaves for aquatic organisms.

Environment Canada's riparian habitat guidelines recommend 75% of stream length be naturally vegetated, ideally with a 30 metre wide natural stream buffer³. MNR conducted a 2006 GIS riparian buffer exercise and found that the percentage of tributaries buffered by greater than five (5) metres of natural vegetation in Area 1-A is approximately 12 percent. This represents half the riparian buffering in the Sydenham River watershed, the Sydenham watershed being adjacent to

³ Environment Canada, 2004. How much habitat is enough? A framework for Guiding Habitat Rehabilitation in Great Lakes Areas of Concern. Second Edition. Available from Canadian Wildlife Service, Downsview, Ontario or wildlife.ontario.ec.gc.ca



Map 6: AOC Wetlands



Map 7: Percent Wetland Cover



the St. Clair River tributary watershed (AOC). This exercise highlighted the need for improved buffering in Area 1-A⁴. See **Appendix B for CRIC Work Plan**.

Woodlands

Environment Canada³ has provided guidelines on forest habitats, specifically indicating that at least 30 percent of the watershed should be in forest cover in order to support viable fish and wildlife populations. The table below provides the % forest cover for each subwatershed and the % forest cover for the AOC Area 1-A and entire St. Clair Region Conservation Authority watershed as a comparison.

Table 3: % Woodland Cover Within Each Subwatershed

Subwatershed	Total Woodland area (km ²)	Subwatershed area (km ²)	% woodland cover	% Cover of SCRCA Total Woodlands
Baby Creek	2.515950134	21.0097	11.97518353	0.512413469
Bowens Creek	2.432339711	6.6198	36.74340178	0.49538487
Clay Creek	11.46666219	56.6698	20.23416739	2.335369082
Whitebread/Marshy Creek	2.403702394	43.849	5.481772433	0.489552422
Maxwell Creek/Bear/Rankin	0.730317433	56.279405	1.297663742	0.148740821
McKeough	3.027565271	21.7352	13.92931867	0.616612072
Running Creek Lower Sydenham	0.274812467	49.3795	0.55653149	0.055969953
Sarnia/Pt. Edward	1.76804607	34.813787	5.078580133	0.360090849
St. Clair	4.03589899	47.793409	8.444467708	0.821975354
Talford Creek	12.7683515	57.168	22.33478782	2.600478921
Walpole Island	21.31325917	147.120635	14.48692712	4.340785981
Total	60.2209552	542.438236	11.10190086	12.77737379

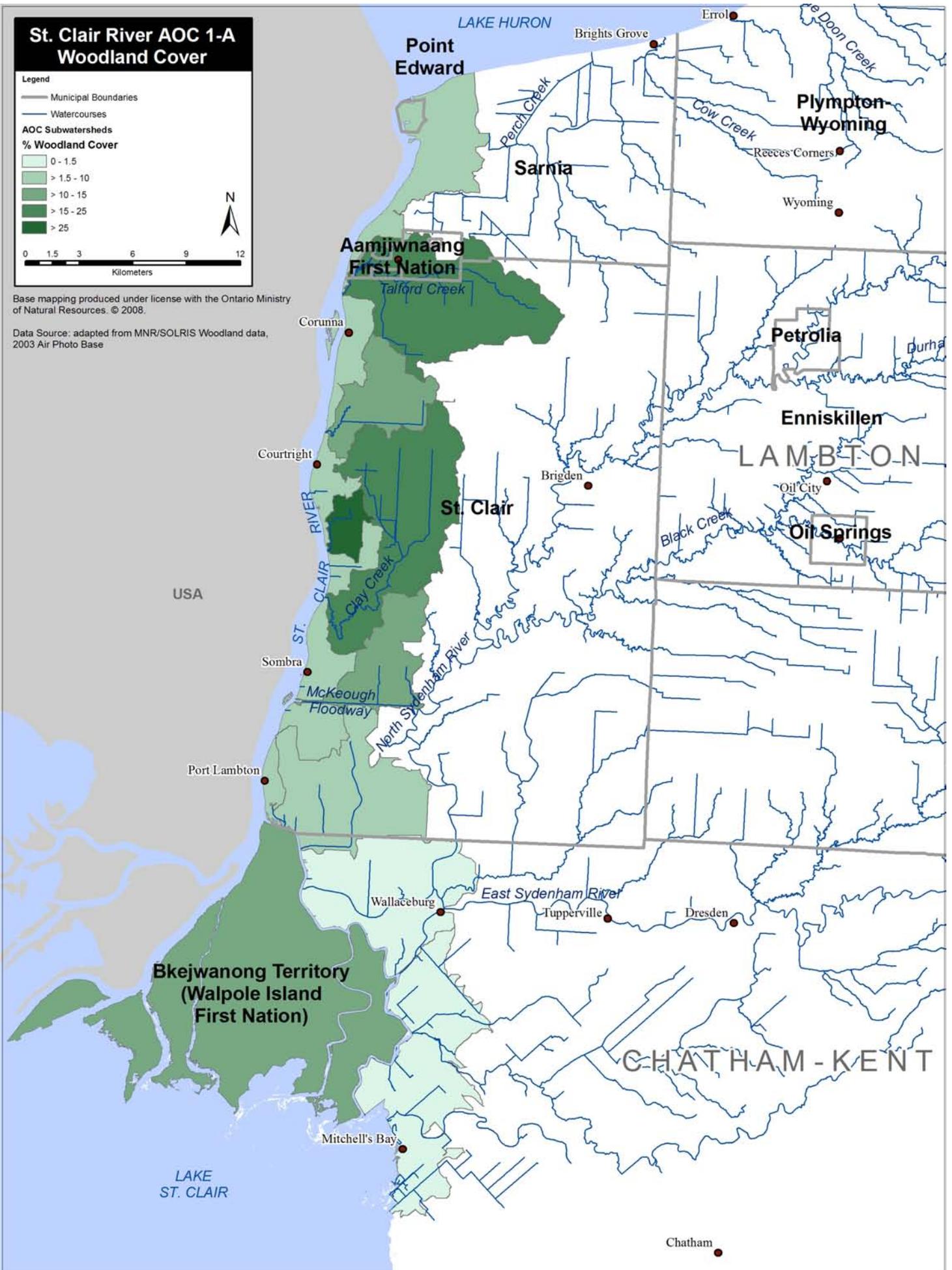
SCRCA Area 4130 km²
 Woodland Cover 491 km²
 % Woodland Cover 11.88861985%

Historic records of the region indicate that there were extensive deciduous woodlands across the region. The area is classified as Great Lakes Deciduous Forest, which includes sugar maple, American beech, red oak, basswood and white ash. In comparing the southwest AOC area to the entire St. Clair Region, there are more southerly “Carolinian” species including black cherry, black walnut, sycamore, white oak, swamp white oak, chinquapin oak, and shagbark hickory. Several rarities such as tulip tree, blue ash, Kentucky coffee tree, hop tree, shumard oak, big shellbark hickory and pawpaw are also found in the region.

Today, in Lambton County and Area 1-A, the largest area of woodland is within the Walpole Island First Nation and the second largest within Aamjiwnaang First Nation. The largest contiguous forest outside First Nation lands is Bickford Oak Woods, in St. Clair Township.

The linear east-west pattern of most woodlots in the area is due to the practice of clearing the acreage closest to the concession road for farming, while retaining the “back 40” in treed cover. **Map 8: Woodland Cover** shows the woodland cover with the First Nation lands identified. The lowest amount of cover is found in the Lake St. Clair subwatershed areas, where marshland occurred historically prior to European settlement. This area is intensively farmed due to the favourable soils and artificial drainage. The mapping information indicates that direct St. Clair tributary watersheds have minimal woodland cover in comparison to the surrounding subwatersheds.

⁴ St. Clair River Canadian RAP Work Plan 2007, p. 14



Map 8: Percent Woodland Cover



2.2 Aquatic Characteristics

Aquatic ecosystems provide habitat for aquatic organisms and for some specific life stages of semi-aquatic species. Aquatic ecosystems include watercourses (streams, rivers, and drains), water bodies (lakes, reservoirs, and ponds), and wetlands.

Habitat

When comparing the quality of aquatic habitat of the AOC tributaries to the rest of the Sydenham watershed, it is suffering the greatest environmental impact.

Fisheries

During the last 30 years, 67 species of fish have been recorded in the AOC Area. This represents 40% of the 165 fish species known in Ontario. The master species list was prepared using information from the Ontario Ministry of Natural Resources (OMNR), the Royal Ontario Museum (ROM), Fisheries and Oceans Canada (DFO) and both SCRCA and UTRCA staff, who have sampled the fish communities using seine netting, minnow trapping, backpack electro-fishing and boat electro-fishing. The Department of Fisheries and Oceans completed a boat electro-fishing survey of the St. Clair River fishes in 2004⁵ and compared their results with an OMNR 1994 study.

These species are listed in Table 4. The table also ranks according to the Committee on the Status of Endangered Wildlife in Canada (COSEWIC)⁶. Five of these species are considered Species at Risk (SAR) by COSEWIC. Additional information on SAR is provided in Table 4.

Table 4: Species at Risk – St. Clair Region

Common Name	Scientific Name	Type of organism	COSEWIC	SARO	SRANK
Plants					
Colicroot	<i>Aletris farinosa</i>	Plant	THR	THR	S2
Green Dragon	<i>Arisaema dracontium</i>	Plant	SC	SC	S3
Bluehearts	<i>Buchnera americana</i>	Plant	END	END-NR	S1
False Hop Sedge	<i>Carex lupuliformis</i>	Plant	END	END-R	S1
American Chestnut	<i>Castanea dentata</i>	Plant	END	END-NR	S2
Hill's Thistle	<i>Cirsium hillii</i>	Plant	THR	THR	S3
Dune Thistle	<i>Cirsium pitcheri</i>	Plant	END	END-NR	S2
Small White Lady's-slipper	<i>Cypripedium candidum</i>	Plant	END	END-R	S1
American Columbo	<i>Frasera caroliniensis</i>	Plant	SC	SC	S2
Blue Ash	<i>Fraxinus quadrangulata</i>	Plant	SC	SC	S3
White Prairie Gentian	<i>Gentiana alba</i>	Plant	END	END-NR	S1
Kentucky Coffeetree	<i>Gymnocladus dioicus</i>	Plant	THR	THR	S2
Swamp Rosemallow	<i>Hibiscus moscheutos</i>	Plant	SC	SC	S3
Butternut	<i>Juglans cinerea</i>	Plant	END	END-NR	S3?
Dense Blazingstar	<i>Liatris spicata</i>	Plant	THR	THR	S2
Purple Twayblade	<i>Liparis liliifolia</i>	Plant	END	END-NR	S2
Riddell's Goldenrod	<i>Oligoneuron riddellii</i>	Plant	SC	SC	S3
Broad Beech Fern	<i>Phegopteris hexagonoptera</i>	Plant	SC	SC	S3
Heartleaf Plantain	<i>Plantago cordata</i>	Plant	END	END-R	S1

⁵ Edwards, A., J. Barnucz and N.E. Mandrak, 2006. Boat electro-fishing survey of the fish assemblages in the St. Clair River, Ontario. Can. Manuscr.Rpt.Fish. Aquat. Sci. 2742:v + 57 p.

⁶ NHIC website www.mnr.gov.on.ca/MNR/nhic/nhic.html



Common Name	Scientific Name	Type of organism	COSEWIC	SARO	SRANK
Eastern Prairie White-fringed Orchid	<i>Plantanthera leucophaea</i>	Plant	END	END-NR	S2
Pink Milkwort	<i>Polygala incarnata</i>	Plant	END	END-R	S1
Common Hoptree	<i>Ptelea trifoliata</i>	Plant	THR	THR	S3
Shumard Oak	<i>Quercus shumardii</i>	Plant	SC	SC	S3
Prairie Rose	<i>Rosa setigera</i>	Plant	SC	SC	S3
Willowleaf Aster	<i>Symphotrichum praealtum</i>	Plant	THR	THR	S2
Drooping Trillium	<i>Trillium flexipes</i>	Plant	END	END-R	S1
Bird's-foot Violet	<i>Viola pedata</i>	Plant	END	END-R	S1
Reptiles					
Spiny Softshell Turtle	<i>Apalone spinifera</i>	Reptile	THR	THR	S3
Eastern Foxsnake	<i>Elaphe gloydi</i>	Reptile	THR	THR	S3
Eastern Ratsnake	<i>Elaphe obsoleta</i>	Reptile	THR	THR	S3
Blanding's Turtle	<i>Emys blandingii</i>	Reptile	THR	THR	S3
Northern Map Turtle	<i>Graptemys geographica</i>	Reptile	SC	SC	S3
Eastern Hognose Snake	<i>Heterodon platirhinos</i>	Reptile	THR	THR	S3
Milksnake	<i>Lampropeltis triangulum</i>	Reptile	SC	SC	S3
Queen Snake	<i>Regina septemvittata</i>	Reptile	THR	THR	S2
Common Musk Turtle	<i>Sternotherus odoratus</i>	Reptile	THR	THR	S3
Butler's Gartersnake	<i>Thamnophis butlerii</i>	Reptile	THR	THR	S2
Eastern Ribbonsnake	<i>Thamnophis sauritus</i>	Reptile	SC	SC	S3
Birds					
Black Tern	<i>Chilodonia niger</i>	Bird	NAR	SC	S3B
Northern Bobwhite	<i>Colinus virginianus</i>	Bird	END	END	S1S2
Cerulean Warbler	<i>Dendroica cerulea</i>	Bird	SC	SC	S3B
Prairie Warbler	<i>Dendroica discolor</i>	Bird	NAR	NAR	S3S4B
Acadian Flycatcher	<i>Empidonax virescens</i>	Bird	END	END	S2B
Yellow-breasted Chat	<i>Icteria virens</i>	Bird	SC	SC	S2S3B
Least Bittern	<i>Ixobrychus exilis</i>	Bird	THR	THR	S3B
Loggerhead Shrike	<i>Lanius lucovicianus</i>	Bird	END	END-R	S2B
Red-headed Woodpecker	<i>Melanerpes erythrocephalus</i>	Bird	SC	SC	S3B
Prothonotary Warbler	<i>Protonotaria citrea</i>	Bird	END	END-R	S1S2-B
King Rail	<i>Rallus elegans</i>	Bird	END	END-R	S2B
Forster's Tern	<i>Sterna forsteri</i>	Bird	DD	DD	S2S3B
Hooded Warbler	<i>Wilsonia citrina</i>	Bird	THR	THR	S3B
Fishes					
Eastern Sand Darter	<i>Ammocrypta pellucida</i>	Fish	THR	THR	S2
Lake Chubsucker	<i>Erimyzon sucetta</i>	Fish	THR	THR	S2
Grass Pickerel	<i>Esox americanus</i>	Fish	SC		S3
Greenside Darter	<i>Etheostoma blenniodes</i>	Fish	SC	SC	S4



Common Name	Scientific Name	Type of organism	COSEWIC	SARO	SRANK
Blackstripe Topminnow	<i>Fundulus notatus</i>	Fish	SC	SC	S2
Bigmouth Buffalo	<i>Ictiobus cyprinellus</i>	Fish	SC	SC	SU
Spotted Gar	<i>Lepisosteus oculatus</i>	Fish	THR	THR	S2
Striped Shiner	<i>Luxilus chrysocephalus</i>	Fish	NAR	NAR	S4
Spotted Sucker	<i>Minytrema melanops</i>	Fish	SC	SC	S2
Golden Redhorse	<i>Moxostoma erythrurum</i>	Fish	NAR	NAR	S4
Pugnose Shiner	<i>Notropis anogenus</i>	Fish	END	END	S2
Ghost Shiner	<i>Notropis buchanani</i>	Fish	NAR	NAR	S2
Brindled Madtom	<i>Noturus miurus</i>	Fish	NAR	NAR	S2
Channel Darter	<i>Percina copelandii</i>	Fish	THR	THR	S2
Mussels					
Northern Riffleshell	<i>Epioblasma torulosa rangiana</i>	Mussel	END	END	S1
Snuffbox	<i>Epioblasma triquetra</i>	Mussel	END	END	S1
Wavyrayed Lampmussel	<i>Lampsilis fasciola</i>	Mussel	END	END	S1
Round Hickorynut	<i>Obovaria subrotunda</i>	Mussel	END	END	S1
Round Pigtoe	<i>Pleurobema sintoxia</i>	Mussel	END		S1
Kidneyshell	<i>Ptychobranchus fasciola</i>	Mussel	END	END	S1
Mudpuppy Mussel	<i>Simpsoniaias ambigua</i>	Mussel	END	END	S1
Rayed Bean	<i>Villosa fabalis</i>	Mussel	END	END	S1
Mammals					
American Badger	<i>Taxidea taxus</i>	Mammal	END	END	S2
Gray Fox	<i>Urocyon cinereoargenteus</i>	Mammal	THR	THR	SNA

Recent surveys (between 1999 and 2004) have concentrated on the St. Clair and Sydenham Rivers. Additional species would probably be added to the list if the tributaries along Lake St. Clair and the Great Lakes connecting channels were investigated thoroughly. This is suggested by the five species at risk found in the Whitebread Drain⁷. More recent surveys as a result of a proposed Shell refinery have also found northern pike in St. Clair River tributaries. All the tributary watercourses in the AOC area are warm temperature streams.

Mussels

Freshwater mussels are valuable indicators of environmental degradation because they are affected by many kinds of habitat alteration and pollution. They are useful for bio-monitoring environmental contamination because they are long-lived, sedentary bottom-dwellers and accumulate many toxic substances⁸.

Mussel surveys and monitoring programs have been extensive in the Sydenham River watershed, but not for the tributaries. Past monitoring found that when compared to drainage basins of similar size in the State of Ohio, the Sydenham River had greater than average mussel and fish diversity, with over 30% more species of mussels than the average watercourse of this size⁹. However, the work in the late 1990s indicated that in general, habitat conditions for mussels were deteriorating and the diversity and population of mussels were declining. This decline is also suspected in the AOC subwatersheds, however, mussel species distribution in the area outside the Sydenham River watershed is an information gap.

⁷ Shawn Staton 2004 pers. commun.

⁸ Metcalfe-Smith, J., A. MacKenzie, I. Carmichael and D. McGoldrick. 2005. "Photo Field Guide to the Freshwater Mussels of Ontario" St. Thomas Field Naturalist Club Incorporated, St. Thomas, ON. 60pp. (in press)

⁹ Metcalfe-Smith, J. L. 1999. Sydenham River Mussel Communities. Unpublished report from National Water Research Institute. 12pp.



Aquatic (Benthic) Macroinvertebrates

Aquatic macroinvertebrates have been used effectively to evaluate the quality of water in rivers, streams and lakes. Benthic, or bottom-dwelling, macroinvertebrates live on or in the substrate of water bodies and include organisms such as mayflies, stoneflies, aquatic worms and snails. These river bottom bugs provide an excellent tool for water quality assessment because different species have different tolerances to pollution. Several benthic monitoring studies have been undertaken by various organizations in the AOC area. Each of these utilized different protocols, but basically the general findings were that water quality was impaired at all sites evaluated on Clay Creek, Baby Creek, Talford Creek, Bowens Creek and Grape Run. The upstream sites on Baby and Clay Creeks were the least impaired sites. Consistent monitoring over several years by the Conservation Authority indicates no improvement, with readings averaging “Poor”. Bio-monitoring of the St. Clair River itself has occurred since at least 1957¹⁰, when contaminants were identified in the river sediments. Due to presence of contaminants in varying degrees of concentration, degradation of the benthos in the St. Clair River was a major environmental issue. Recent sediment assessments of Talford creek identified the presence of contaminants; the most degraded samples taken from the creek outlet to the St. Clair River. Deposition of the contaminants at the mouth of Talford Creek can be attributed to spills upstream in the St. Clair River. The contaminated sediment has resulted in the benthic community being impaired, along with body burdens of benthics. Six years of monitoring the benthics in the tributaries of the St. Clair River has concluded that the benthic communities are impaired. When comparing the quality of aquatic habitat of the St. Clair River/Lake St. Clair Tributaries to the rest of the Sydenham watershed, the AOC tributaries are suffering the greatest environmental impact with the SCRCA score of “Poor”. This is based on six years of benthic monitoring.

Species at Risk

Species at Risk classifications are defined as follows:

Endangered – A species facing imminent extirpation or extinction.

Threatened – A species that is likely to become endangered if limiting factors are not reversed.

Special Concern – A species is of special concern because of characteristics that make it particularly sensitive to human activities or natural events.

Table 4 provides a summary of Species at Risk for the region which includes the AOC 1-A area¹¹. This table also includes information on the provincial ranking for species (SARO – Species at Risk Ontario) together with the COSEWIC (Committee on the Status of Endangered Wildlife in Canada). The table includes plants, reptiles, birds, fishes, mussels, and mammals. Neither MNR nor Environment Canada has status ranking for the insects as yet. However, Odonate species (dragonflies and damselflies) are tracked by the Natural Heritage Information Centre (NHIC) and the Nature Conservancy (TNC).

Mussels

Although the Sydenham River has been surveyed thoroughly for mussels, the St. Clair tributaries have not. Some species of freshwater mussels including the Mapleleaf (Threatened) have been found in Clay Creek, however detailed surveys have not been undertaken.

Fish

Five Species at Risk were recently found in Whitebread Drain which is a tributary of the lower St. Clair River. These species included Spotted Sucker (Special Concern), Pugnose Shiner (Endangered), Pugnose Minnow (Special Concern), Grass Pickerel (Special Concern) and Blackstripe Topminnow (Special Concern)¹². Little Bear Creek in Dover Township has Pugnose Shiner (Endangered). Grass Pickerel (Special Concern) was also found in both Maxwell Creek and Little Bear Creek watercourses.

Reptiles

Eight species of reptiles which are Species at Risk have been found in the AOC, including four turtle species and four snake species. NHIC records Spiny Softshell turtles from the outlet of Clay Creek in 1986, but more recent NHIC records are only on the Sydenham River.

¹⁰ <http://lis.sarnia.com/pdf%20files/Water2Biomonitoring.pdf> Retrieved November 6 2005.

¹¹ Ontario Ministry of Natural Resources Natural Heritage Resource Centre (NHIC), 2006

¹² Staton 2004 pers. comm.



Dragonflies and Damselflies

Neither MNR nor Environment Canada has status ranking for these insects. However Odonate species (dragonflies and damselflies) are tracked by NHIC and TNC (Regional ranking by The Nature Conservancy of Arlington, Virginia, U.S.A.). Of those 39 species recorded by NHIC for the AOC within the last 30 years, six odonates from the AOC are provincially rare.

It is important to monitor Species at Risk as they are sensitive to environmental change and may provide warning signs of deteriorating environmental health. The distribution and abundance of Species at Risk in the St. Clair Region may be valuable indicators of a change in the environmental health of the region. Principal stresses affecting populations of Species at Risk in the AOC are toxic compounds, sediment loadings causing turbidity and siltation, nutrient loads, thermal effects and exotic species. Identification of Species at Risk in the AOC is incomplete. Detailed surveys of mussels and fish are needed. Identification of the stresses on aquatic systems is also an information gap.

Invasive Species

Invasive species have had a significant negative impact on the ecosystem by out-competing native species, carrying pathogens, disrupting communities, causing extinction, altering the food chain, disturbing habitat, affecting environmental/ecosystem health, and impacting water quality¹³.

Introduced fish species include the Common Carp, Goldfish, Alewife, Round Goby and Sea Lamprey. The most serious invasive species for this region to date has been the Zebra Mussel. This European species has already decimated the native mussels of the St. Clair River and delta. Prolific with an ability to tolerate a wide range of environmental conditions, Zebra Mussels compete with native mussels for food supply and have a severe effect on water intakes by reducing pipe diameters.

Common Reed/Giant Reed (*Phragmites australis*) has overtaken the majority of wetlands along the St. Clair River and its tributaries. Growing into dense monocultures, it prevents the growth of native terrestrial species, such as cattails, which impacts the use of the habitat by fish and wildlife and impacts the hydrology as well.

Emerald ash borer is native to China and eastern Asia. As of June 2008, it is now found in Lambton County. Its impact on woodlands is not known yet but ash trees form a large part of the local tree cover.

2.3 Human Characteristics

The majority of the AOC area is within the Census Canada region of Lambton County. Lambton County makes up 80% of the watershed area while the remainder is in the census region of Chatham-Kent. Table 5 provides a summary of the proportion of the regions in the study area.

Table 5: Census Region Area Within AOC Area 1-A

Census Region	Total Area (sq km)	Area within AOC Area 1-A		
		(sq km)	Percentage of Municipality	Percentage of AOC Area 1-A Watershed
Lambton County	3,002	433	14	80
Chatham-Kent	2,490	108	4	20
Total	8,825	541	18	100

Population and Population Distribution

The total population in the study area is about 234,000 based on the 2001 census. Most of the population is concentrated in urban communities surrounded by agricultural land as illustrated by the urban/industrial areas shown on **Map 9: Generalized Land Cover and Designated Growth Areas.**

¹³ Cinura, K.A., L.A. Meyerson, and A. Gutierrez. 2004. The ecological and socio-economic impacts of invasive alien species in inland water ecosystems. Report to the Conservation on Biological Diversity on behalf of the Global Invasive Species Programme, Washington, D.C. p 34 (may be downloaded at <http://www.biodiv.org/doc/ref/alien/ias-inland-waters-en.pdf>)



Lambton County and Chatham-Kent population distributions are outlined in Table 6 and Table 7 respectively.

Table 6: Lambton County Population Distribution

	Population 2006	Population 2001	Land Area in sq km	Population Density Per sq km	% of area within AOC Area 1-A
Lambton County	128,204	126,971	3002	43	80
• City of Sarnia	71,419	70,876	800	89	20
• St. Clair	14,649	14,659	620	24	37
• Point Edward	2,019	2,101	3	673	100
• Walpole Island FN	1,878	1,843	147	13	100
• Aamjiwnaang FN	706	695	13	54	100

Table 7: Chatham-Kent Population Distribution

	Population 2006	Population 2001	Land Area in sq km	Population Density Per sq km	% of area within AOC Area 1-A
Chatham-Kent	~108,054	107,341	2470	44	4%
• Wallaceburg Centre	~11,225	11,114	11	1020	100%
• Chatham (Township)	~8,208	6,002	356	23	14
• Dover (Township)	~3,920	3,923	280	14	20

In the AOC, the City of Sarnia has the largest population (70,876). The majority of the dense urban fabric is situated within the AOC. The city does have a large rural land base as a result of the amalgamation of the City and the adjacent township. However, the majority of the rural land base is outside the study area and drains to Lake Huron. The second largest urban centre is the former Town of Wallaceburg with a population of 11,772. Population totals for St. Clair Township indicate a higher population than Wallaceburg at 14,659; however, this population is spread throughout a larger land base and population totals from the smaller centres such as Corunna and Sombra are not available.

Population Projections

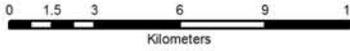
Table 8: Historic Populations gives the populations for 2001 and 1996 with the % change for the communities in the study area.

Both Lambton County and Chatham-Kent experienced a decline in population over the five year period from 1996 to 2002.

St. Clair River AOC 1-A Generalized Land Cover and Designated Growth Areas

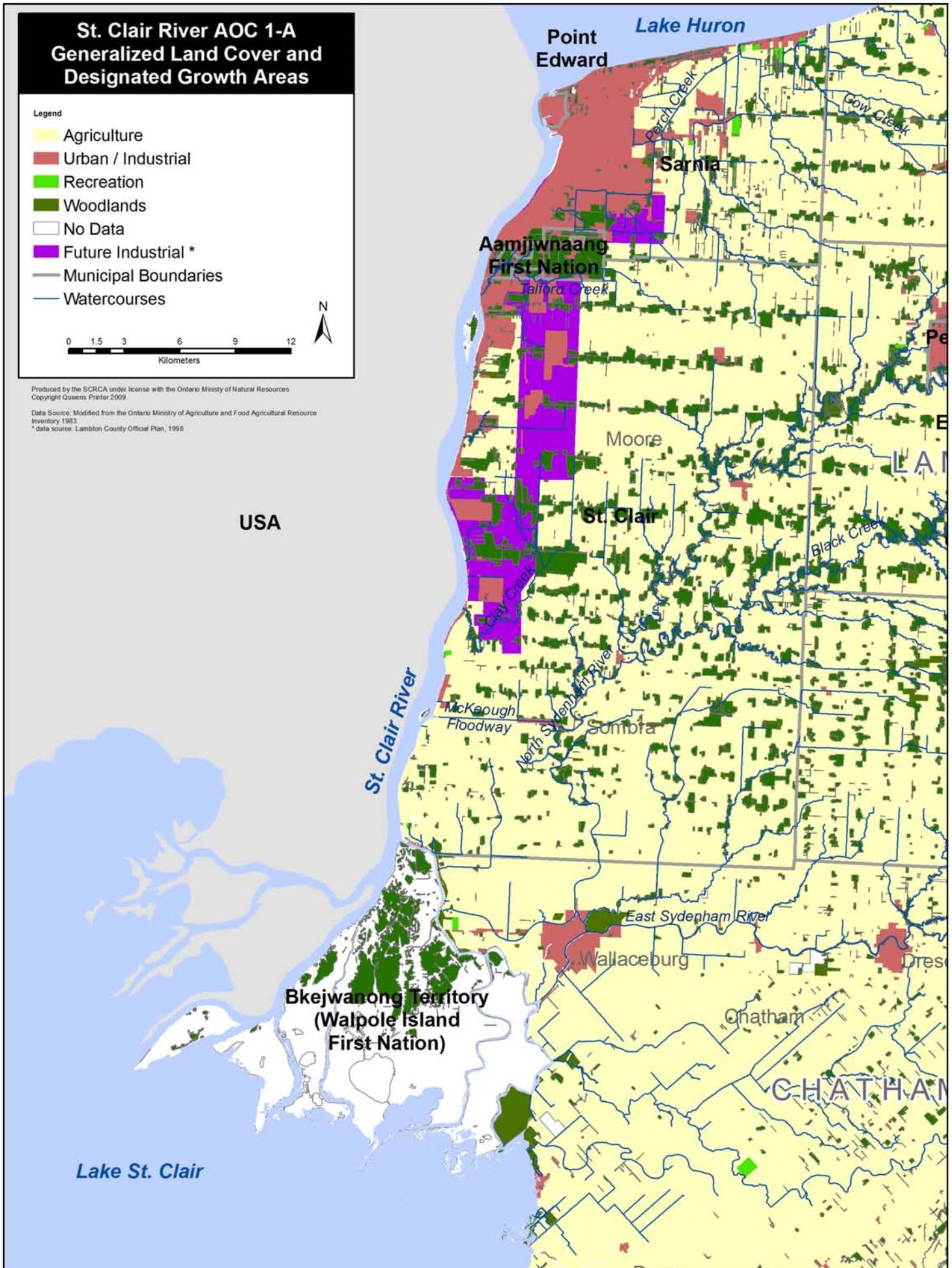
Legend

- Agriculture
- Urban / Industrial
- Recreation
- Woodlands
- No Data
- Future Industrial *
- Municipal Boundaries
- Watercourses



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Data Source: Modified from the Ontario Ministry of Agriculture and Food Agricultural Resource
Inventory 1983.
* data source: Lambton County Official Plan, 1996



Map 9: Generalized Land Cover and Designated Growth Areas



Table 8: Historic Populations in AOC Area 1-A

	2006 Population	2001 Population	1996 Population	1996 to 2001 Population Change %	2001 to 2006 Population Change %
Lambton County	128,204	126,971	128,975	-1.6	+0.97
• City of Sarnia	71,419	70,876	72,738		
• St. Clair	14,649	14,659	15,081		
• Point Edward	2,019	2,101	2,257		
• Walpole Island FN	1,878	1,843	1,525	+20.9	+1.9
• Aamjiwnaang FN	706	695	n/a		+1.6
Chatham-Kent	108,054	107,341	109,350	-1.8	+0.66
• Wallaceburg Centre	~11,225	11,114	11,772		
• Chatham (Township)	~8,208	6,022	6,321		
• Dover	~3,920	3,923	4,040		

The Ontario Ministry of Finance Report, 2004¹⁴ projected only a 0.6% and 3.3% increase in growth rate over the next 27 year period for Chatham-Kent and Lambton County respectively. This is well below the provincial average of 27.8%.

The Sarnia/St. Clair Township industrial base suffered setbacks in the 1980s and 1990s, impacting job opportunities, thus affecting population growth. Business leaders recently began pursuing opportunities in alternative energy and industrial bio-projects which are directed at diversification of the local economy. Some gains, although minor, have been made due to this diversification.

2.4 Climate

Different networks have been established to monitor meteorological and climatic trends. The two main ones are the Environment Canada network, and the Conservation Authority networks. The Environment Canada network of automatic and synoptic stations is best for observing long-term trends. These stations have longer periods of record, measure winter precipitation and have uniform quality control. The local Sarnia monitoring station has a period of record from 1882 – present.

Data from some of the Environment Canada climate stations are provided in Figure 1 and Figure 2 to illustrate climatic differences across the region. Figure 2 illustrates an Environment Canada annual precipitation plot graph for Sarnia, Wallaceburg and Strathroy 1950 to 2005. Table 9: St. Clair Region Annual Precipitation 1950-2005 illustrates how annual precipitation can vary by over two times from year to year. For example, at Sarnia, the minimum annual precipitation was as low as 443 mm in 1963 and the maximum precipitation was as high as 1,092 mm in 1984. The variation in precipitation from year to year means there can be a significant difference in the water available to recharge ground water aquifers or maintain stream flow.

Table 9: St. Clair Region Annual Precipitation 1950-2005 in mm

Location	Average	Max (year)	Min (year)
Sarnia	819	1,086 (1984)	443 (1963)
Wallaceburg	806	1,170 (1996)	561 (1963)
Strathroy	914	1,162 (1976)	532 (1963)

¹⁴ Ontario Ministry of Finance, Ontario Population Projections, 2004-2031

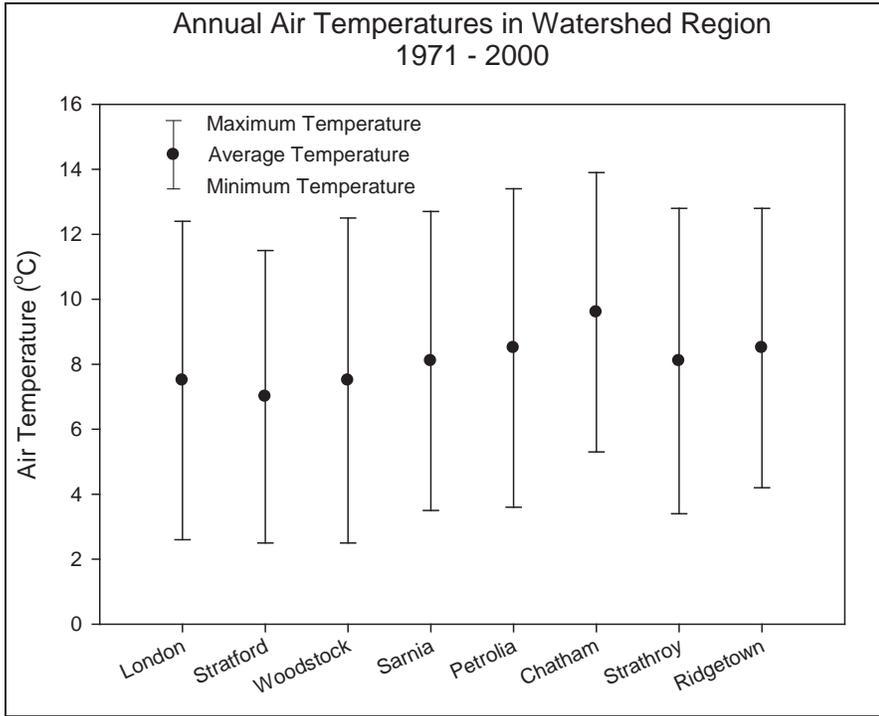


Figure 1: Annual Air Temperatures in the AOC and Surrounding Area for Comparison

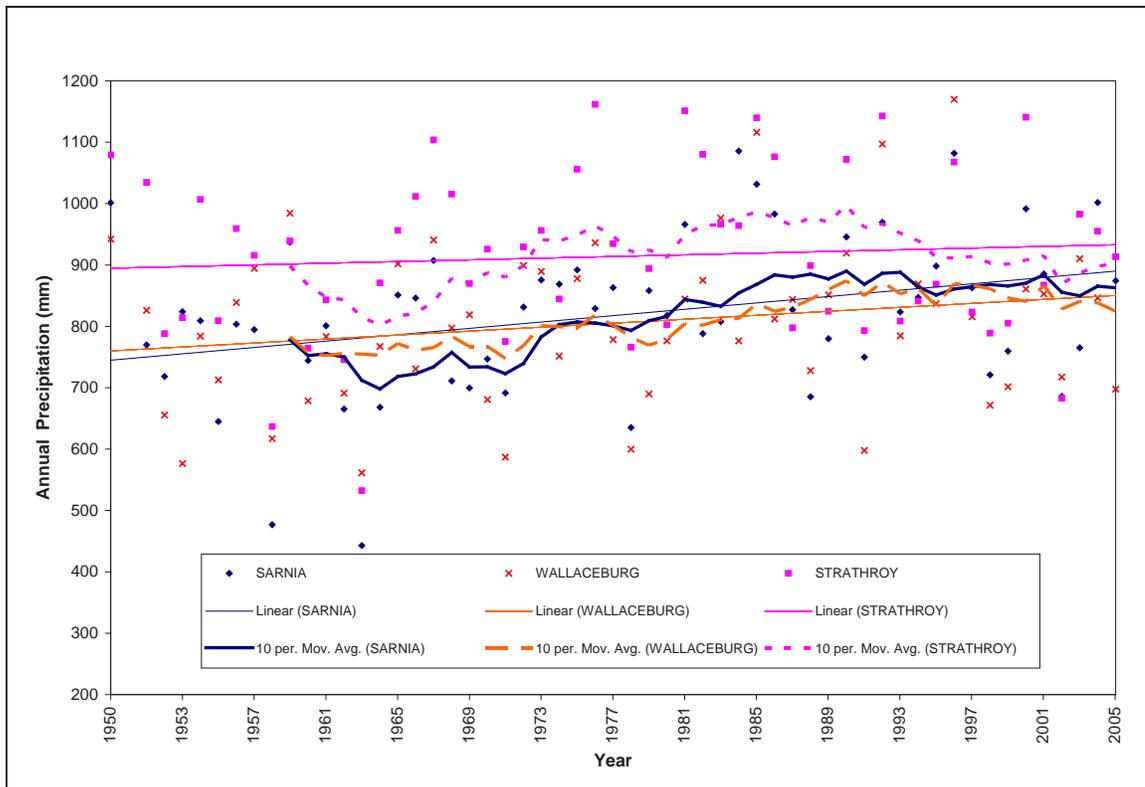


Figure 2: Annual Precipitation from Sarnia, Wallaceburg and Strathroy Climate Stations



Climate Trends

Figure 2 also includes ten-year running average linear trend lines, which have been calculated and plotted on the graphs. The ten-year running averages begin in 1959 which is the first year a ten-year average can be calculated for this data set. Generally, the ten-year average indicates a downward trend in more recent years.

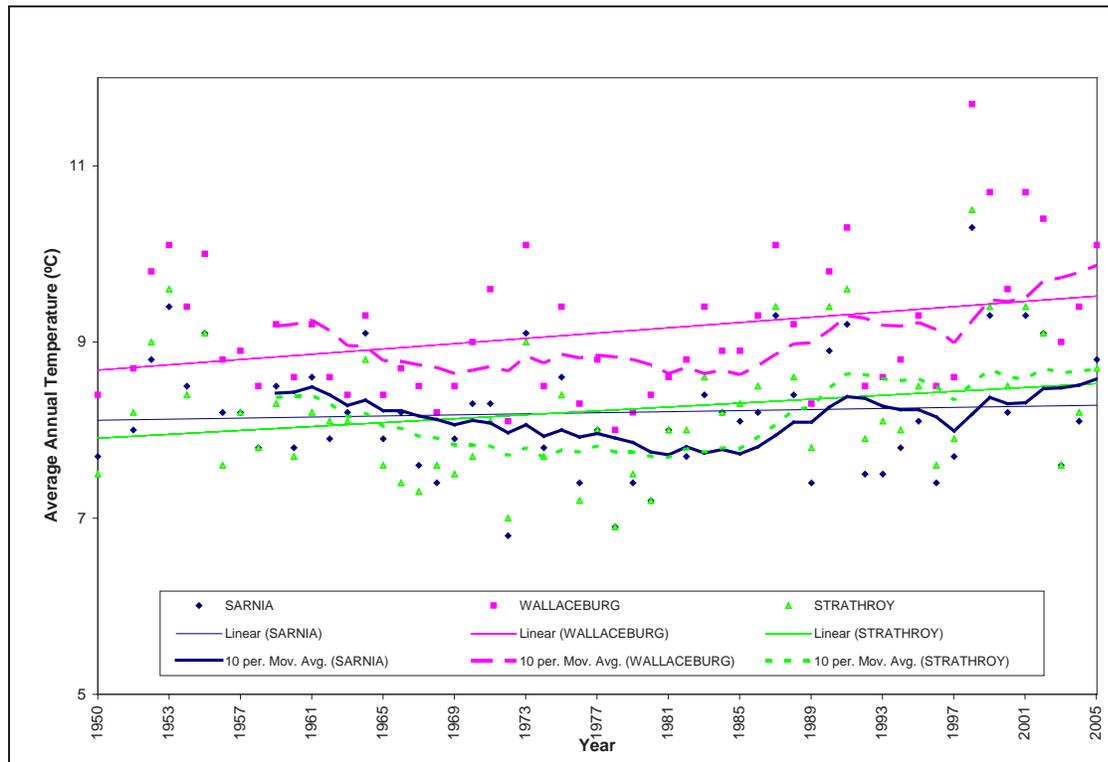


Figure 3: Average Temperature 1950-2005 from Sarnia, Wallaceburg and Strathroy

Figure 3 indicates that the stations have similar highs and lows in the ten-year running averages. An upward trend is occurring at all stations in recent years.

The Great Lakes and Connecting Channels System

The AOC includes the connecting channel, St. Clair River and Lake St. Clair. Due to its size, Lake St. Clair is not officially considered a “Great Lake”, but is an important part of the system. The Great Lakes and connecting channels receive their water supplies from the precipitation that falls on the lakes and channels themselves and the portion of the precipitation in their drainage basins which eventually flows into the system. Great Lake water levels vary from season to season and from year to year because of the combined effects of precipitation, runoff and evaporation.

A plot of the average annual water level recorded in Lake St. Clair since 1918 is provided in Figure 4 Lake St. Clair Water Levels. More than a century of records in the Great Lakes basin indicates no regular, predictable cycle. However, it does illustrate the effect climatic and meteorological conditions can have on water supplies.

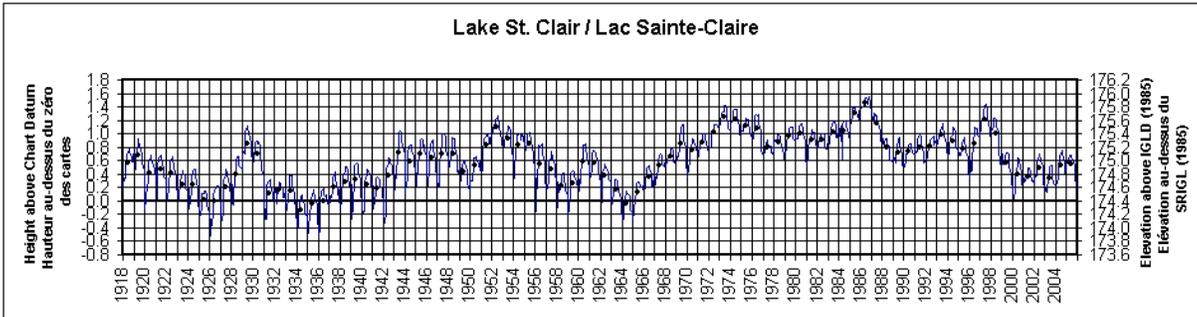


Figure 4: Lake St. Clair Water Levels

Extremely low levels were recorded in 1926, the mid-1930s and mid-1960s while high levels occurred in 1952, 1973 and 1985-86¹⁵. From the mid 1970s to the late 1990s, there has been a 20-year period of high water levels. In the early 2000s, they have returned to lower levels experienced in the past. At one point, it was predicted that the system was going to achieve a new record low. However, the precipitation received in the fall of 2007 and winter 2008 prevented this lowering.

Predicted Changes in the Regional Climate

A review of the available regional analyses regarding temperature and precipitation trends, and expected effects on southwestern Ontario suggests the following:

- Spring and summer temperatures in the Great Lakes Region are predicted to be 1.5 to 2.0° C above current averages by 2030. Predictions are not as precise, but fall and winter temperatures are expected to begin warming by the middle of this century. It is expected that warmer temperatures will increase the water temperatures of the lakes, increasing them by 1 to 7° C. 150 years of records indicate that ice cover on inland waters will decrease and evaporation will therefore increase.
- Average annual precipitation is predicted to increase up to 10% by 2030 and up to 20% by the end of the century. Depth of snow cover in winter is actually expected to decrease due to the overall warming trends. Snow will melt or fall as rain.

The impact of these trends means extreme or greater-than-normal variations in runoff to lakes, streams and groundwater. Runoff in winter, spring and fall will be slightly higher and summer moisture and runoff conditions are expected to be drier. Although a decrease in lake levels is not certain via modelling, the frequency of extreme weather events has been predicted and indeed data are already showing trends in this direction. The number of heavy 24-hour and multiple day rainstorms is likely to increase steadily until at least the next century. Increased extreme rainfall may be accompanied by long dry spells, between storms¹⁶. If the business-as-usual scenario with current trends continues in the future, the past records as provided in the Climate Figures and tables would change, creating substantially different ten-year average trends. First and foremost, stormwater discharge and inputs to watercourses will be impacted as well as the current state of the aquatic systems. Climate change will influence other components of society and more details can be provided in references dealing with climate change adaptation.

¹⁵ Environment Canada, Freshwater Website, Fluctuating Water Levels (Great Lakes), July 2006

¹⁶ Natural Resources Canada, 2007, From Impacts to Adaptation: Canada in a Changing Climate, Chapter 6: Ontario or Jacques Whitford, Consultant, Draft EA, Apr 14, 2008, Shell Refinery, p. 6-107-109.



2.5 Hydrology, Water Use and Water Value

The water uses reflected below emphasize direct use of water within the AOC. The St. Clair River and Lake St. Clair are important sources of drinking water for several communities on the Canadian side. Both Wallaceburg and Walpole Island F.N. drinking water intakes are situated within the River. The southern Lake St. Clair communities of Belle River, Stoney Point and Tecumseh, take raw water from Lake St. Clair. Population totals for these communities are approximately 285,000 Ontario residents. Also directly impacted by Lake St. Clair water quality, the City of Windsor takes raw water from the Fleming Channel of the Detroit River opposite Belle Isle. The water treatment plants have a combined rated capability of 337,600 m³/day. The majority of residents within the AOC are obtaining raw water via pipelines from the Great Lakes or connecting channel intakes.

The industries situated along the upper St. Clair River utilize St. Clair River surface water for industrial cooling as well as in other plant processes¹⁷.

The shipping channel situated within Lake St. Clair and the St. Clair River is an important economic transportation corridor. Recent numbers for commercial traffic indicate there were a total of 6,262 passings. This would include vessels over 20 m in length. The channel is important for the large petrochemical industry in the Upper St. Clair River as there are four designated oil handling facilities where petroleum products are loaded or unloaded from ships. The channel is an integral part of the St. Lawrence Seaway system because it links the upper Great Lakes with the lower Great Lakes and the Atlantic Ocean. Navigational dredging of the corridor to ensure adequate draft for ships began in 1873. The maximum natural depth of the St. Clair River is 30.5 m with a mean depth of 11 m. Lake St. Clair has an average depth of 3.7 m, a maximum natural depth of 6.4 m and maximum dredged shipping channel depth of 8.3 m. The construction of the St. Clair Cutoff Channel created a large volume of dredged material that was deposited beside the new channel at the edge of Lake St. Clair, creating Seaway Island.

Within the AOC area, there are seven marinas along the Canadian shore. This is relatively low in comparison to the 211 marinas found on the U.S. side of Lake St. Clair shores.

There are five identified swimming beaches along the St. Clair River (Sarnia Centennial Park, Willow Park, Seager Park, Marshy Creek Park and Brander Park) and two along Lake St. Clair (Willow Park in Walpole FN and Mitchell's Bay).

First Nations

The AOC area is considered to be traditional territory of Walpole Island First Nation, Aamjiwaang First Nation, and Kettle and Stony Point First Nations¹⁸. Long before the arrival of Europeans, the ancestors of these first nations used animals, fish, plants and minerals for subsistence, commerce, social and ceremonial purposes. The following is a summary of resource uses more directly related to water use outlined in the 2008 TEK study.

Fishing

Nearly all participants in the Walpole Island TEK study consume locally caught fish. Walpole Island is the main area fished, with numerous channels and other water bodies in and around the Island also being productive. Species fished for include pickerel (also known as walleye), perch, sunfish, bass, white bass, silver bass, pike, catfish, carp, ling, smelt and sturgeon. Smelt fishing on the beaches was popular, but due to the crash in the smelt population, it is no longer.

Small Game Hunting

Significant muskrat trapping and hunting occurred in the 1950s-1960s, but this has drastically declined. Prior to 1980, more than 100,000 animals were taken annually (RAP, Stage 1); decreasing to only 10,000 pelts post 1980s, and has continued to decline. Mink occupied the marshlands and their pelts were valuable historically but their value and consumption has declined as well.

¹⁷ Lambton County Groundwater Study, Dillon and Golder, 2004

¹⁸ Traditional Ecological Knowledge Study: Walpole Island First Nation and the St. Clair River Corridor, Final Report, 2008, Victor P. Lytwyn, Ph.D., for Walpole Island FN.



Reptiles and Amphibians

Hunting frogs was once a mainstay in the summertime; as they were plentiful. Turtles were sought in small quantities; used in soups and their shells and hearts for medicinal purposes.

Waterfowl Hunting

The Chenal Ecarte shoreline and lower island canals are used extensively to hunt ducks for personal consumption and to share amongst local residents. Guiding tourists for the purpose of duck hunting was a significant business in the Walpole area. An income of at least \$1.5 million Canadian was generated by First Nations for licenses, lease fees and revenue from guiding (RAP, Stage 1). However with the downturn in the economy and impaired duck population, guiding for hunting purposes has decreased.

Hydrology

St. Clair River and Lake St. Clair

Roughly 98% of the water entering Lake St. Clair originates from the St. Clair River and the upper Great Lakes, which have a combined drainage of 146,600 km².

The St. Clair River has a short retention time (approximately 21 hours) as it drains into Lake St. Clair. The average annual discharge of the river is approximately 5,000 m³/s. Flow velocities can range from 1.67 m/s at the Blue Water Bridge (head of the St. Clair River) to 0.31 m/s at Lake St. Clair. The total average fall from Lake Huron to Lake St. Clair is 1.5 metres.

The St. Clair River behaves like three separate panels of water: two nearshore sections strongly influenced by discharges and a centre panel which passes through the river with minimal change¹⁹. Studies have shown that transboundary movement of river water does not occur and that contaminant plumes tend to hug the shoreline resulting in approximately 5 percent of the total flow available for dilution. Sediment and water sample transects across and throughout the river have led to the acceptance that contaminant plumes spread slowly downstream and are generally confined to within 300 m of the Canadian shoreline at Port Lambton²⁰. With the advent of climate change and lowering lake levels, St. Clair River modelling is currently being examined with updated bathymetry and new, state-of-the-art models.

The St. Clair delta is the river's most significant landform. The delta is a classical bird-foot morphology and typically characterizes a marine type delta. The delta continues to develop, however, very little deposition occurs on the eastern side due to channel dredging on the western side for navigation²¹. The flow from the St. Clair River into the lake is divided by the St. Clair delta into three main channels (North Channel, South Channel and Chenal Ecarte) in the upper portion of the delta and a number of secondary channels in the lower portion of the delta. **See Map 4: St. Clair River Delta.**

Based on the volume of the lake and inflow from the St. Clair River, the average residence time for Lake St. Clair is about nine days. Wind direction and velocity can have significant impacts on the residence times and circulation patterns in the lake. The residence time for the water from the individual channels and the major tributaries can range from four days for the Middle Channel to more than 30 days for water from a major tributary (i.e. the Thames River).

¹⁹ St. Clair AOC Stage 1 RAP, 1992

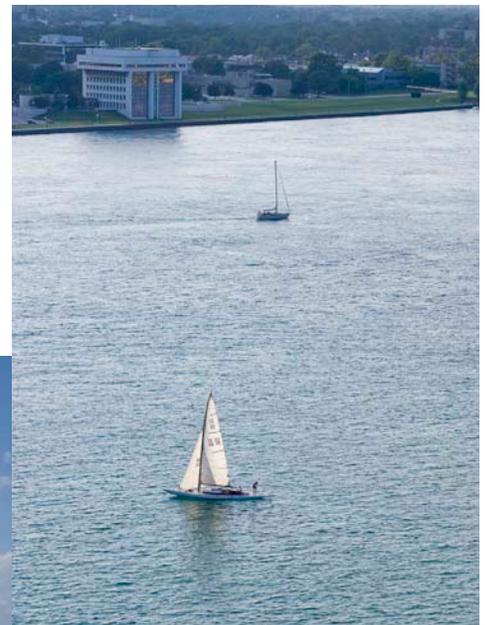
²⁰ "Ibid"

²¹ "Ibid"



Groundwater

The groundwater quality in the AOC 1-A area is not unlike the general groundwater quality of Lambton County. It is heavily influenced by the presence of thick layers of clay soils, with a low susceptibility for contamination. Groundwater flow is east to west towards the St. Clair River and is not a significant discharge feature to the River. The low permeability of the clay till soils restricts recharging of the deep aquifer and, in fact, the freshwater aquifer that is situated at the base of the overburden has been found to be recharged thousands of years ago. The aquifer is described as being “brackish”, with methane and hydrogen sulphide present, in the western part, adjacent the St. Clair River. The higher chloride and sodium concentrations in the western portion of the aquifer are generally attributed to regional discharge conditions from deeper formations (saline Hamilton Group aquitard)²². The St. Clair Region Conservation Authority, in partnership with the Ministry of Environment, samples one groundwater well in the AOC 1-A watershed as part of an overall network of wells. The well is situated in Guthrie Park along the St. Clair River north of Corunna and has been sampled and analyzed for four consecutive years (2006-2009). The well is not used as a source of drinking water. Sodium was found to be the only parameter that is in exceedence of the Ontario Drinking Water Quality Standards; the average 390 mg/L in comparison to the aesthetic standard of 200 mg/L. Exceedence was atypical of historic sampling and reflects the hydrogeologic and geochemical nature of the overburden/bedrock aquifer²³.



²² Lambton County Groundwater Study, Dillon and Golder, 2004

²³ SCRCA Board Report – PGWMN, November 2008, H. MacKenzie & M. Andreae



3

Chapter 3

Subwatershed Characterization

3.1 Point Edward/Sarnia Subwatershed

The Point Edward/Sarnia subwatershed encompasses a land area of 34.81 km². Open watercourses are not prevalent within the subwatershed as the area is highly urbanized and a significant portion of the watershed is drained via storm sewers. The stormwater outlets to the St. Clair River and Lake Huron. The entire municipality of Point Edward with an area of 2.34 km² is situated in this watershed while approximately 20% of the City of Sarnia is contained within this area. The majority of Sarnia's Chemical Valley is situated along the St. Clair River in this subwatershed.

The only Environmentally Significant Area (ESA) which is currently recognized in this subwatershed is a small portion of Aamjiwnaang First Nation²⁴. The Conservation Authority does not have any information on fish species, benthic indices or surface water quality within this subwatershed.

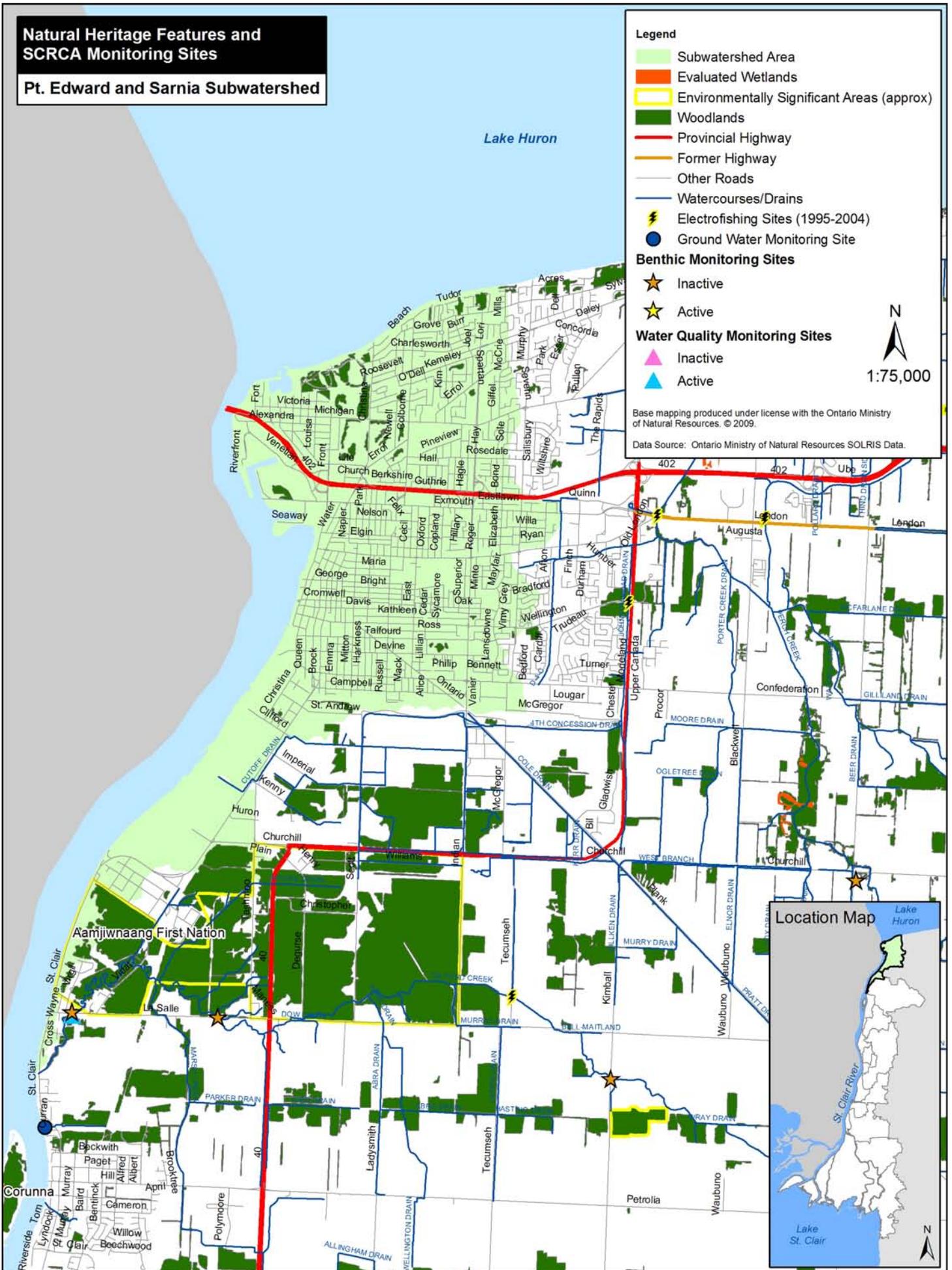
The Point Edward area is situated on a spit of land where Lake Huron outlets into the St. Clair River. This depositional area is a flat sand plain with soils consisting of a sand loam as well as silt and clay loams. The majority of Sarnia soils are silt and clay which are common throughout the Lambton clay plain. Soils are coarser closer to Lake Huron and beach sands are prevalent along the lake and around the point. **See Map 3: Soils.**



²⁴ ESA 59 in "University of Waterloo. 1980. Lambton County preliminary environmentally significant areas study. Prepared for the County of Lambton Planning Department, Sarnia, Ontario. 243 pp."

Natural Heritage Features and SCRCA Monitoring Sites

Pt. Edward and Sarnia Subwatershed



Map 10: Pt. Edward and Sarnia Subwatershed



3.2 Talford Creek Subwatershed

Almost 77% of the Aamjiwnaang First Nation is situated within the Talford Creek subwatershed. The subwatershed encompasses a land area of 57.12 km². A portion of Sarnia’s Chemical valley is situated here. Aamjiwnaang First Nation was recognized as an ESA in 1980 (University of Waterloo, op. cit.) and consists of a large continuous woodland area of approximately 10.88 km² in size, described as oak-hickory savannah and swamp forest by the University of Waterloo study. Although a large part of the Aamjiwnaang First Nation subwatershed is forested, water quality in the creek has been negatively impacted as a result of historic industrial actions.

A second woodlot from this subwatershed is also listed in the 1980 ESA study Special Appendix Areas: Indian Pipe Woodlot (SA15) in geographic Moore Township was a large maple-beech forest with diverse non-vascular plants such as Indian Pipe on the wooden deadfall.

The Conservation Authority completed a Drain Classification process in 1999-2000, using a protocol which had been developed with Fisheries and Oceans Canada. In the Talford Creek subwatershed 36% of the watercourses were not readily accessible and were not classified. 27% of the 67.8 km of watercourses were considered natural and the remaining portions were Type C (2.6 km of warm water fisheries with baitfish species) or were Type F (21.9 km of intermittent watercourses). **Map 11: Subwatershed DFO** provides an overview of the drain classifications for 10 subwatersheds; excluding First Nations lands. Electro-fishing of Talford Creek in 2000, above the First Nation land, found eight species of warm water fish which are listed in **Table 10: Fish Species Electro-fished by SCRC in St. Clair River Tributaries** representing the perch, sucker, stickleback, mudminnow and minnow and carp families.

Table 10: Fish Species Electro-fished by SCRC in St. Clair River Tributaries

Common name	Latin name	Easting	Northing	Date
TALFORD CREEK				
Mudminnows	Umbridae			
Central Mudminnow	<i>Umbra limi</i>	388455	4752150	27/07/2000
Minnows and Carp	Cyprinidae			
Creek Chub	<i>Semotilus atromaculatus</i>	388455	4752150	27/07/2000
Fathead Minnow	<i>Pimephales promelas</i>	388455	4752150	27/07/2000
Northern Redbelly Dace	<i>Phoxinus oreas</i>	388455	4752150	27/07/2000
Common Shiner	<i>Luxilus cornutus</i>	388455	4752150	27/07/2000
Suckers	Catostomidae			
White Sucker	<i>Catostomus commersoni</i>	388455	4752150	27/07/2000
Sticklebacks	Gasterosteidae			
Brook Stickleback	<i>Culaea inconstans</i>	388455	4752150	27/07/2000
Perch	Percidae			
Johnny Darter	<i>Etheostoma nigrum</i>	388455	4752150	27/07/2000
BABY CREEK				
Mudminnows	Umbridae			
Central Mudminnow	<i>Umbra limi</i>	385964	4740898	12/07/2000
Central Mudminnow	<i>Umbra limi</i>	380918	4743800	12/07/2000
Minnows and Carp	Cyprinidae			
Bluntnose Minnow	<i>Pimephales notatus</i>	380918	4743800	12/07/2000
Spotfin Shiner	<i>Cyprinella spiloptera</i>	380918	4743800	12/07/2000
Common Shiner	<i>Luxilus cornutus</i>	380918	4743800	12/07/2000



Common name	Latin name	Easting	Northing	Date
Creek Chub	<i>Semotilus atromaculatus</i>	380918	4743800	12/07/2000
Suckers	Catostomidae			
White Sucker	<i>Catostomus commersoni</i>	380918	4743800	12/07/2000
Catfishes	Ictaluridae			
Black Bullhead Catfish	<i>Ameiurus melas</i>	380918	4743800	12/07/2000
Sunfishes	Centrarchidae			
Pumpkinseed	<i>Lepomis gibbosus</i>	380918	4743800	12/07/2000
Rock Bass	<i>Ambloplites rupestris</i>	380918	4743800	12/07/2000
Perch	Percidae			
Johnny Darter	<i>Etheostoma nigrum</i>	380918	4743800	12/07/2000
Yellow Perch	<i>Perca flavescens</i>	380918	4743800	12/07/2000
CLAY CREEK				
Mudminnows	Umbridae			
Central Mudminnow	<i>Umbra limi</i>	381563	4732922	27/09/2000
Pikes	Esocidae			
Northern Pike	<i>Esox lucius</i>	381563	4732922	27/09/2000
Minnnows and Carp	Cyprinidae			
Golden Shiner	<i>Notemigonus crysoleucas</i>	381563	4732922	27/09/2000
Spotfin Shiner	<i>Cyprinella spiloptera</i>	381563	4732922	27/09/2000
Suckers	Catostomidae			
White Sucker	<i>Catostomus commersoni</i>	381563	4732922	27/09/2000
Sunfishes	Centrarchidae			
Green Sunfish	<i>Lepomis cyanellus</i>	381563	4732922	27/09/2000
Pumpkinseed	<i>Lepomis gibbosus</i>	381563	4732922	27/09/2000
MARSHY CREEK				
Minnnows and Carp	Cyprinidae			
Common Carp	<i>Cyprinus carpio</i>	377636	4722158	27/09/2000
Sunfishes	Centrarchidae			
Bluegill	<i>Lepomis macrochirus</i>	377636	4722158	27/09/2000
Largemouth Bass	<i>Micropterus salmoides</i>	377636	4722158	27/09/2000



St. Clair Region Conservation Authority

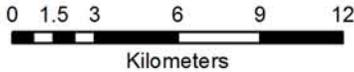
205 Mill Pond Crescent, Strathroy, ON N7G 3P9
Tel: (519) 245-3710 Fax: (519) 245-3348
Email: stclair@scrca.on.ca
Web: http://www.scrca.on.ca

St. Clair River AOC 1-A

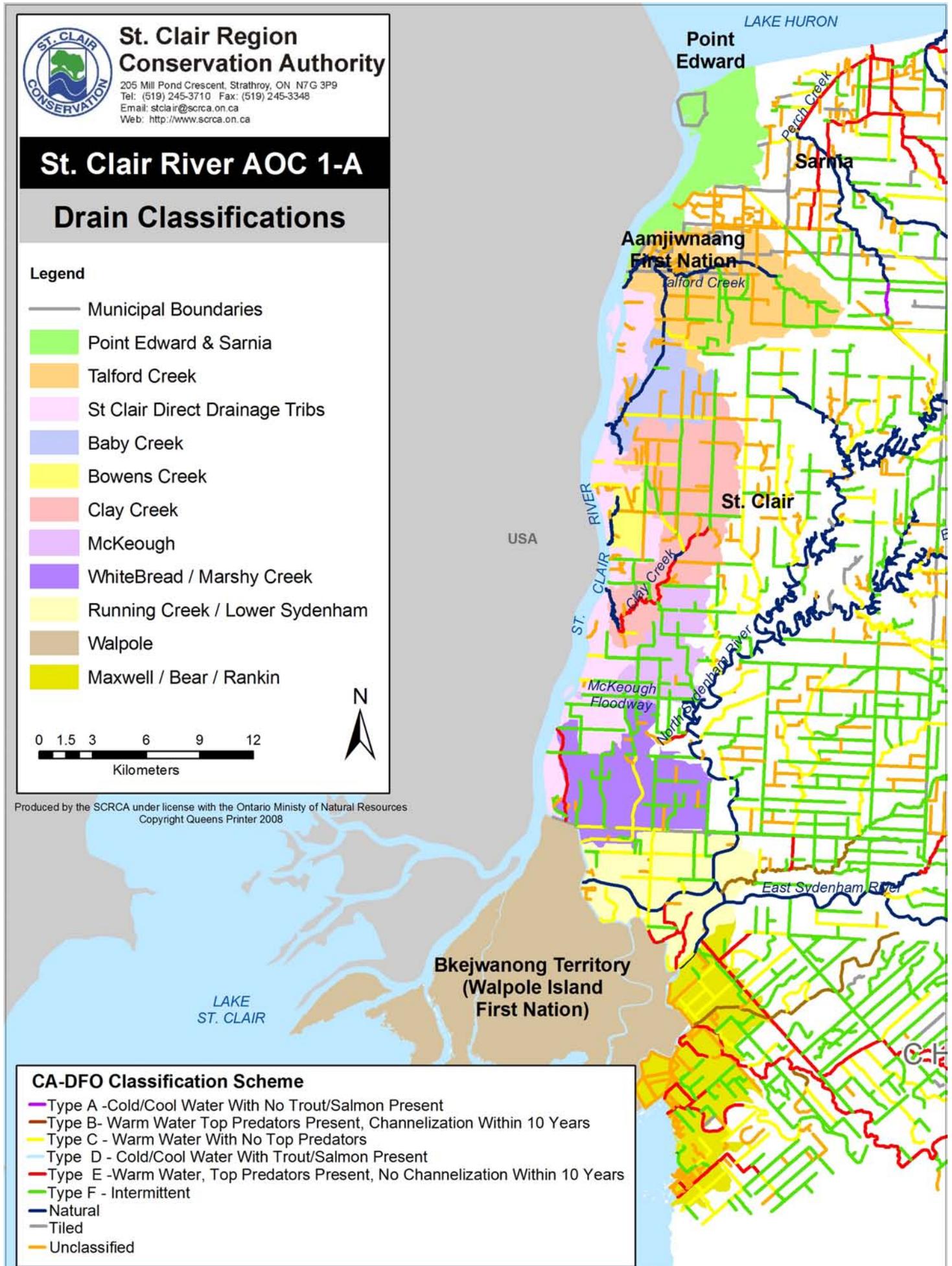
Drain Classifications

Legend

- Municipal Boundaries
- Point Edward & Sarnia
- Talford Creek
- St Clair Direct Drainage Tribs
- Baby Creek
- Bowens Creek
- Clay Creek
- McKeough
- WhiteBread / Marshy Creek
- Running Creek / Lower Sydenham
- Walpole
- Maxwell / Bear / Rankin



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CA-DFO Classification Scheme

- Type A - Cold/Cool Water With No Trout/Salmon Present
- Type B - Warm Water Top Predators Present, Channelization Within 10 Years
- Type C - Warm Water With No Top Predators
- Type D - Cold/Cool Water With Trout/Salmon Present
- Type E - Warm Water, Top Predators Present, No Channelization Within 10 Years
- Type F - Intermittent
- Natural
- Tiled
- Unclassified

Map 11: Subwatershed DFO



Benthic sampling has been carried out in Talford Creek at the LaSalle Line crossings nine times since 1999. Each time the samples have been collected using three-minute kick-and-sweep technique with the disturbed sample collected in a 500 micron D-shaped net. The samples are preserved and a random subsample of 100 to 200 invertebrate organisms identified to the family level. The Hilsenhoff Family Biotic Index (FBI) which is associated with each of these families is a reflection of the water quality, whereby the presence of organisms like mayfly nymphs indicates well-oxygenated water and therefore good quality water. Mayfly nymphs have a low FBI value. In poorly-oxygenated water or suspended silt the mayflies cannot survive and organisms like nematodes are abundant. Nematodes have a high FBI value, indicating poor water quality which has been impacted by land management practices. The average FBI value of the nine samples collected in Talford between 1999 and 2008 ranged from 5.37 to 7.21 with an average of 6.22. This is considered Fairly Poor²⁵ and graded a C in the Conservation Ontario Report Card protocol²⁶.

The SCRCA has sampled surface water in Talford Creek in partnership with the Ontario Ministry of the Environment (OMOE) since 2004. Samples are collected by the SCRCA up to eight times a year during the frost-free season and analyzed at the OMOE laboratory in Etobicoke. Samples are analyzed for 37 parameters listed in **Table 11: Surface Water Quality Parameters Analyzed 2004 – 2008**. Samples collected from 2004 to 2008 have been reviewed using four key parameters including: total phosphorus, nitrates, suspended solids, and chloride.

Table 11: Surface Water Quality Parameters Analyzed 2004-2008

Alkalinity	Dissolved Solids	Phosphate
Aluminum	Dissolved Oxygen	Phosphorus
Ammonia	Hardness	Potassium
Barium	Iron	Suspended Solids
Beryllium	Kjeldahl Nitrogen	Sodium
Biochemical Oxygen Demand	Lead	Strontium
Cadmium	Magnesium	Temperature
Calcium	Manganese	Titanium
Chloride	Molybdenum	Turbidity
Chromium	Nickel	Vanadium
Cobalt	Nitrate	Zinc
Conductivity	Nitrite	
Copper	pH	

²⁵ Hilsenhoff, W.L. 1988. Rapid Field Assessment of Organic Pollution with a Family Level Biotic Index, J. N. Am. Benthol. Soc., 7:65-68

²⁶ Conservation Ontario. 2003. The Guide to Watershed Report. Prepared by Conservation Ontario in partnership with the Government of Ontario, the Upper Thames River Conservation Authority and the Rideau Valley Conservation Authority.



Total phosphorus conditions in this watershed routinely exceeded the Interim Provincial Water Quality Objective of 0.03 mg/L. Four samples were within the objective although 90% of the 40 samples were at least twice the objective.

The samples from Talford Creek had chloride readings in 2004 to 2008 ranging from 33.7 to 200 mg/L. All samples were below the Environment Canada guideline of 210 mg/L for toxicity to sensitive species. The Canadian Council of Ministers of the Environment (CCME) has published Canadian Environmental Quality Guidelines in 1996 (updated in 2006) which provide guidelines for the protection of aquatic life. These guidelines can be modified to units of mg/L NO_3^- - N in order to be comparable with the nitrate data from the OMOE data networks.

Nitrate concentrations were compared with the modified Canadian Environmental Quality Guidelines published by the CCME and it was found that 18% of the 40 samples exceeded the modified CCME guideline of 2.93 mg/L for the protection of aquatic life. It is recognized that these surface waters are not a source of drinking water, but two samples did exceed the Provincial Drinking Water Standard of 10 mg/L (maximum acceptable concentration of nitrate). Values ranged from .005 to 20.6. Seven readings were above 2.93 including two readings above 10.

There are no established water quality standards for suspended solids. Turbid water is undesirable for healthy aquatic life, recreation, aesthetics and water supplies. Suspended solids can also transport significant quantities of phosphorus, metals and other hazardous contaminants. The samples from Talford Creek had readings between 3.1 and 356 mg/L, with 13% of the samples having levels above 50 mg/L. Values ranged from 3.1 to 356 with five over 50.

The Soils map indicates a coarser soils deposition of silt and clay loam interspersed with sands in the Aamjiwnaang First Nation area.





3.3 St. Clair River Direct Drainage Subwatershed

This subwatershed consists of those lands which directly drain into the St. Clair River south of Talford Creek. The area is 47.79 km² and is within the municipality of St. Clair Township. It includes Stag Island and Fawn Island. Stag Island has an area of 1.1 km² and Fawn Island is 0.21 km². Both Fawn Island and Stag Island accommodate seasonal private recreational areas. These uses started prior to the turn of the century and access is by watercraft only. The smaller communities of Corunna, Courtright, Sombra and Port Lambton are situated along the river within this subwatershed, with Corunna being the largest. A small portion of Chemical Valley is situated north of Corunna. The subwatershed contains 26.22 km of watercourses and drains which directly outlet to the St. Clair River.

One ESA was identified in this subwatershed. Stag Island in the St. Clair River off of Corunna includes a provincially-owned “wildlife reserve” which has meadow and a Provincially Significant Wetland. The “Special Appendix Areas” of Lambton’s ESA report included two woodlots within this subwatershed: Fertilizer Plant Woodlot (SA16) and Hydro Plant Woodlot (SA19). A portion of the provincially significant wetland complex, evaluated in 2007 and identified generally as Bickford Oak Woods, extends into this subwatershed.

The Drain Classification described previously indicates that in this subwatershed 41% of the watercourses were not readily accessible and were not classified. 45% of the 28.7 km of watercourses were Type F (intermittent watercourses) and the remaining classified reaches were Type C (warm water fisheries with baitfish species).

The Conservation Authority does not have any information on fish species, benthic indices or surface water quality within this subwatershed.

The soils of the mainland are of the common Lambton silt and clay.



Natural Heritage Features and SCRCA Monitoring Sites

St. Clair Direct Drainage Tributaries

Legend

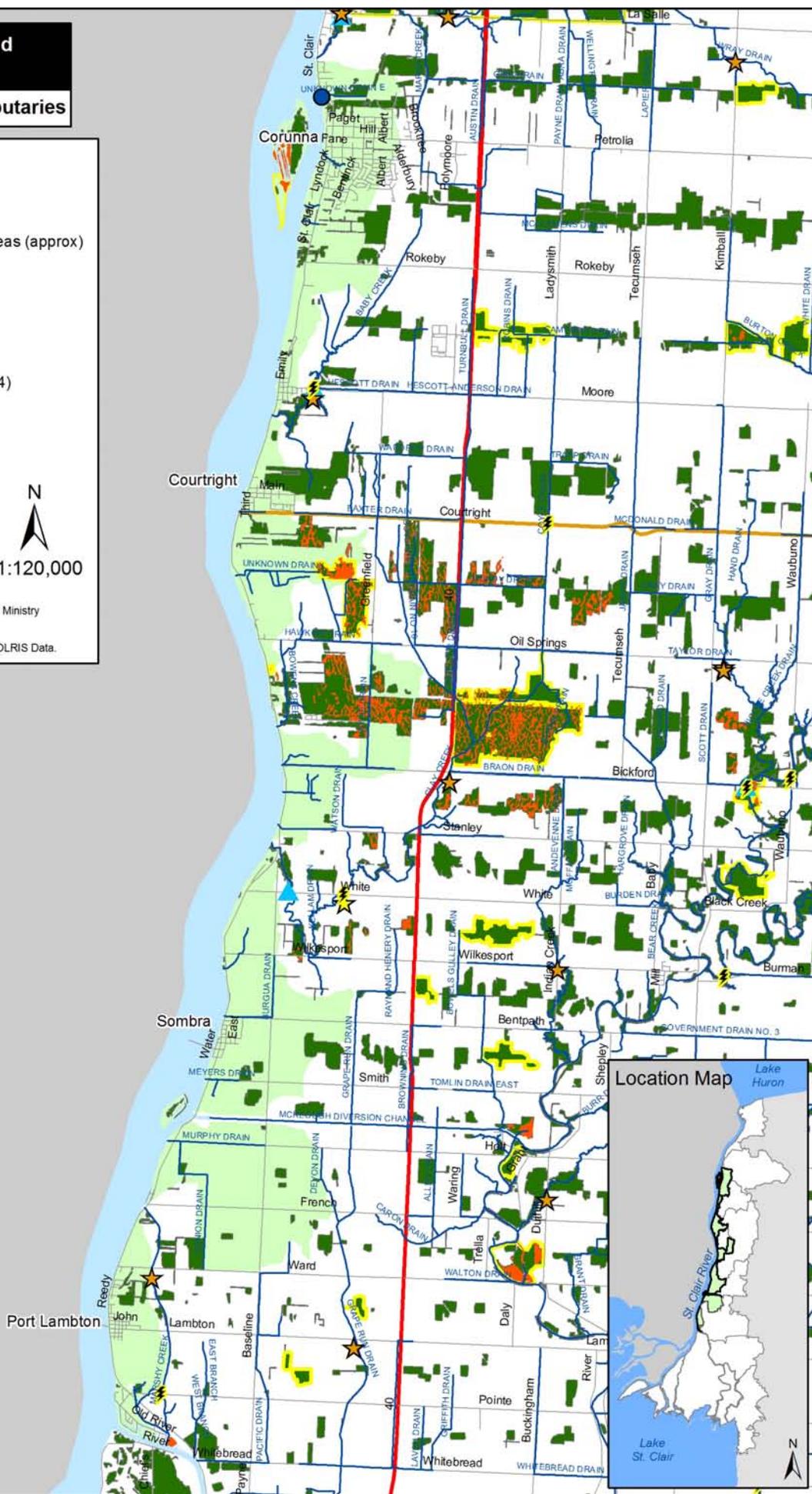
- Subwatershed Area
 - Evaluated Wetlands
 - Environmentally Significant Areas (approx)
 - Woodlands
 - Provincial Highway
 - Former Highway
 - Other Roads
 - Watercourses/Drains
 - Electrofishing Sites (1995-2004)
 - Ground Water Monitoring Site
- Benthic Monitoring Sites**
- Inactive
 - Active
- Water Quality Monitoring Sites**
- Inactive
 - Active

N

 1:120,000

Base mapping produced under license with the Ontario Ministry of Natural Resources. © 2009.

Data Source: Ontario Ministry of Natural Resources SOLRIS Data.



Map 13: St. Clair Direct Drainage Tributaries



3.4 Baby and Bowens Creek Subwatersheds

Baby and Bowens Creek subwatersheds are two of the smaller subwatersheds within the AOC 1-A area. The Baby Creek subwatershed encompasses a land area of 21 km² and the main channel is 7.7 km with a total tributary watercourse length of 20.4 km. The watercourse is considered natural for 9.3 km, a Type C municipal drain for 6.1 km and is unclassified for 12.7 km.

No ESAs have been recognized by Lambton County in this subwatershed but there is one Special Appendix Area briefly described in the literature²⁷: Payne Woodlot (SA 12). Electro-fishing of Baby Creek in 2000 found 11 species of warm water fish which are listed in **Table 10: Fish Species Electro-fished by SCRC in St. Clair River Tributaries** representing the sunfish, catfish, perch, sucker, mudminnow, and minnow and carp families.

Benthic samples have been collected from Baby Creek on Moore Line. The average FBI value of the six samples collected in Baby Creek between 2000 and 2006 ranged from 4.96 to 7.19 with an average of 6.18. This is considered Fairly Poor²⁸ and graded a C in the Conservation Ontario Report Card protocol.

The SCRC has sampled surface water in Baby Creek in partnership with the Ontario Ministry of the Environment (OMOE) since 2005. Samples are collected by the SCRC up to eight times a year during the frost-free season and analyzed at the OMOE laboratory in Etobicoke. Samples are analyzed for 37 parameters listed in **Table 11: Surface Water Quality Parameters Analyzed 2004 – 2008**. Samples collected from Baby Creek have been reviewed using four key parameters including: total phosphorus, nitrates, suspended solids, and chloride.

Total phosphorus conditions in this watershed consistently exceeded the Interim Provincial Water Quality Objective of 0.03 mg/L. All of the samples were in excess of this objective and the majority of the readings (20/32) were more than three times the objective.

The samples from Baby Creek had chloride readings in 2005 to 2008 ranging from 20.4 to 150 mg/L. All samples were below the Environment Canada guideline of 210 mg/L for toxicity to sensitive species.

The Canadian Council of Ministries of the Environment (CCME) has published Canadian Environmental Quality Guidelines in 1996 (updated in 2006) which provide guidelines for the protection of aquatic life. These guidelines can be modified to units of mg/L NO₃⁻ - N in order to be comparable with the nitrate data from the OMOE data networks.

Nitrate concentrations were compared with the modified Canadian Environmental Quality Guidelines published by the CCME and it was found that 13% (4/32) of the samples exceeded the modified CCME guideline of 2.93 mg/L for the protection of aquatic life. It is recognized that these surface waters are not a source of drinking water, but one sample did exceed the Provincial Drinking Water Standard of 10 mg/L (maximum acceptable concentration of nitrate).

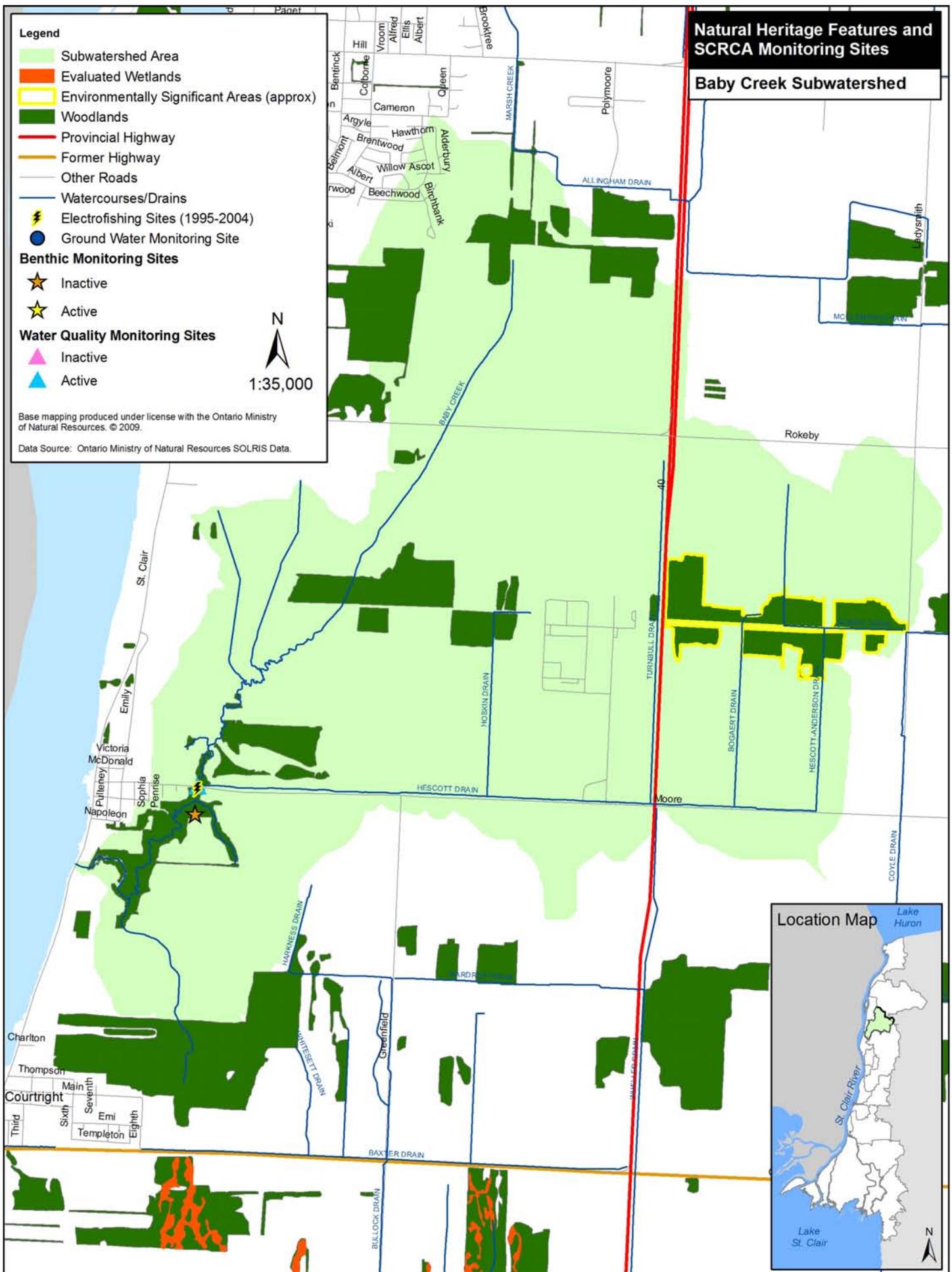
There are no established water quality standards for suspended solids. Turbid water is undesirable for healthy aquatic life, recreation, aesthetics and water supplies. Suspended solids can also transport significant quantities of phosphorus, metals and other hazardous contaminants. The samples from Baby Creek had readings between 4.9 and 319 mg/L, with 16% of the samples having levels above 50 mg/L. Values range from 4.9 to 319 with five over 50.

The Bowens Creek subwatershed encompasses a land area of 6.61 km² and the main channel is 3.4 km with a total tributary watercourse length of 8.3 km. The watercourse is considered natural for 3.4 km and is unclassified for 8.3 km. A portion of the Bickford Oak Woods and provincially significant wetland complex extends into this subwatershed. The Conservation Authority has no benthic, fish or surface water quality information for this subwatershed.

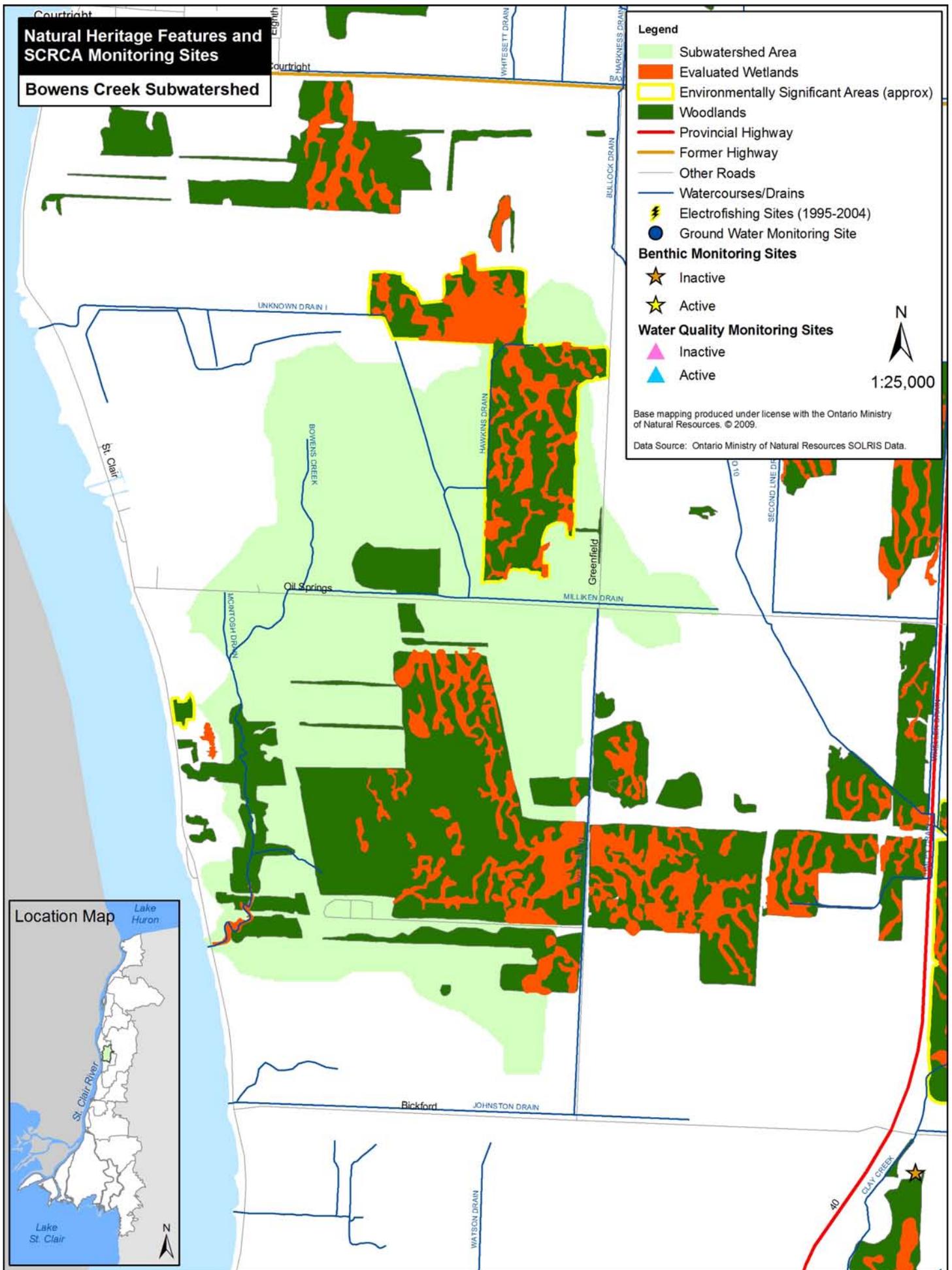
The soils are clay and silt.

²⁷ University of Waterloo op.cit.

²⁸ Hilsenhoff, op.cit.



Map 14: Baby Creek Subwatershed



Map 15: Bowens Creek Subwatershed



3.5 Clay Creek Subwatershed

The subwatershed encompasses a land area of 56.65 km² and the main channel is a meandering natural stream for a distance of 12.8 km at the lower portion of the watershed. In total there are 82.7 km of open watercourse with 4.4 km of natural stream, and 32.6 km of unclassified and 45.7 km of classified drains. The majority of the environmentally significant Bickford Oak Woods and provincially significant wetland is situated within the upper middle portion of the subwatershed.

Electro-fishing of Clay Creek in 2000 found seven species of warm water fish which are listed in **Table 10: Fish Species Electro-fished by SCRCA in St. Clair River Tributaries** representing the sunfish, pike, sucker, mudminnow, and minnow and carp families.

Benthic samples have been collected from Clay Creek on Bickford and White Line. The average FBI value of the nine samples collected in Clay Creek between 2002 and 2008 ranged from 5.50 to 7.49 with an average of 6.87. This is considered Poor²⁹ and graded a D in the Conservation Ontario Report Card protocol.

Samples collected from Clay Creek between 2005 and 2008 have been reviewed using four key parameters: total phosphorus, nitrates, suspended solids, and chloride.

Total phosphorus conditions in this watershed routinely exceeded the Interim Provincial Water Quality Objective of 0.03 mg/L. All of the samples were in excess of this objective and most of the samples (24/32) were more than triple the objective.

The samples from Clay Creek had chloride readings in 2004 to 2008 ranging from 15.9 to 133 mg/L. All samples were below the Environment Canada guideline of 210 mg/L for toxicity to sensitive species.

The Canadian Council of Ministries of the Environment (CCME) has published Canadian Environmental Quality Guidelines in 1996 (updated in 2006) which provide guidelines for the protection of aquatic life. These guidelines can be modified to units of mg/L NO₃⁻ - N in order to be comparable with the nitrate data from the OMOE data networks.

Nitrate concentrations were compared with the modified Canadian Environmental Quality Guidelines published by the CCME and it was found that 13% (5/40) of the samples exceeded the modified CCME guideline of 2.93 mg/L for the protection of aquatic life. It is recognized that these surface waters are not a source of drinking water, but two samples did exceed the Provincial Drinking Water Standard of 10 mg/L (maximum acceptable concentration of nitrate).

There are no established water quality standards for suspended solids. Turbid water is undesirable for healthy aquatic life, recreation, aesthetics and water supplies. Suspended solids can also transport significant quantities of phosphorus, metals and other hazardous contaminants. The samples from Clay Creek had readings between 5.1 and 190 mg/L, with 34% of the samples having levels above 50 mg/L.

The soils are clay and silt.



²⁹ Hilsenhoff, op.cit.



3.6 McKeough Subwatershed

The McKeough Floodway subwatershed was created artificially in the early 1980s when a floodway diversion channel was dug from the North Sydenham River to the St. Clair River. When flood stage occurs, flows from the North Branch of the Sydenham River will split and enter the floodway by way of a weir. Under normal flow conditions, overland surface runoff from several drains enter the channel and flow to the St. Clair River. The subwatershed is small with an area of 21.72 km² and 28.3 km of open drains. The McKeough channel is 11 metres deep and 7 km in length.

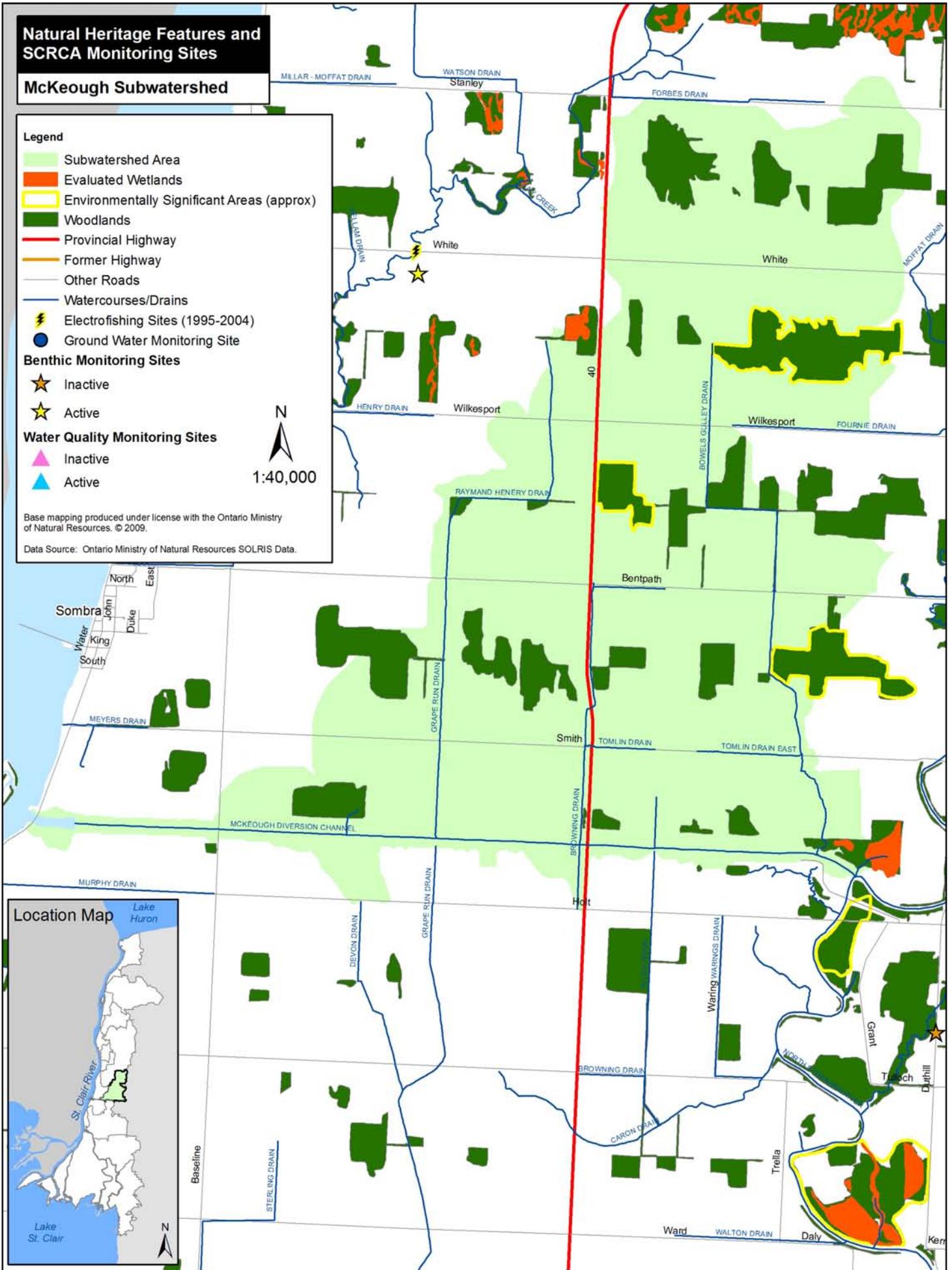
No ESAs have been recognized by Lambton County in this subwatershed but there are three Special Appendix Areas from this subwatershed briefly described in the literature³⁰: Spicebush Woods (SA22), Combine Woodlot (SA23) and Upland Plover Woods (SA24).

The Conservation Authority does not have any information on fish species, benthic indices or surface water quality within this subwatershed.

The soils are clay and silt.



³⁰ University of Waterloo op.cit.



Map 17: McKeough Subwatershed



3.7 Marshy Creek Whitebread Tap Drain Subwatershed

The Whitebread Tap Drain subwatershed consists of several large artificial drainage systems. Marshy Creek is a larger, more natural watershed and consists of a 5.4 km long main channel, while Whitebread Tap Drain's main channel is 3.5 km long. The outlet of drainage within this subwatershed is the Chenal Ecarte. A very small proportion of the lower drainage basin (6%) is contained within the municipality of Chatham-Kent. The entire subwatershed area is 43.84 km².

One ESA was identified in this subwatershed: Sassafras Woods. There is also one Special Appendix Area identified³¹: Sycamore Woods (SA20).

Electro-fishing information provided by Fisheries and Oceans Canada³² indicated five federally-designated Species at Risk had been found in the Whitebread Drain: Spotted Sucker, Pugnose Shiner, Pugnose Minnow, Grass Pickerel and Blackstripe Topminnow.

One benthic sample was collected from Marshy Creek on Ward Line in 2000, and had an FBI value of 7.96. This is considered Very Poor³³ and graded an F in the Conservation Ontario Report Card protocol. The Conservation Authority does not have any surface water quality data for this subwatershed.

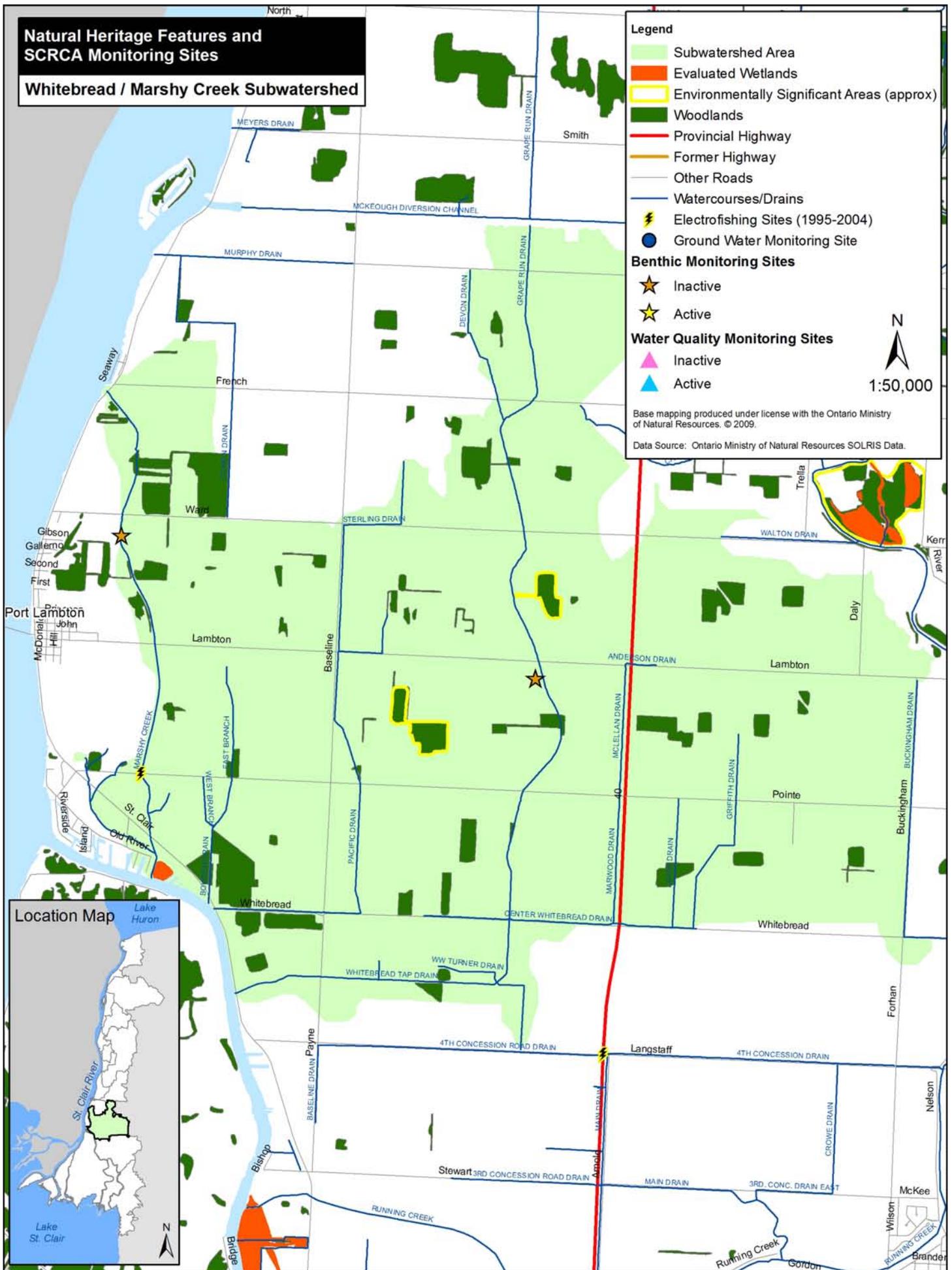
The soils depict the once marshy poorly drained lands. Loams and minor areas of sand loams are situated along the river and Chenal Ecarte.



³¹ University of Waterloo op.cit.

³² Staton pers.comm. 2003

³³ Hilsenhoff, op.cit.



Map 18: Whitebread / Marshy Creek Subwatershed



3.8 Running Creek and Lower Sydenham River Subwatershed

With a population of 11,114, the larger community of Wallaceburg is situated within the Running Creek and Lower Sydenham River subwatershed. The entire watershed above Wallaceburg is not included in the AOC 1-A area, as the AOC 1-A area concentrates on the immediate impact zones of the AOC. Running Creek flows can change dependent on wind direction and water volumes in the Sydenham River and, due to the extremely flat gradient, Running Creek can flow upstream or downstream. Although Running Creek is not controlled via a pumping system, many large ditches and canals in this subwatershed are controlled with pumps and dykes. The main Sydenham River downstream from Wallaceburg is the largest inland watercourse and flows 5 km from Wallaceburg to its outlet at the Chenal Ecarte. The subwatershed area is 49.37 km².

No ESAs have been recognized here and the Conservation Authority does not have any benthic information in this subwatershed.

Electro-fishing by Authority staff in a tributary of the lower Sydenham resulted in only one species; green sunfish. The Sydenham River itself has been examined by Royal Ontario Museum staff upstream of Wallaceburg. In 2001, Erling Holm completed a survey using seining and electro-fishing by boat in the lower Sydenham from Dresden to Tupperville³⁴. Holm identified 34 species of fish representing nine families including the pike, mooneye, sucker, carp and minnow, catfish, stickleback, sunfish, perch and drum families.

Surface water quality samples collected by the SCRCA and analyzed by MOE from the Sydenham River in Wallaceburg (McNaughton Avenue bridge) from 2004 to 2008 have been reviewed using four key parameters: total phosphorus, nitrates, suspended solids, and chloride. Flows in Wallaceburg are affected by water from the St. Clair River flowing, at times, east along Running Creek into the North Sydenham since the river bottom throughout Wallaceburg is at lake level. Consequently, the water quality in Wallaceburg may be readily affected by the quality of the St. Clair River water.

Total phosphorus values from Wallaceburg samples routinely exceeded the Interim Provincial Water Quality Objective of 0.03 mg/L. Two of the samples from 2004 to 2008 were within this objective and most (24/37) were between twice and triple the provincial objective.

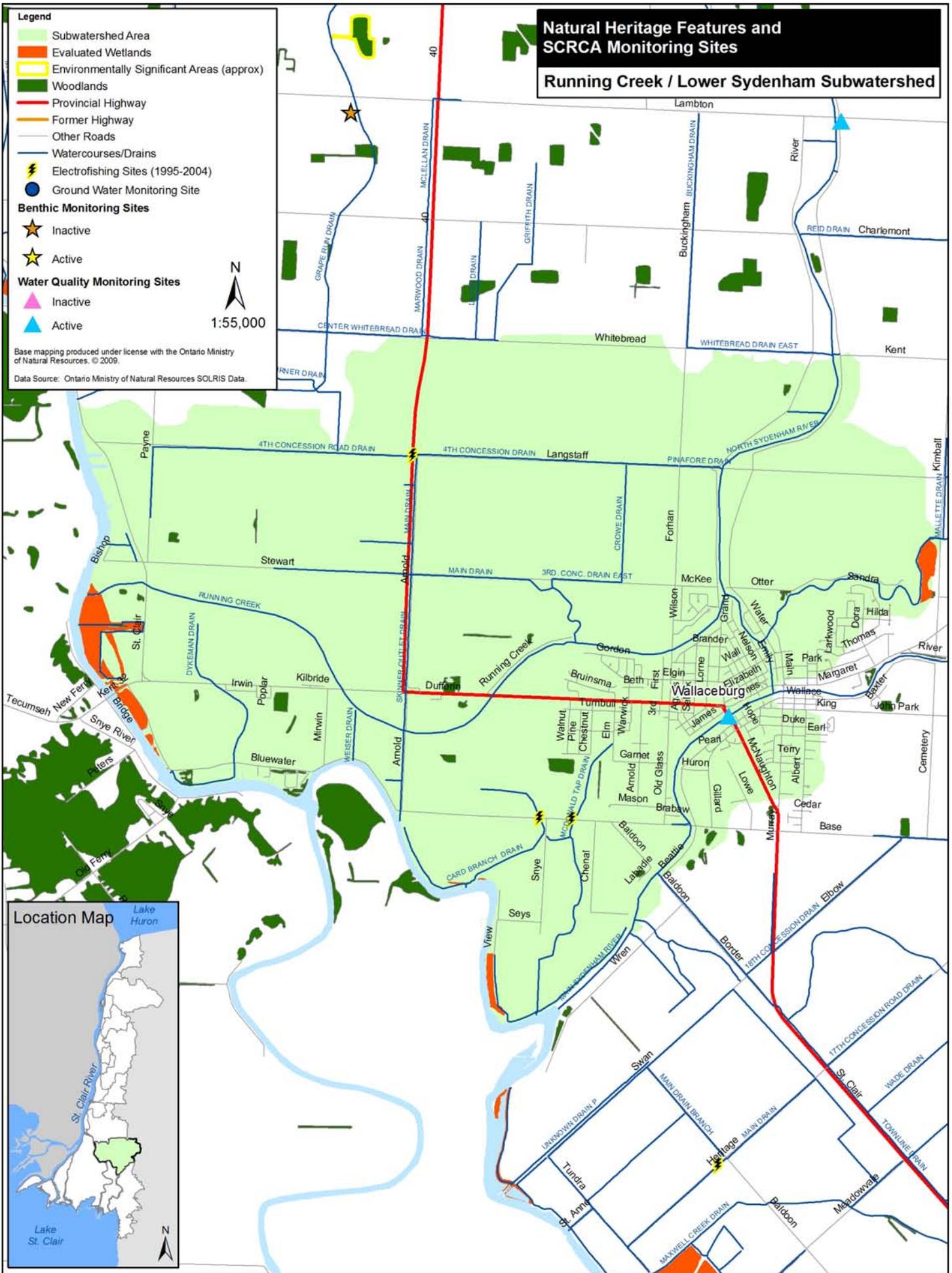
The samples from Wallaceburg had chloride readings in 2004 to 2008 ranging from 10.2 to 36 mg/L. All samples were below the Environment Canada guideline of 210 mg/L for toxicity to sensitive species.

Nitrate concentrations were compared with the modified Canadian Environmental Quality Guidelines published by the CCME and it was found that 24% of the samples exceeded the modified CCME guideline of 2.93 mg/L for the protection of aquatic life. It is recognized that these surface waters are not a source of drinking water, but none of the samples exceeded the Provincial Drinking Water Standard of 10 mg/L (maximum acceptable concentration of nitrate).

There are no established water quality standards for suspended solids. Turbid water is undesirable for healthy aquatic life, recreation, aesthetics and water supplies. Suspended solids can also transport significant quantities of phosphorus, metals and other hazardous contaminants. The samples from Wallaceburg where suspended solids were analyzed had readings between 7.2 and 40.3 mg/L, with none of the samples having levels above 50 mg/L.

South of Running Creek, more loamy type soils are found, whereas north of Running Creek, clay soils predominate.

³⁴ Holm, Erling. 2001. Report to the Ministry of Natural Resources, Chatham Area Office on Biological Inventory and Assessment Activities in the Sydenham River between Tupperville and Dresden, June 2001 115 pp.



Map 19: Running Creek / Lower Sydenham River Subwatershed



3.9 Lower Maxwell, Lower Bear and Lower Rankin Creek Subwatershed

Similar to the Running Creek/Lower Sydenham River subwatershed, this subwatershed situated east of Lake St. Clair and the Chenal Ecarte is low lying and many of the large ditches and canals are controlled with pumps and dykes. In order to crop this highly productive land, extensive drainage and pumping schemes are required. This subwatershed area is 56.21 km². Drainage length consists of 134.9 km of watercourse.

Two ESAs have been recognized in this subwatershed: the Chenal Ecarte Prairie was described in 1984³⁵. In addition, the northern portion of the Lake St. Clair Marshes extends along Lake St. Clair and marshes have been readily re-established on several inland properties.

The Conservation Authority does not have any electro-fishing or benthic information from this subwatershed. In the upper reaches of these watercourses electro-fishing and benthic information have been collected but there are no sites within the area outlined within Area 1-A.

Surface water quality samples were collected from 2004 to 2008 from Little Bear Creek on Bear Line Road. The MOE analyses of these samples have been reviewed using four key parameters: total phosphorus, nitrates, suspended solids, and chloride.

Total phosphorus conditions in this subwatershed routinely exceeded the Interim Provincial Water Quality Objective of 0.03 mg/L. All 40 samples were in excess of this objective and 18% (7/40) were more than triple the objective.

The samples from Little Bear Creek had chloride readings ranging from 22.9 to 61.1 mg/L. All samples were below the Environment Canada guideline of 210 mg/L for toxicity to sensitive species.

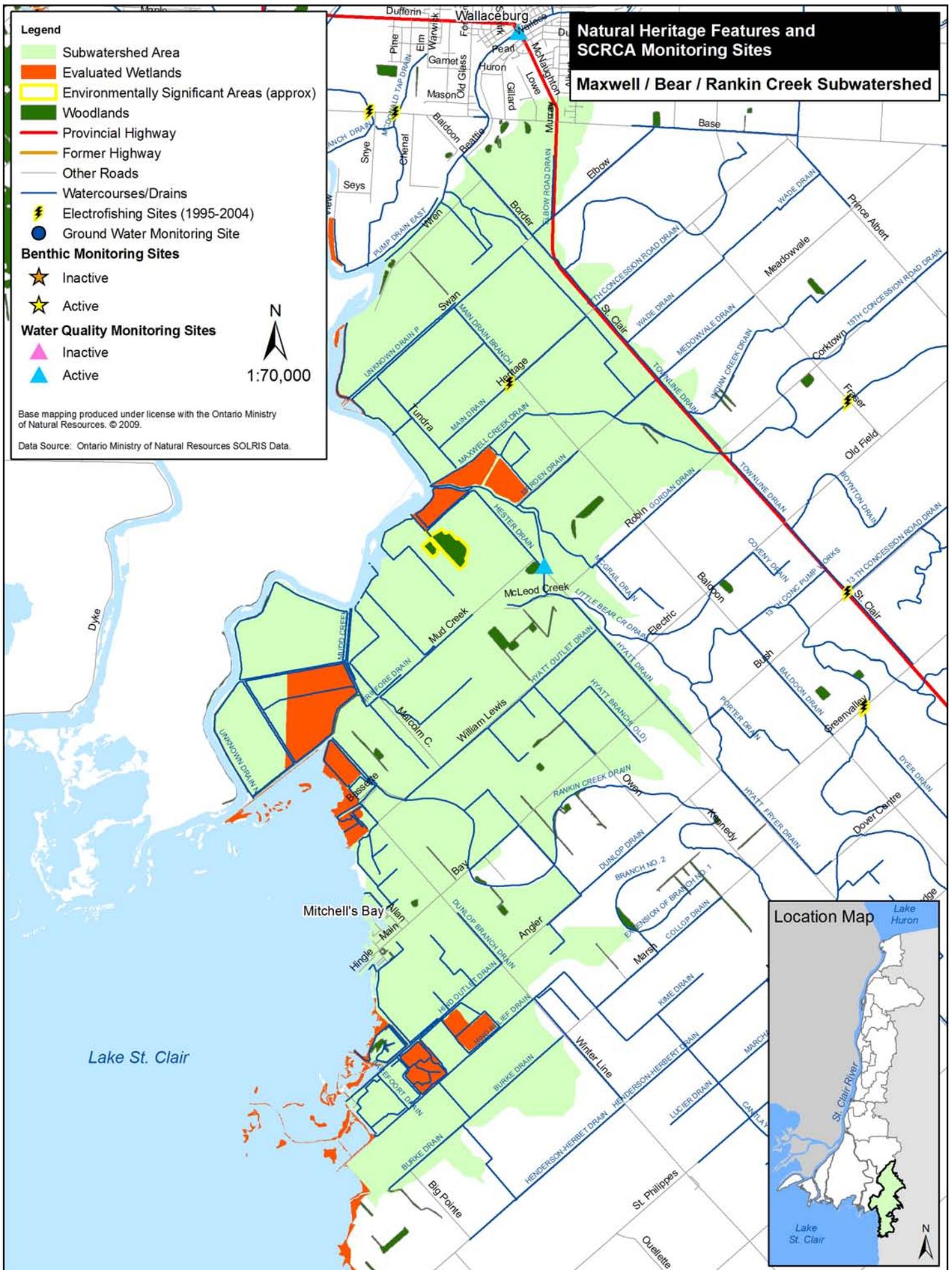
The Canadian Council of Ministries of the Environment (CCME) has published Canadian Environmental Quality Guidelines in 1996 (updated in 2006) which provide guidelines for the protection of aquatic life. These guidelines can be modified to units of mg/L NO₃⁻ - N in order to be comparable with the nitrate data from the OMOE data networks.

Nitrate concentrations were compared with the modified Canadian Environmental Quality Guidelines published by the CCME and it was found that 40% of the samples exceeded the modified CCME guideline of 2.93 mg/L for the protection of aquatic life. It is recognized that these surface waters are not a source of drinking water, but two samples did exceed the Provincial Drinking Water Standard of 10 mg/L (maximum acceptable concentration of nitrate).

There are no established water quality standards for suspended solids. Turbid water is undesirable for healthy aquatic life, recreation, aesthetics and water supplies. Suspended solids can also transport significant quantities of phosphorus, metals and other hazardous contaminants. The samples from Little Bear Creek had readings between 4.7 and 42.7 mg/L, therefore none of the samples had levels above 50 mg/L.

The Chatham Clay Plain soils are predominantly silt and clay with coarser soils found closer to the Lake St. Clair shoreline. The headwaters of these creeks are a mixture of a silt and clay loam material.

³⁵ Klinkenber, R. 1984. Life Science Areas of Natural and Scientific Interest in Site District 7-1: A Review and Assessment of Significant Natural Areas in Site District 7-1. Ontario Ministry of Natural Resources, London. Vii + 22pp. + appendices



Map 20: Maxwell / Bear / Rankin Creek Subwatershed



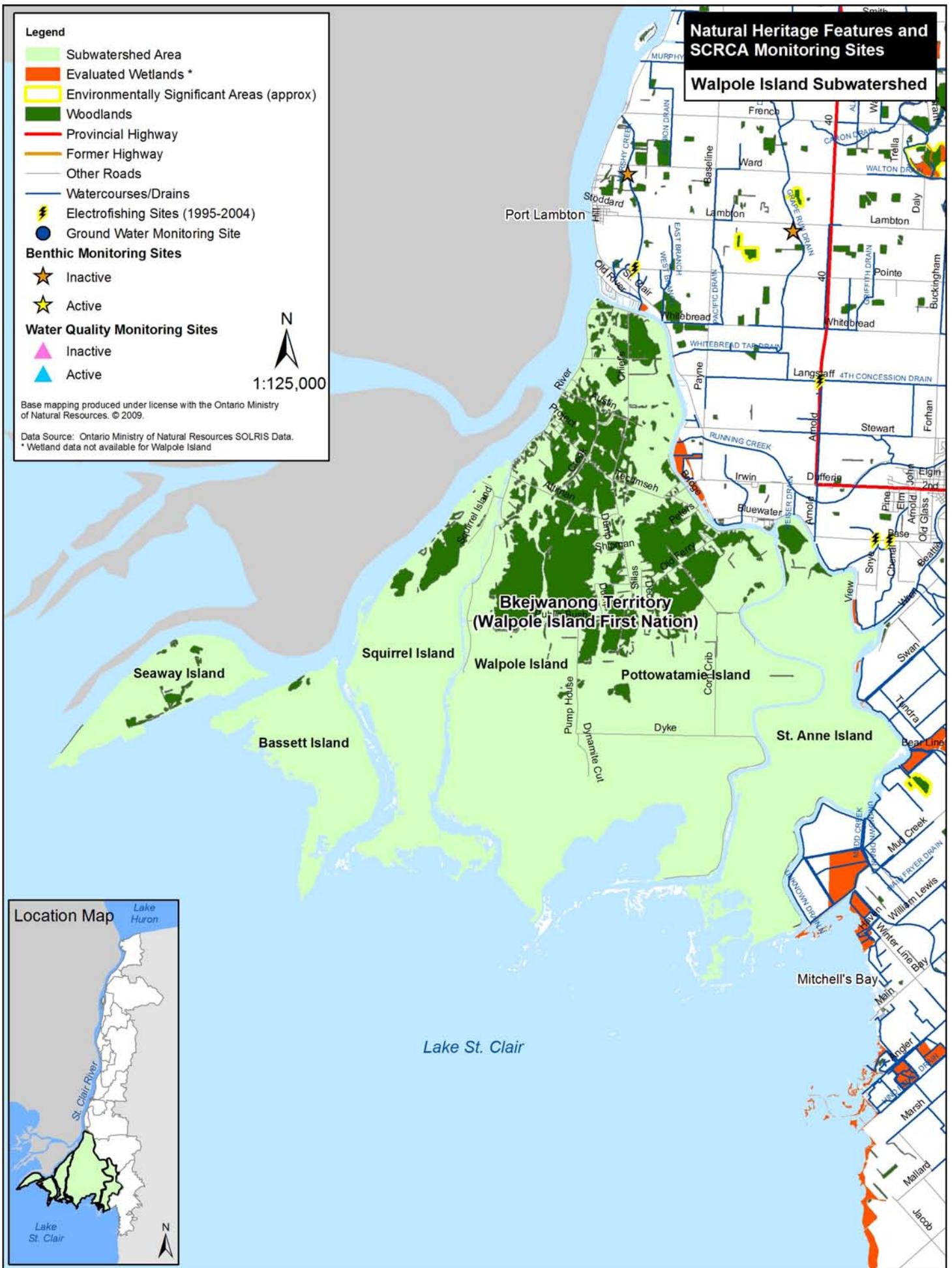
3.10 Walpole Island First Nation

Walpole Island First Nation is referred to in the Ojibwe language as “Bkejwanong” which means – where the waters divide – which accurately describes the large delta island complex situated in the mouth of the St. Clair River along the northern portion of Lake St. Clair. **See Map 21: Walpole Island Subwatershed.** These delta islands cover 147.12 km² approximately and are part of the traditional homeland of the Ojibwe, Odawa and Pottawatomi people who together comprise a political compact known as the Three Fires Confederacy³⁶. The soils are indicative of the alluvial nature of lands being sand loam and more organic in nature where the southern wetland features are present. **See Map 3: Soils and Map 4: St. Clair River Delta.**

The ecosystem of the island is rich in its diversity from a biological perspective. It was recognized as ecologically significant more than 35 years ago³⁷, subsequently named as an Environmentally Significant Area³⁸ and studied in more detail³⁹. Rare remnant natural communities exist here including: tallgrass prairie, oak savanna, Carolinian forest and the largest wetland system in the St. Clair River and Lake St. Clair system. 68.9 km² of wetlands exist on the island. Although minor alterations and the creation of channels have occurred on the island, the extensive Chatham-Kent pumping and artificial drainage schemes do not exist on the island. At least five main islands were created from the channels that dissect the delta. The islands are referred to as Squirrel, Walpole, Pottowatamie and St. Anne. Goose Lake is situated between Walpole and Pottowatamie Island.



36 Walpole Island Heritage Centre, 2002, Species at Risk on the Walpole Island First Nation.
 37 Campbell, C.A, 1974. A preliminary assessment of ecological assets and impacts on Walpole Island Indian Reserve. Prepared for Indian and Northern Affairs, Ontario Regional Office, Planning Sect&on. 29 pp.
 38 University of Waterloo op.cit.
 39 Woodliffe, P.A. and G.M. Allen, 1990. A Life Science Inventory and Ranking of 30 Natural Areas of Walpole Island Indian Reserve pp. 37-48 in “Conserving Carolinian Canada”, edited by G.M. Allen, P.F.J. Eagles and S.D. Price.



Map 21: Walpole Island Subwatershed



4

Chapter 4

Summary of Impairments/Issues/Problems

4.1 Prioritized Pollutants/Impairments and Watershed Concerns

Although improvements have been made, surface water quality remains a concern in the AOC. The effects of land use activities on water quality has a significant impact. Over the years, water quality standards, objectives and guidelines have been developed by federal and provincial governments to protect both aquatic life and human water uses. Human uses include drinking water, crop irrigation, animal watering and recreation uses such as fishing, boating, swimming and aesthetic value. The current (most recent) standards, objectives and guidelines are summarized in Table 3.2.3.1 Water Quality Standards, Objectives and Guidelines found in the SCRCA's Draft Watershed Characterization Report, 2007⁴⁰.

4.2 Point Source Pollutants and Stressors

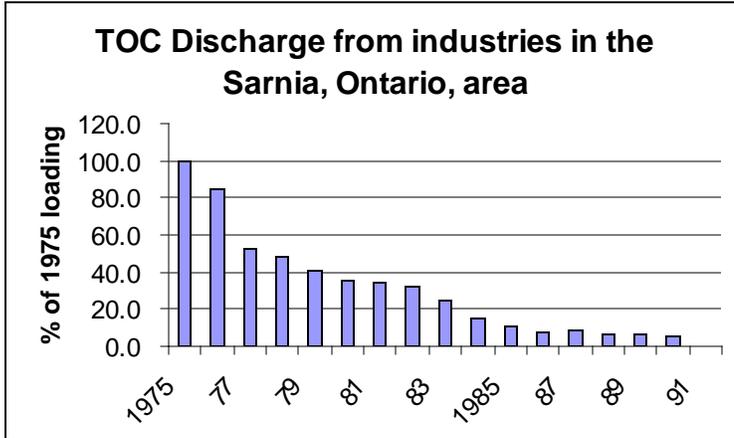
Point Source discharges refer to a source of pollution that is distinct and identifiable. Manufacturing and sanitary wastewaters, as well as stormwater would be identified as a point source. Discharges from these sources are typically treated before being released to a watercourse, through a sewer or ditch. Generally, stormwater is not treated unless facilities have been implemented to allow for settling which removes a portion of water contaminants. If stormwater runoff from "heavy" industrial sites is expected to contain unacceptable pollutants, stormwater facilities have been incorporated as required by the Ministry of the Environment (i.e. Refineries).

Historically, point source discharges and spills have had a significant impact on water quality in the St. Clair River and inland watercourses. Sediment contamination from past discharge practices continue to have environmental impacts. Sediment contamination and remediation will be dealt with more fully in Section 4.4.3.

Today, industrial discharges now contribute fewer pollutants than in the past. Increased government regulation and voluntary efforts throughout the 1970s and 1980s led to this decrease. The 1990 daily discharge of total organic carbon was approximately 3% of the amount that was discharged in 1975⁴¹. The most recent 1996 SOE report indicated that the annual loadings of five different pollutant categories had continued to be reduced on the St. Clair River.

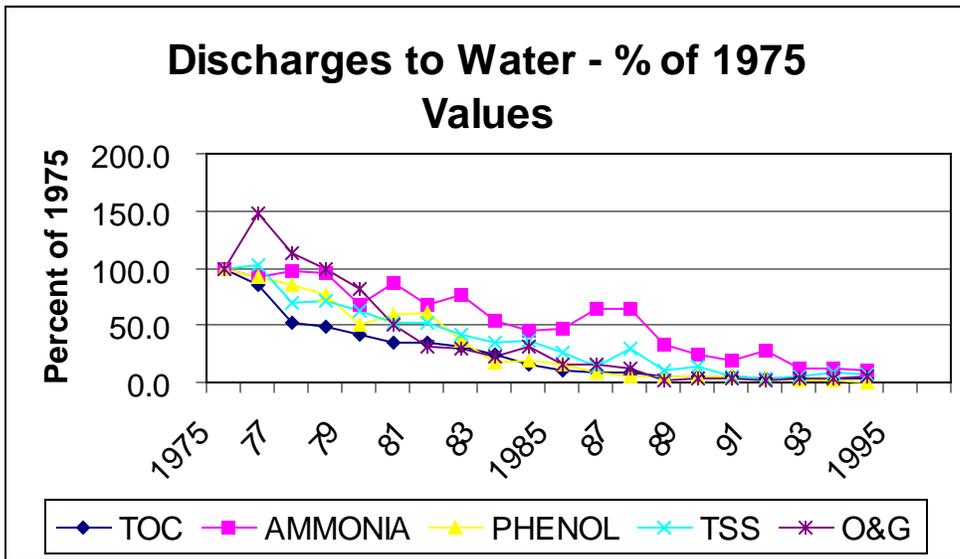
⁴⁰ www.scrca.on.ca/

⁴¹ State of Canada's Environment (SOE) Report, 1991, Minister of the Environment.



Source: The State of Canada's Environment 1991
 1975 loading 30,887 kg/day

Figure 5: Total organic carbon (TOC) loadings from industries to the St. Clair River, 1975-1990, as a percentage of 1975 loading (1975 loading 30,887 kg/day)



Source: The State of Canada's Environment 1996

Figure 6: Annual loadings of pollutant categories – TOC, ammonia, phenol, tSS and oil and grease to the St. Clair River, 1975-1994, as a percentage of 1975 loadings

Government regulation in the form of the Municipal-Industrial Strategy for Abatement (MISA) program, provided pollution control requirements based on Best Available Technology Economically Achievable. Under MISA, specific Clean Water Regulations were developed for each industrial sector. The Sarnia Chemical Valley industries are controlled by Clean Water Regulations under the electric power, inorganic chemicals, organic chemicals and petroleum sectors. In terms of the local refineries, they are regulated by provincial regulations and also by the federal Petroleum Refinery Liquid Effluent Regulations guidelines. The 1996/97 Compliance Inspection Summary indicates that the overall compliance rate for the federal regulation was 99% for all refineries in Ontario⁴². There are four designated oil handling facilities along the St. Clair River where petroleum products are being loaded or unloaded from ships. The Response Organizations and Oil Handling Facilities Regulations control these facilities.

⁴² Lake St. Clair Canadian Watershed Technical Report: an examination of current conditions, 2005, Environment Canada and Lake St. Clair Canadian Watershed Coordination Council.



Spills

Spills are untreated discharges of pollutants that typically include chemicals, fuels and sewage most commonly from industrial, municipal, commercial, and agricultural sources. Within the AOC, the spill of chemicals, oils, hydrocarbons and wastes from the industrial lands in the upper St. Clair River are the focus. Compared to other U.S./Canadian connection channel corridors, for Canadian spills, the St. Clair River has a greater number of spills⁴³. This is due to the presence of the industrial sector in Sarnia. The location and inventory of industries within the AOC are illustrated on each subwatershed map titled **“Base Map and Industry Locations” (See Appendix A)**. Since the mid-1990s, the number of serious spills along the St. Clair River corridor has declined. Restrictions on drinking water consumption were originally identified as one of the beneficial use impairments in the St. Clair River. The 1997 Stage 1 RAP update stated that drinking water was no longer considered impaired due to the reduction in spills from chemical industries affecting the downstream water supplies of Wallaceburg and Walpole Island First Nation. **See Map 22: Wallaceburg Drinking Water Intake.**

Minor spills still occur and spill incidents have fallen from 140+ annually in the late 1980s to 40-60 annually⁴⁴. Even small spills cause public alarm. Although a spill may be determined to not cause a risk to human or aquatic health, there is public concern with each occurrence of reported spills. In 2003 and 2004, however, there were several spills that caused public alarm and did result in the temporary closures of water intake facilities. Even small spills that might have previously gone unnoticed came under greater public scrutiny.

As a result of public concern over the spills that occurred in 2003 and 2004 (Royal Polymer and Imperial Oils respectively), the Ministry of the Environment’s Sarnia Inspection Sweep team conducted a comprehensive inspection of 35 petrochemical and related industrial facilities in Sarnia. The purpose of the inspection was to ensure compliance with environmental legislation in order to help reduce future threats. The report stated that there was no identification of any non-compliance which would lead to immediate human health or environmental impacts as a result of a spill. There was non-compliance with other requirements in almost 100% of the facilities⁴⁵. The other requirements ranged from no spill contingency or prevention plans to not having updated their approvals. It is worthy to note that the sweep also found a wide variety of sound practices ranging from containment facilities, automatic trip gates, alarms to prevent discharges, monitoring, closed loop systems or electric fans for cooling. The 2006 International Joint Commission Review of spills in the Great Lakes Basin and the St. Clair – Detroit River corridor found progress in many areas but did make the following recommendations: accessibility to spill data, shared approaches for spill data management and spill prevention. It is recognized that the Ministry of the Environment relies on solid modelling to predict potential impacts of reported spills on the River. Continuous improvements are being made to the model in order to provide accurate predictions. This requires bi-national cooperation and this aspect of spill prevention and contingency planning is currently being reviewed, and state-of-the-art predictive models are being implemented.

Municipal Wastewater Pollution Control Sources

Water Pollution Control Plants (WPCPs) within the study area are situated in the Village of Point Edward, City of Sarnia, and the communities of Corunna and Courtright in St. Clair Township. There are also sewage lagoons in the community of Sombra and Port Lambton in St. Clair Township. All the aforementioned facilities discharge directly to the St. Clair River.

Municipal Urban Stormwater Sources

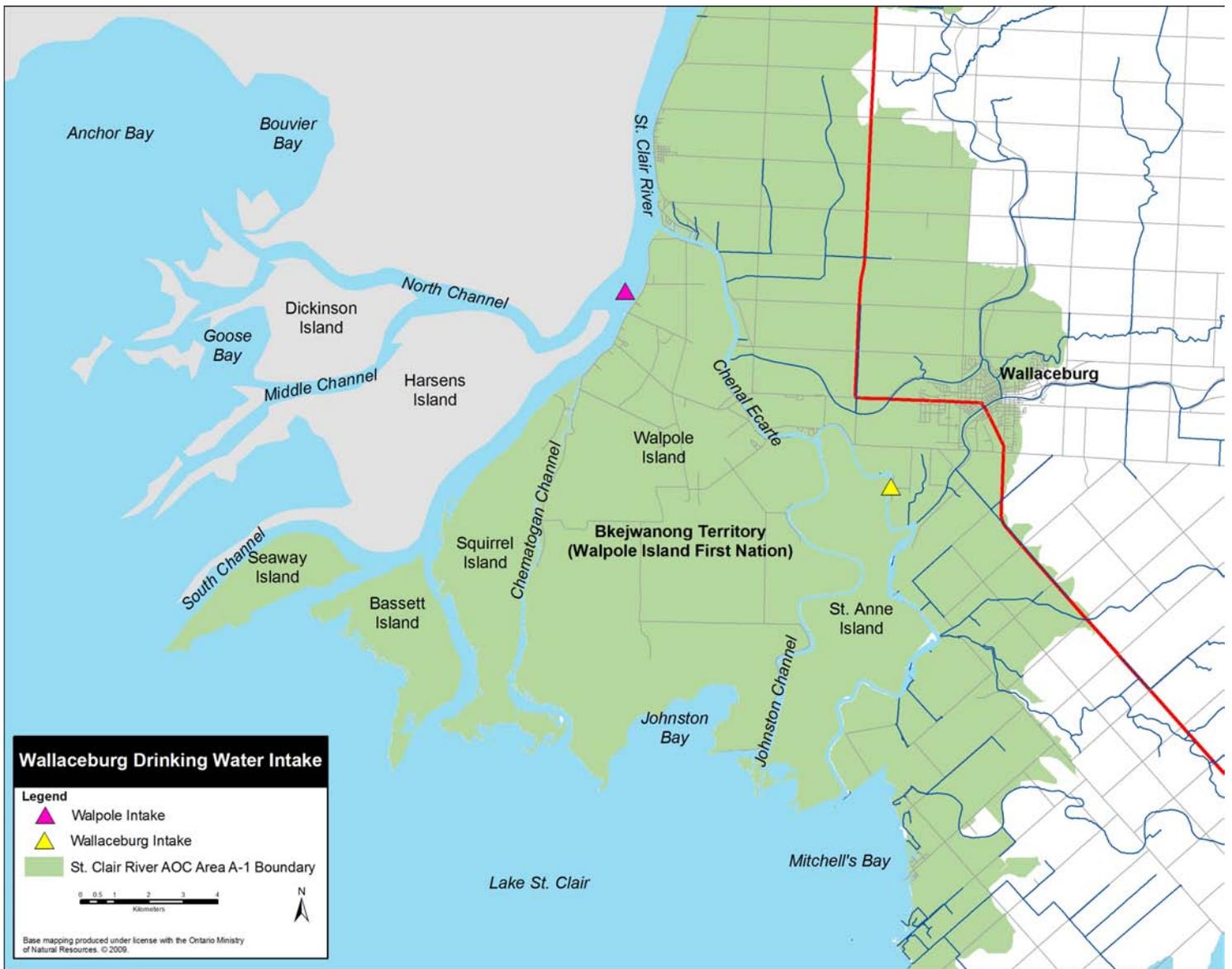
Discharges from storm sewers can be a significant source of pollutant loadings due to runoff of contaminants. Pollution sources include: nutrients and pesticides spread on lawns, sediment from construction sites, petroleum and chemical runoff from industrial areas and heavy metals, salt, oil and grease from automobiles and road maintenance. In the AOC, “combined” sewer systems were recognized as a particular problem. Originally, many of the sewer systems in the Sarnia area were “combined” meaning that, when it rained, the sewers carried both stormwater and sanitary wastes in the same pipe. In a combined system, when the carrying capacity of the sewer is exceeded, they are designed to overflow into the river causing combined sewer overflows (CSOs).

The City of Sarnia is continuing to separate the sewers or install holding tanks to contain runoff from most storm events. This was recognized as an issue in the 2003 RAP.

⁴³ Report on Spills in the Great Lakes Basin – with a special focus on the St. Clair-Detroit River Corridor, July 2006, International Joint Commission

⁴⁴ Ibid

⁴⁵ Ibid



Map 22: Wallaceburg Drinking Water Intake





City of Sarnia

The November 2006 Sierra Legal report on 20 cities in the Great Lakes basin ranked Sarnia a Grade C due to 10% of their sanitary sewage system being combined⁴⁶. Sarnia's results were similar to Toronto, Syracuse and Hamilton getting below average grades, while Detroit, Cleveland and Windsor were graded D. In 2007, the City of Sarnia obtained wastewater infrastructure funds in the amount of \$34.9 million to assist in reducing the number of combined sewer overflows during heavy rains by separating sewers. It is anticipated that the Sarnia Pollution Control Plan will result in a 56% reduction in suspended solids, 55% reduction for BOD, 26% reduction for phosphorus and 99% for faecal bacteria. Combined sewage overflows are in large part responsible for the bacterial contamination of the Sarnia waterfront and are responsible for restrictions on recreational activities such as beach closures. Pollution from the municipal sources in Sarnia may be partly responsible for the restrictions on fish consumption and degradation of the downstream benthic communities as well. Significant work has been undertaken in the last several years on sewer separations as well. The extent of work needed is formidable. Sarnia has three combined sewers totalling 22-23 kilometres in length. When separating sewers, streets need to be rebuilt and water lines reinstalled. Dependent on funding, it is estimated that sewer separation will take 15-20 years, however the priority is eliminating the three combined sewer overflows.

Township of St. Clair

Municipal Wastewater Pollution Control Sources

A water pollution study found that a group of residential homes along the St. Clair River between Courtright Line to the Lambton Generating Station had failing septic systems. By way of stormwater flow, the failing systems were draining directly to the River. In fact, the study included downstream river sampling which found that the *E. coli* count was 1,500 times the allowable limit of 100 cfu/100 mL and that the pollution was directly attributable to the failing septic systems. To eliminate this source, a new 1,480 metre long main sanitary sewer was installed as well as a pump station and forcemain. The extension of the main sanitary sewer to individual homes also took place. The main sewer was connected to the existing Courtright Sewage Treatment Plant. In recent years, this sewage treatment plant has also undergone significant upgrades.

Issues with failing septic systems were also evident in the small Village of Wilkesport. Wilkesport drains to the North Branch of the Sydenham River which eventually flows into the lower St. Clair River delta area. Gravity sanitary sewers are currently being installed for the 60 residential units. A new pumping station pumps the sewage to the existing lagoons near the Village of Sombra.

4.3 Non-point Source Pollutants and Stressors

The 1995 Stage 2 RAP identifies bacteria, sediment and nutrients as the priority non-point source pollutants impacting the water quality of the AOC. Each of these critical pollutants are further discussed in Section 4.4. Agricultural land use and soil erosion are significant sources of upland sediment and the 2007 CRIC Work Plan recognizes the need for more riparian buffers both along the St. Clair River but particularly along the tributaries in Area 1-A. Large sections of the inland tributaries have been physically modified by dredging, channel straightening and other maintenance activities to increase flows and improve conveyance. Any opportunity to restore the hydrology in headwater areas and restore and enhance unstable stream channels would reduce the delivery of sediment and other non-point pollutants to the watercourse. Urban stormwater runoff as a non-point source pollutant is discussed further in Section 6.1.3.

4.4 Sources of Critical Pollutants

4.4.1 Toxic Pollutants and Sediment

A source of toxic pollutants is effluent loadings from industrial sources. Since the 1995 Stage 2 Remedial Action Plan, industries have implemented measures that address point source toxic pollutants. Actions have included: significant upgrades to facilities, sophisticated monitoring systems, environmental management systems, installation of river separation programs and improved control over process water. Detailed loading information and status can be obtained from progress reports available on the Friends of St. Clair website⁴⁷.

⁴⁶ Sierra Legal, 2006 www.sierralegal.org

⁴⁷ www.friendsofstclair.ca



Environment Canada (EC) has been monitoring toxic chemicals in the St. Clair River - Detroit River corridor for a wide range of heavy metals and persistent organic pollutants since 1986. This is the principal information source pertaining to water quality in the corridor. Monitoring has indicated declining concentrations of several organochlorine pesticides in the surface water over time. Mercury concentrations in suspended sediment appear to be relatively constant throughout the St. Clair River but slightly higher in the South Channel. However, toxic chemicals in surficial bottom sediment are present.

Contaminated sediments are a concern in the AOC, as toxic materials may be stored in downstream sediment at the bottom of the river and may be released into the water column during periodic storm events, or by dredging. Historic toxic chemical loadings in the 1960s-1970s led to bottom sediment contamination. Figure 7 provides an overview of Mercury concentration in sediments and water and Figure 8 provides an overview of PCB concentrations in sediment and water.

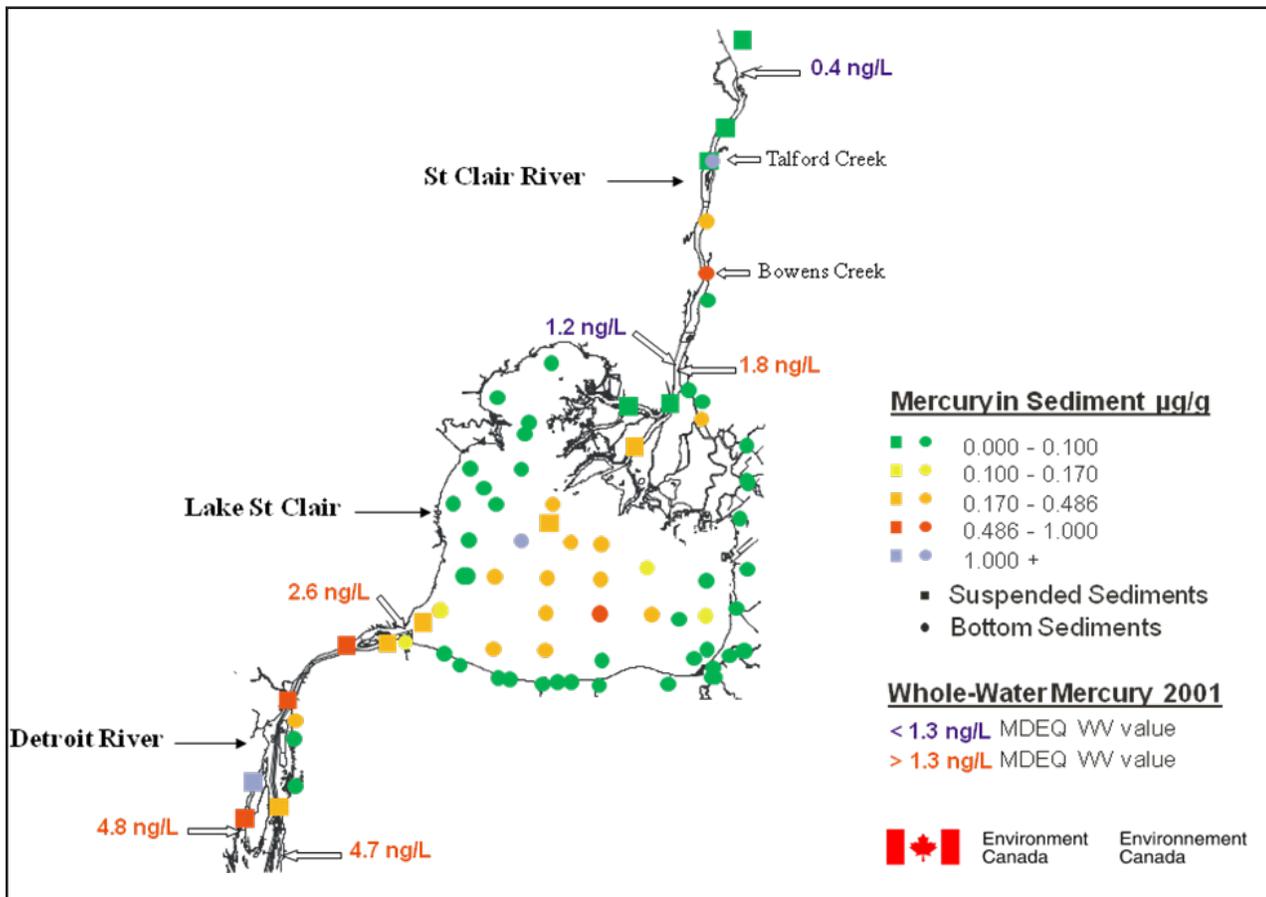


Figure 7: Mercury concentrations in sediments and water in the St. Clair River – Detroit River corridor
(Source: Environment Canada)

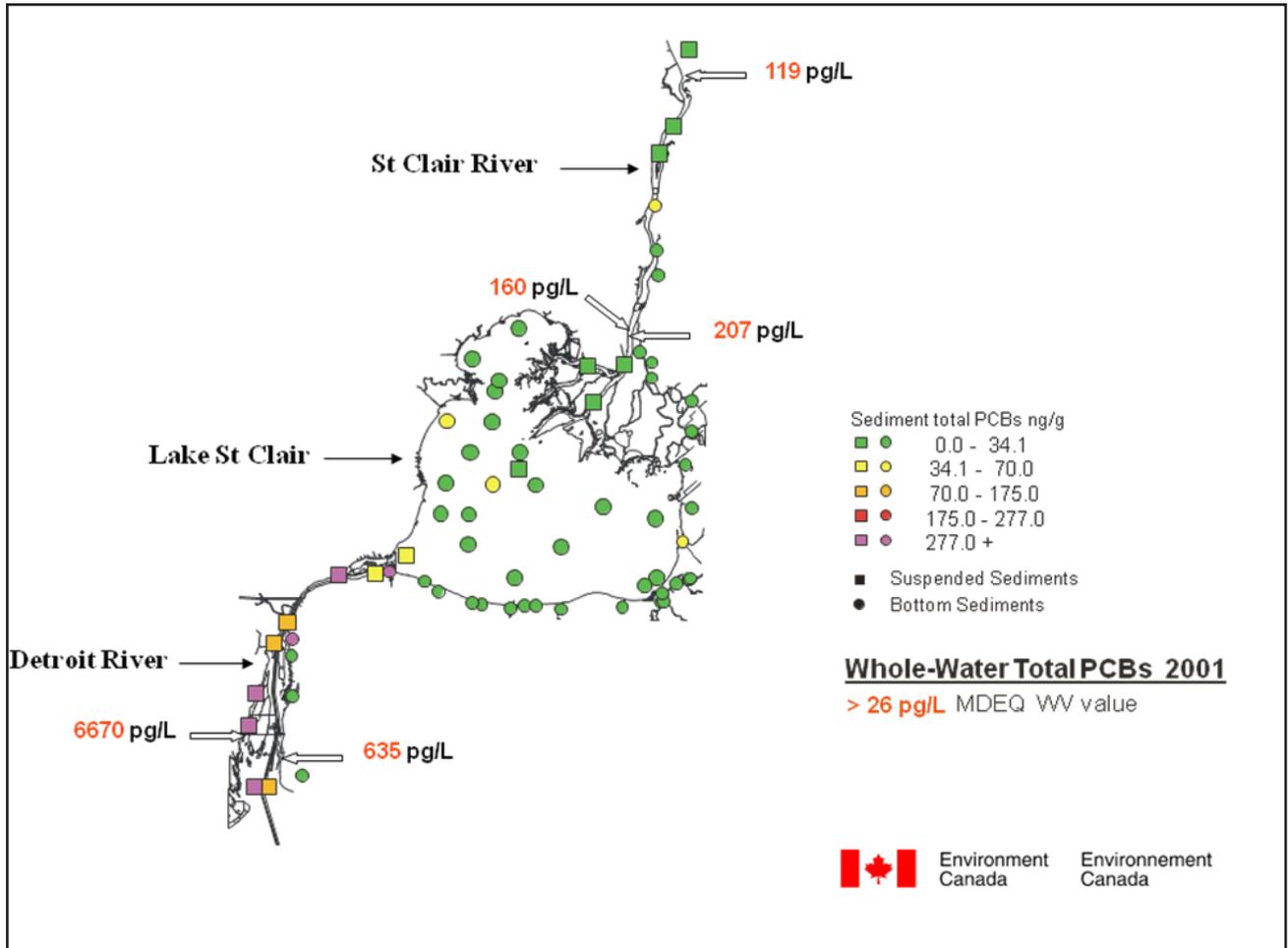


Figure 8: Total PCB concentration in sediment and whole water samples taken from the St. Clair River – Detroit River corridor
 (Source: Environment Canada)

Zones 1-3

As the above mapping indicates, a known contaminated zone offshore of the Sarnia industrial complex exists. Sediment characterization has been focused in this area.

The recent removal of contaminated bottom sediments offshore from DOW Chemical Canada Inc. (Contaminated Area Zone 1) was a major step in remediating a highly contaminated zone offshore of the Sarnia Industrial Complex. A Management Plan comprising several components is currently being undertaken for the remaining Zones 2 and 3. High levels of mercury and PCB concentrations are the toxic pollutants of concern in Zones 2 and 3.

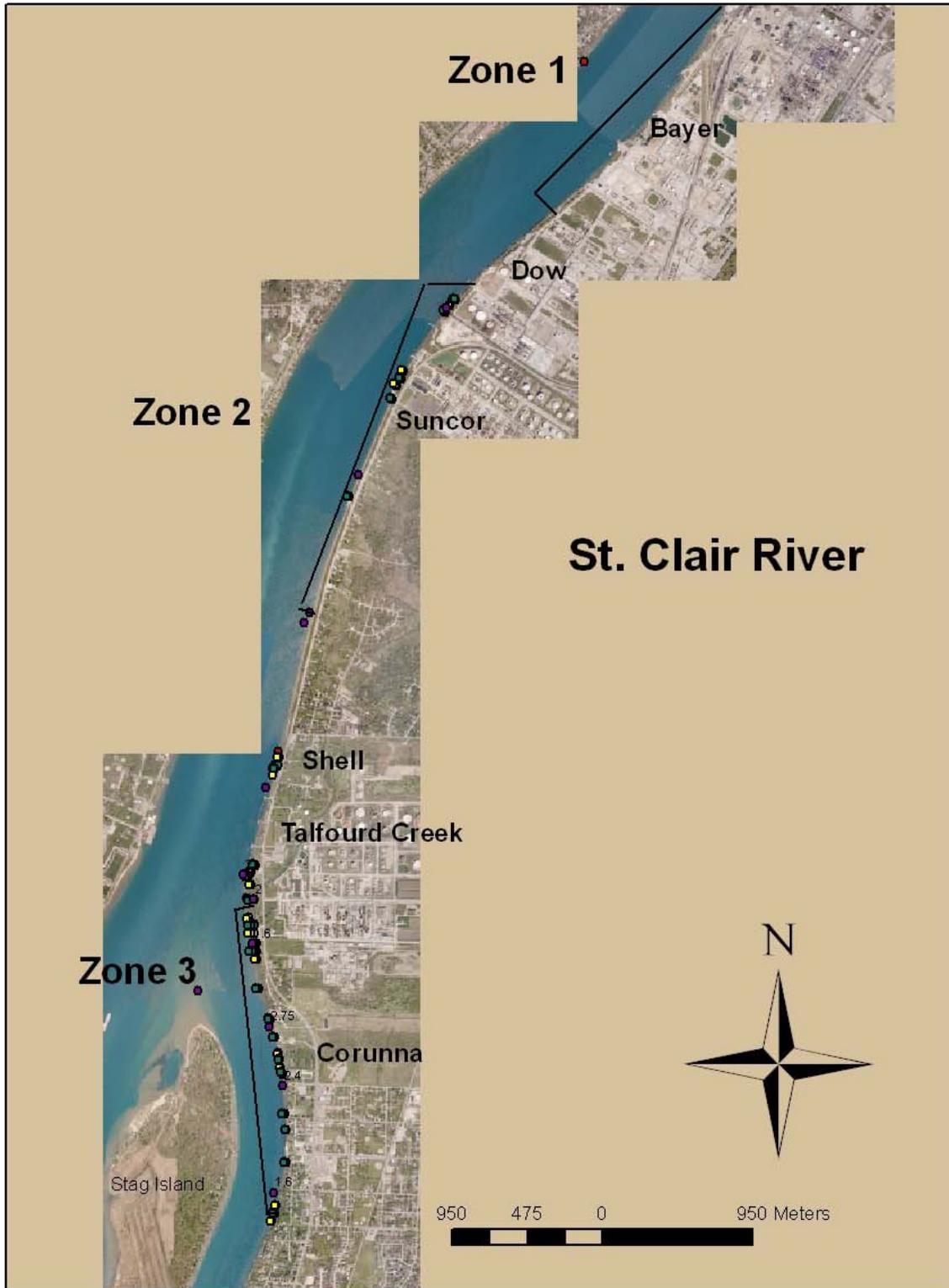


Figure 9: For Contaminated Sediment Areas Zones 1-3



Sediment samples collected indicate approximately 30% of Zone 2 had Hg concentration ranging from 2-9.30 mg/kg. The recommended clean-up target is 1 mg/kg. Octachlorostyrene concentrations exceeded the 20 ng/g target throughout 80% of Zone 2. Concentrations ranged from 3-150 ng/g. Although Hexachlorobenzene (HCB) and hexachlorobutadiene (HCBD) were present, these chemical concentrations did not exceed the target criteria. Mercury contamination in the aquatic system between Bowens and Talford Creek is a major concern and is the focus of present investigations and clean-up.

Restrictions on fish consumption in the St. Clair basin are related to the elevated mercury, total PCBs, octachlorostyrene (OCS) and hexachlorobenzene (HCB). Elevated contaminant concentrations in sediment can also have negative effects associated with fish tumours and deformities and restrictions on dredging. Recent studies have found that fish and wildlife deformities or reproductive problems are not an issue but that restrictions on dredging persist; particularly in Zones 1-3 and the St. Clair River delta area.

St. Clair River Delta Area Southeast Bend Cutoff Channel

Maintenance dredging in the Southeast Bend Cutoff Channel located in the lower Walpole Island delta is required for ship passage. In reports published by Public Works and Government Services Canada (PWGSC, 2001), dredge spoil sample contamination levels were assessed. A wide range of metals and nutrients were assessed. They include silver, arsenic, cadmium, chromium, copper, iron, mercury, manganese, nickel, lead, zinc, phosphorus, total organic carbon, total Kjeldahl nitrogen (TKN – nitrogen in the form of organic proteins or their decomposition product ammonia), oil and grease, $\text{NH}_3\text{-N}$ and CN as well as a wide range of pesticides, total PCBs and industrial compounds hexachlorobenzene (HCB) and octachlorostyrene (OCS). Samples were also analyzed for a wide range of polycyclic aromatic hydrocarbons (PAHs). The results indicate there were few exceedences of either the Ontario Sediment Quality Guidelines or the St. Clair River RAP yardsticks. The overall toxicity level of the dredged spoil was low.

More recent sediment sampling was undertaken from the four longest channels of the Walpole Delta. They were Chenal Ecarte, Johnson, Chematogen and Bassette channels. Goose Lake was also sampled. The 2005 samples indicated only two organochlorine pesticides exceeded OMOE's sediment quality objectives. These were hexachlorobenzene (HCB) and pp'-DDT. Total mercury was the most frequent inorganic contaminant observed to exceed OMOE sediment quality objectives. Almost all sites exceeded OMOE lowest effect level (LEL) values. From all investigated sites, Goose Lake samples demonstrated the lowest levels of contamination for organic contaminants and metals⁴⁸.



For comparison purposes, suspended and bottom sediment concentrations in the St. Clair River and Lake St. Clair were modest in comparison to levels in the Trenton Channel situated in the lower Detroit River.

⁴⁸ Great Lakes Institute for Environmental Research & Department Biological Sciences, University of Windsor, 2006, Revised via Environment Canada comments Aug 3, 2008.



4.4.2 Bacteria Beaches

E. coli is fecal coliform bacteria found in human and animal waste. The presence of *E. coli* is one of the key water quality indicators. The presence of *E. coli* bacteria is a strong indicator that there may be other disease-causing organisms in the watercourse. Public health units in Ontario now use a mean level of 100 *E. coli* per 100 mL of water as a guideline for determining whether recreational water is “safe” for swimming and bathing. If the guideline level is exceeded at a beach, warnings are posted and the affected beach is considered “closed” until the water quality improves. At some beaches, such warnings are posted permanently, for example, when it is not feasible to determine when the water quality impairments will no longer exist. The only official beach monitored for *E. coli* by the Health Unit in the AOC Area 1-A is Mitchell’s Bay on Lake St. Clair. Samples are taken at Centennial Beach in Sarnia Bay, however, this is for the purposes of historical analysis and the beach is permanently posted as closed. **See Map23: Health Unit and CA Bacterial Monitoring Stations.**

Figure 10 shows the percentage of the weekly samples exceeding the recreation water quality guidelines over three years (2005 – 2008). Figure 11 shows the summer average mean *E. coli* counts for each sampling site.

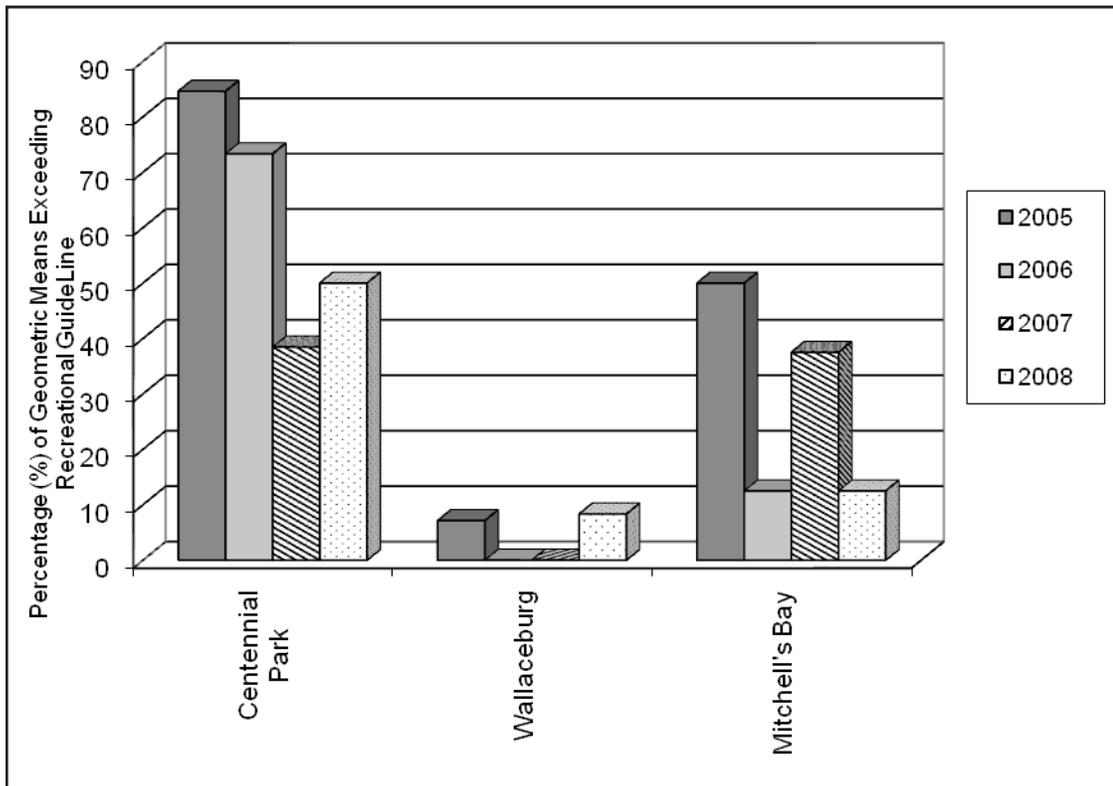


Figure 10: Bacterial monitoring results from weekly summer samples collected at AOC Area 1-A sites showing the percentage of sampling that exceeded the recreational water quality guideline for full body contact

(Source: Chatham-Kent Health Unit, Lambton County Health Unit and St. Clair Region Conservation Authority)

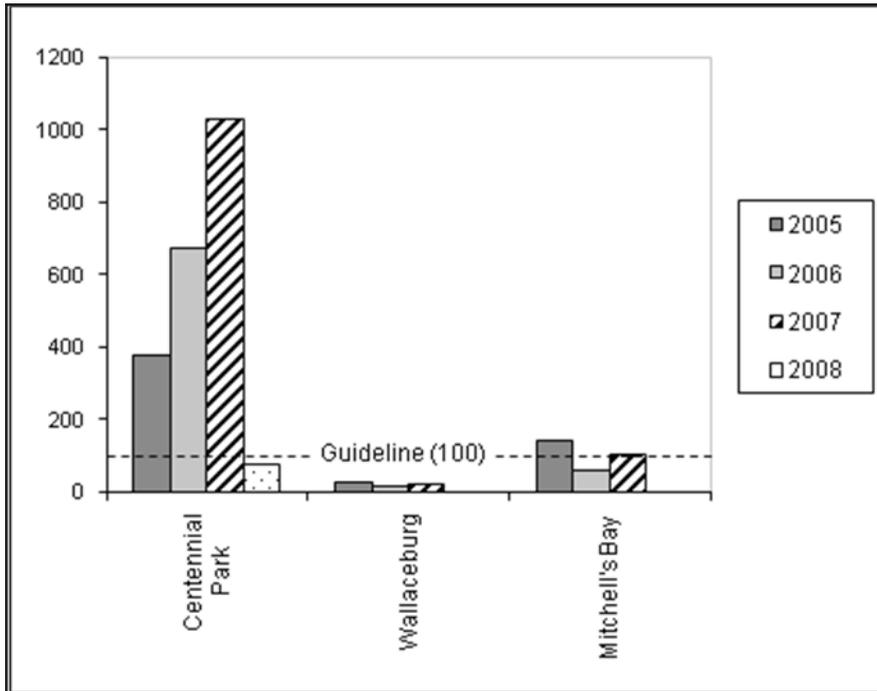


Figure 11: Summer average mean *Escherichia coli* counts for AOC Area 1-A sampling sites

(Source: Chatham-Kent Health Unit, Lambton County Health Unit and St. Clair Region Conservation Authority)

Beach postings and closures from elevated bacteria counts indicate the need to address sources of bacteria. Good water quality at Mitchell's Bay has led to this beach being open virtually most of the time in comparison to Southeast Lake Huron beaches and other Lake St. Clair beaches. Rural non-point sources of pollution such as failing septic systems, poor manure management and urban stormwater can contribute to high bacterial counts. Mitchell's Bay beach has the advantage of not being directly downstream from large outfalls including tributaries where *E. coli* counts are generally high. The location of the sites monitored by the Health Units and the SCRCA in the AOC are shown on Map 23.

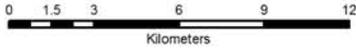
Sampling over the years has indicated there is still a recognized concern for combined sewer overflow from Sarnia on the Canadian side. Combined sewer overflows (CSOs) are a common source of sewage and can lead to excessive bacteria counts. This source of bacteria is being mitigated by the ongoing sewer separation project by the City of Sarnia.



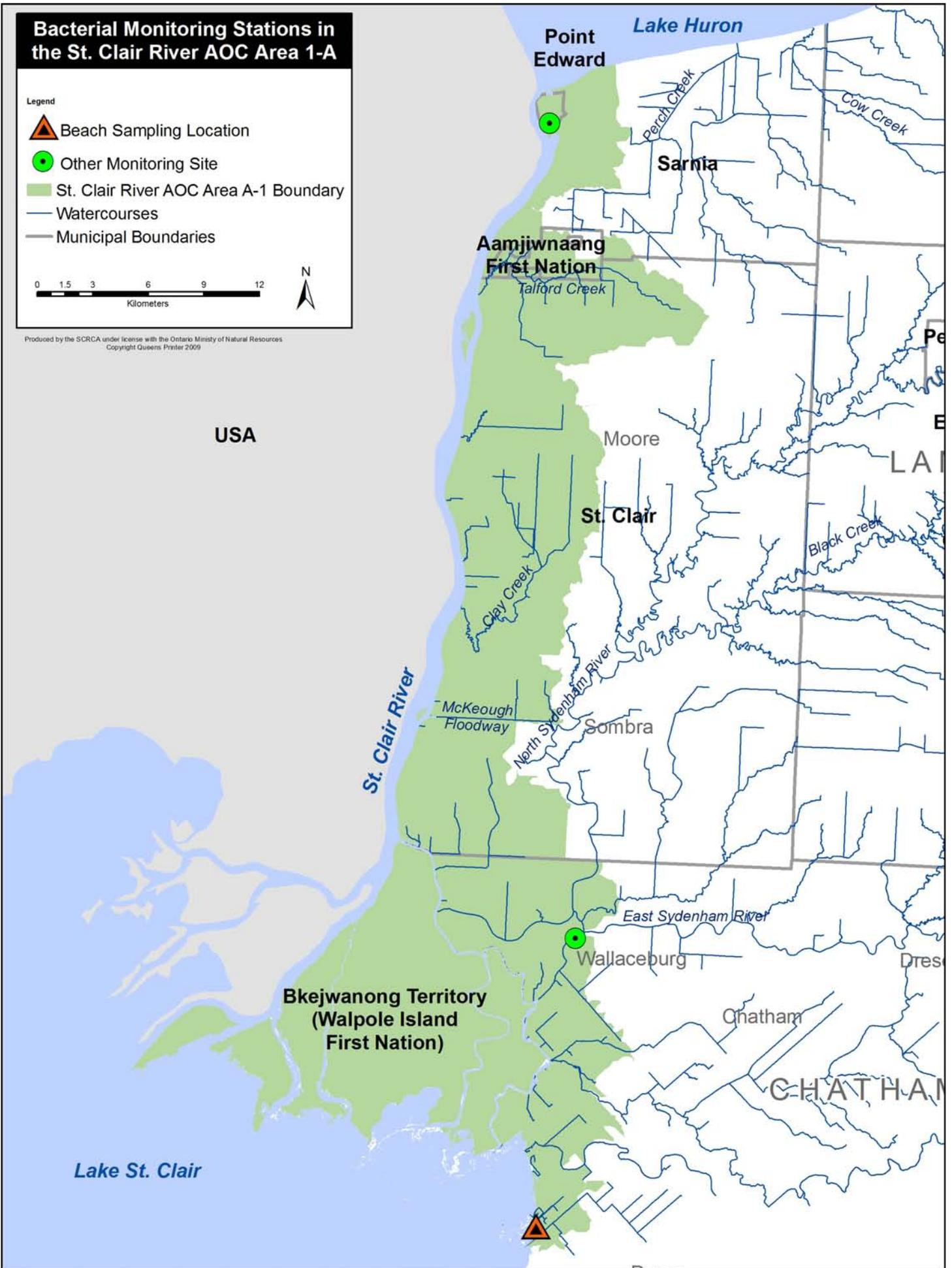
Bacterial Monitoring Stations in the St. Clair River AOC Area 1-A

Legend

-  Beach Sampling Location
-  Other Monitoring Site
-  St. Clair River AOC Area A-1 Boundary
-  Watercourses
-  Municipal Boundaries



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Non-beach Sampling

In 2008, a comprehensive *E. coli* sampling program was conducted in the St. Clair River by the U.S. Environmental Protection Agency in 2008. See Figure 12: U.S. Environmental Protection Agency 2008 bacterial monitoring stations. It included various event-based sampling periods. 11 transects were set up on the River and two sampling transects were established on the delta channels. Sites were chosen based on past combined sewer outflow problems. The results indicate that there were very few high (above guideline) *E. coli* readings on the Canadian side. In particular, in Sarnia, the 2008 sampling showed an improvement over past years' sampling programs. While the results are encouraging, it is recommended that further sampling be continued to assess water quality in the Sarnia area.

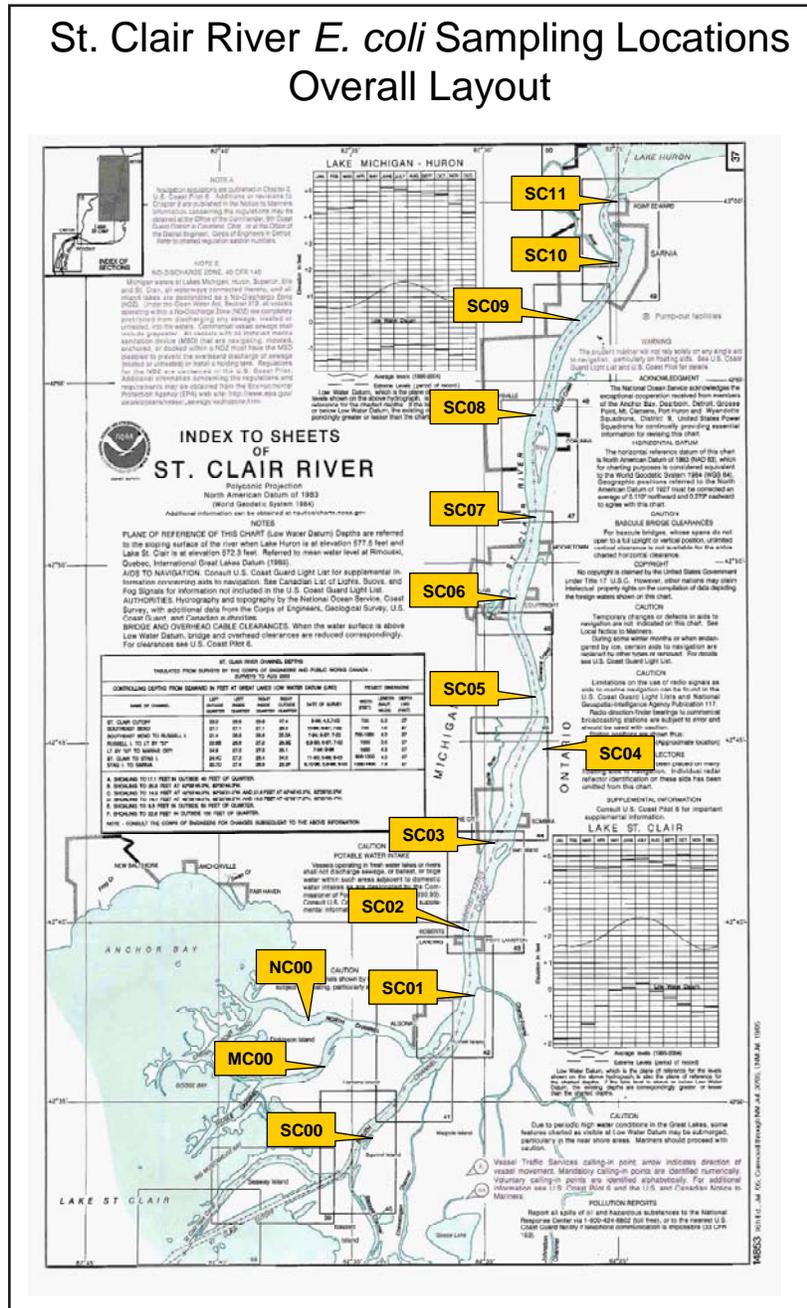


Figure 12: U.S. Environmental Protection Agency 2008 bacterial monitoring stations



Few samples from the Ontario Ministry of the Environment Provincial Water Quality Network are tested for *E. coli*. However, a monitoring site in Wallaceburg is routinely tested for bacteria. Wallaceburg is situated on the Sydenham River. One of the main tributaries of Lake St. Clair, the Sydenham River's water quality is heavily influenced from agricultural non-point sources due to its drainage basin. The test results normally exceed the acceptable recreational guideline and the area is permanently posted. During the summers of 2000 – 2008, 91% of the sampling had counts above the guidelines. The station in Wallaceburg tends to have a bacteria count lower than the other stations in the Sydenham River watershed. Dilution from St. Clair River/Chenal Ecarte backwater may be influencing the counts. When sampling began in the early 1970s, bacteria levels were extremely high (200 to over 600 counts/100 mL). During a period in the late 1980s, bacteria levels generally decreased. However, since this time, bacteria counts have increased and some stations now have levels as high or higher than 1970 levels.

4.4.3 Nutrients and Chlorides

The status of the nutrient levels in the St. Clair River and tributaries for this report were obtained from several sources. They are: Shell Manufacturing Centre raw water intake data, the SLEA monitoring station in Courtright, Environment Canada's Head and Mouth Survey program, MOE's Provincial Drinking Water Surveillance Program (PDWSP) and MOE's Provincial Water Quality Monitoring Network (PWQMN), SCRCA's monitoring program and the proposed Shell Refinery surface water field program in 2007-2008. For the purposes of this plan, nutrient levels of ammonia, nitrogen, and phosphorus are characterized for the water bodies. These parameters are selected, as they represent the nutrient indicator parameters for inland watershed management.

The Conservation Ontario February 2003 draft report "Water Sampling and Data Analysis Manual" for PWQMN partners recommends the use of these parameters to represent nutrient levels. The report also recommends obtaining chloride levels to assess salt loading⁴⁹. Phosphorus and nitrate are essential plant growth nutrients. However, an imbalance of nutrients in water bodies may result in algal growth. Excessive algal growth can lead to eutrophication, choking the water body by depleting oxygen and thereby harming aquatic life. Certain types of algae, a blue-green algae, or cyanobacteria, produce toxic substances which can be responsible for poisoning animals and humans who come in contact with it⁵⁰. High concentrations of nitrates can affect aquatic life and can cause "blue baby syndrome" (methaemoglobinaemia) in humans if high levels are present in drinking water. This syndrome is a condition in which enough oxygen cannot be released to body tissues and mostly affects infants under three months of age. Chlorides are conservative chemicals, moving with the water. Chloride can be toxic to aquatic organisms at high concentrations as well, and can affect growth and reproduction at lower concentrations.

St. Clair River

The water quality characteristics of the St. Clair River bear little similarity to the water quality characteristics of the tributaries of the River in the AOC. This is due to the significant difference in the factors which influence water quality in the large St. Clair River drainage basin and the relatively small agricultural drainage basins. These factors include physical characteristics, human uses, contaminants and institutional regimes that manage the resource. Further information on the hydrology and physical characteristics is discussed in Sections 2.1 and 2.5.

The 2005 RAP progress report notes that nutrient discharge from municipal and industrial point sources have been controlled through ongoing corrective measures. These have included upgrades to facilities, monitoring systems, environmental management systems, improved control over process water in order to improve effluent water quality, reduce or eliminate spills, and improve plant efficiency. These actions occurred mainly since the 1995 RAP Stage 2 Recommended Plan.

A review of past monitoring data indicates ammonium concentrations to be low in St. Clair River waters. At the raw water Lambton County and Walpole Island drinking water intakes, un-ionized ammonia was consistently 4.040 µg/L or lower, which is considerably less than the PWQO guidance criteria. The organic nitrogen concentration is derived by subtracting the TAN (Total Ammonia Nitrogen) concentration from the Total Kjeldahl Nitrogen (TKN) concentration. In the past, the mean organic nitrogen concentration was low at the Walpole Island plant. Similarly, nitrite and nitrate concentrations are

⁴⁹ St. Clair Region Draft Watershed Characterization Report, August 2007, Section 3.0 Water Quality

⁵⁰ http://www.hc-sc.gc.ca/ewh-semt/water-eau/drink-potab/cyanobacteria-cyanobacteries_e.html



low. The concentration of nitrates at Walpole Island at 0.410 mg/L is significantly less than the PWQO level of 2.93 mg/L⁵¹. The Walpole Island water plant provides the best St. Clair River raw water site. The Lambton County raw water site is more readily influenced by Lake Huron. The concentration of organic and inorganic nitrogen in the St. Clair River is typical of oligotrophic conditions.

Phosphorus is generally considered to be the limiting nutrient in determining water productivity. Filterable, reactive phosphorus is largely a measure of orthophosphate, Organophosphates comprise approximately 50% of the total phosphorus concentration and tend to increase from the Lambton County to Walpole Island drinking water plant locations. Total phosphorus concentrations of less than 10 µg/L are typical of oligotrophic conditions found in unproductive lakes. Total phosphorus mean value concentrations at Walpole Island from 1998 – 2002 was 19 µg/L and considerably higher than the upstream Lambton County mean value of 10 µg/L during the same sampling period. The Walpole Island phosphorus concentrations are characteristic of mesotrophic conditions.

Table 12: Descriptive statistics of monitoring data of nutrients collected at Lambton DWTP, Walpole DWTP, Port Lambton and the SMC water intake point

Parameter	Unit	Guidance Criteria	Lambton DWTP		Walpole DWTP		Port Lambton	SMC Intake
			1998-2002	1993-1995	1998-2002	1993-1995	1987-2005	2006-2007
Ammonium, total, unfiltered	mg/L							
Minimum			0.004	<dl	0.004	<dl	0.002	--
Maximum			0.026	0.038	0.032	0.116	0.092	--
Mean			0.010	na	0.010	0.019	0.017	--
75 th percentile			0.010	--	0.010	--	0.021	--
Ammonium+Ammonia as N	mg/L							
Minimum			--	--	--	--	--	0.000
Maximum			--	--	--	--	--	0.240
Mean			--	--	--	--	--	0.056
75 th percentile			--	--	--	--	--	0.070
Ammonia, un-ionized (derived)	µg/L							
Minimum			0.000	--	0.082	--	0.454 ^b	0.000 ^c
Maximum			0.852	--	1.108	--	2.399	1.040
Mean			0.280	--	0.390	--	0.520	0.943
75 th percentile			0.500	--	0.510	--	0.756	1.175
Nitrite	mg/L	--						
Minimum			0.002	<dl	0.002	<dl	--	--
Maximum			0.006	0.006	0.010	0.012	--	--

⁵¹ Jacques Whitford-AXYS, Proposed Shell Refinery Project, Surface Water Baseline Report, April 2008



Parameter	Unit	Guidance Criteria	Lambton DWTP		Walpole DWTP		Port Lambton	SMC Intake
			1998-2002	1993-1995	1998-2002	1993-1995	1987-2005	2006-2007
Mean			0.000	0.003	0.010	0.005	--	--
75 th percentile			0.000	--	0.010	--	--	--
Nitrate	mg/L	--						
Minimum			0.090	0.300	0.268	0.300	--	--
Maximum			0.759	0.405	0.515	0.405	--	--
Mean			0.340	0.342	0.360	0.338	--	--
75 th percentile			0.360	--	0.410	--	--	--
Total Kjeldahl Nitrogen	mg/L	--						
Minimum			0.120	0.120	0.120	0.120	0.052	--
Maximum			0.440	0.280	0.760	0.240	0.399	--
Mean			0.170	0.175	0.210	0.171	0.148	--
75 th percentile			0.160	--	0.200	--	0.161	--
Phosphorus, total filterable, reactive	mg/L	--						
Minimum			0.001	<dl	0.001	<dl	--	--
Maximum			0.010	0.006	0.085	0.003	--	--
Mean			0.003	0.001	0.011	0.001	--	--
75 th percentile			0.002	--	0.003	--	--	--
Total phosphorus	mg/L	0.03 (PWQO)						
Minimum			0.003	<dl	0.002	0.004	0.000	--
Maximum			0.032	0.024	0.160	0.014	0.122	--
Mean			0.007	0.007	0.019	0.007	0.010	--
75 th percentile			0.007	--	0.012	--	0.010	--

Note:

1. Data Sources:

Lambton DWTP	1993-1995 (mean, minimum and maximum), based on 14 samples. 1998-2005, quarterly monitoring data, 15 samples in total.
Walpole Island DWTP	1993-1995 (mean, minimum and maximum), based on 14 samples. 1998-2002, quarterly monitoring data, total 18 samples.
Port Lambton (ON02GG0005)	1987-2005 Head and Mouth Survey, EC.
SLEA	SLEA Courtright continuous monitoring station 1990-2005.
SMC Intake	Based on SMC intake water monitoring data from January 2006 to January 2007.

2. Guidance Criteria:

PWQO	Provincial Water Quality Objectives (Appendix A, February 1999).
CCME	Canadian Water Quality Guideline for the Protection of Aquatic Life (update 6.0 July 2006).
Yardstick	Draft environmental water quality "yardsticks" for the RAP, November 22, 1993.

Note a: (un-ionized ammonia): this value is calculated with temperature of 15°C. The percentages of un-ionized ammonia in aqueous ammonia solution are temperature and pH dependent. For example: un-ionized ammonia is 0.190 for 10°C and pH 7.0.

Note b: un-ionized ammonia at Port Lambton is calculated by using mean pH value of 7.98, and temperature of 15°C.

Note c: un-ionized ammonia at SMC Intake is calculated by using mean pH value of 7.79, and temperature of 15°C.



Tributaries

The most recent sampling and analysis on the tributaries occurred as a result of the proposed Shell Refinery project. The project involved examining the surface water quality of Talford and Clay Creek in the summer of 2007. St. Clair Region Conservation Authority sampling from 2004 – 2005 is also referred to. These watercourses are representative of the majority of the small inland tributaries. The Sydenham River will be discussed separately.

As discussed previously, land uses in the Talford Creek subwatershed consist of a larger proportion of industrial in comparison to the southerly drainage basins. Historic contamination has occurred in Talford and industries discharge treated industrial wastewater and stormwater to Talford Creek. All tributary water sampling mean concentrations were greater than the St. Clair River for all parameters. For turbidity, chloride and sodium, concentrations were 10 to 12 times greater in Talford Creek than measured in the St. Clair River. The mean pH value in Talford Creek was 8.3 compared to 8.0 in the St. Clair River. Total phosphorus samples collected had concentrations above the PWQO. Concentrations of TKN and total phosphorus ranged from four to five times the concentrations measured in the St. Clair River. Total phosphorus concentrations in Talford Creek are indicative of eutrophic conditions, making the creek susceptible to algal blooms, hypoxia and other toxicological effects⁵².

Clay Creek flows through a large agricultural area with very little industrial land use and runoff. Several large agricultural drains outlet into Clay Creek. Again, as evident in Talford Creek, all total phosphorus sample concentrations were above the PWQO. The mean concentration of TKN and total phosphorus was five and ten times the concentrations measured in the St. Clair River, respectively. Concentrations of nutrients measured in Clay Creek were consistently higher in mean concentration than those measured in Talford Creek. The reasoning behind this may be associated with the background concentrations in watershed soils and agricultural uses. Agricultural use was more prevalent in the Clay Creek subwatershed and it was proposed by Shell's consultant that the use of chemical crop fertilization may account for the higher nutrient concentrations in comparison to Talford Creek⁵³.

Table 13: Talford and Clay Creek Monitoring Data - Nutrients

Parameter	Unit	Guidance Criteria	Arithmetic Mean	75 th Percentile	Min. Value	Max. Value
Talford Creek						
Ammonium+Ammonia	mg/L	--	0.029	0.038	0.003	0.088
Un-ionized Ammonia	µg/L	20 ¹ (PWQO)	1.540	2.610	0.110	7.42
TKN	mg/L	--	0.798	0.910	0.220	1.47
Total phosphorus	mg/L	0.03 ² (PWQO)	0.074	0.082	0.025	0.213
Clay Creek						
Ammonium+Ammonia	mg/L	--	0.037	--	0.014	0.104
Un-ionized Ammonia	µg/L	20 ¹ (PWQO)	2.020	--	0.760	5.67
TKN	mg/L	--	1.290	--	0.990	1.86
Total phosphorus	mg/L	0.03 ² (PWQO)	0.126	--	0.054	0.245

Note:

- Un-ionized ammonia is calculated with temperature of 15°C and pH 8.3. The percentages of un-ionized ammonia in aqueous ammonia solution are temperature and pH dependent.
- Excessive plant growth in rivers and streams should be eliminated at a total phosphorus concentration below 30 µg/L. To avoid nuisance concentrations of algae in lakes, average total phosphorus concentrations for the ice-free period should not exceed 20 µg/L. A high level of protection against aesthetic deterioration would be provided by a total phosphorus concentration for the ice-free period of 10 µg/L or less. This should apply to all lakes naturally below this value.

Guidance Criteria:

PWQO Provincial Water Quality Objectives (Appendix A, February 1999).

CWQG CCME Canadian Water Quality Guideline for the Protection of Aquatic Life (update 6.0, July 2006).

Yardstick Draft environmental water quality "yardsticks" for the RAP, November 22, 1993.

⁵² ibid

⁵³ ibid



Sydenham River

The Sydenham River watershed above Wallaceburg is not included in the AOC 1-A area. Remedial works are concentrating on the immediate impact zone of the AOC and therefore a boundary was drawn at Wallaceburg. Although the boundary is drawn at Wallaceburg, it is important to note that the largest source of non-point pollution to the AOC Area 1-A is the Sydenham River. With a watershed area of 2,752 km², Sydenham River waters are enriched by nutrients and turbid. Total phosphorus concentrations typically range from 30 µg/L to 200 µg/L⁵⁴. The Ministry of the Environment Interim Provincial Water Quality Objective of 30 µg/L was set as the limit in preventing the nuisance growth of algae. The highest levels of phosphorus are on the North Branch of the Sydenham River. Levels are six to eight times the PWQO guideline, whereas East Branch levels are less than three times the PWQO⁵⁵.

Surface water quality monitoring on the Sydenham River was initiated in the early 1960s. Conditions have changed over time, with some improvement and some degradation. Methods of analysis have also changed over time. Throughout the last 40 years, the levels of nitrate appear to be rising⁵⁶. At some stations on the North Branch of the Sydenham River, there has been a fivefold increase as well as the steepest increase over the last 30 years. Nutrient levels on the East Branch are generally lower than the North Branch. While chloride levels in the North Branch were once extremely high, levels on both branches are now relatively the same as when compared to historic differences. Over the past 40 years, chloride levels at all sites have increased but are still below the Environment Canada guideline of 210 mg/L. Highest loadings of chloride are typically associated with the application and storage of road salt (e.g. calcium chloride). Urban areas tend to have the highest chloride concentrations.

More detailed nutrient readings from St. Clair Region Conservation Water Quality Monitoring stations throughout the Sydenham Watershed can be found in the 2007 St. Clair Region Draft Watershed Characterization Report: Section 3.0- Water Quality, and the 2008 SCRCA Watershed Report Card background report. Fourteen (14) Report cards have been produced, nine (9) of which are broken down on the Sydenham watershed itself. The remaining five (5) watersheds outlet to either Lake Huron, St. Clair River or Lake St. Clair.

Tributary Sediments

Sediment quality in the St. Clair River is a significant concern in the AOC and is discussed in Section 4.4.1. Sediment sampling on the inland tributaries is not part of a regular monitoring program, however, sporadic sampling has been undertaken in several tributaries of the St. Clair River in conjunction with Canadian and international comprehensive sediment sampling programs. This type of sampling extends as far back as 1957. More recent sediment sampling in Talford Creek, Bowens and Clay Creek have found that, as in most watercourses, sediment quality presented concentrations above guidance criteria for phosphorus, Total Kjeldahl Nitrogen (TKN), total organic carbon (TOC) and a number of metals. However, surficial sediment quality at the mouths of the creeks entering the St. Clair River were most degraded, with Talford Creek mouth samples degraded to the point of affecting organism growth and survival. Based on a review of sediment transport, sediment exceedences noted at the mouths of the creeks are not necessarily due to local sources from the individual watersheds. Due to the alluvial conditions at the mouths of these creeks, sediment quality is an aggregate representation of sediment from both the watershed and the St. Clair River source⁵⁷. The sediment transport and deposition at the creek mouths are part of a dynamic alluvial system.

⁵⁴ Jacques Whitford Environment Ltd 2001, Sydenham River Recovery Plan.

⁵⁵ St. Clair Region Draft Watershed Characterization Report, August 2007, Section 3.0 Water Quality

⁵⁶ St. Clair Region Conservation Authority Watershed Description Report, April 2007

⁵⁷ Jacques Whitford-AXYS, Proposed Shell Refinery Project, Surface Water Baseline Report, April 2008



5

Chapter 5

Priority Areas/Sites and Alternative Actions

The Priority Sites and Alternative Actions build upon recommendations previously adopted by various committees working on the St. Clair River RAP. Based on additional data since the 2007 CRIC Work Plan, priorities and actions have been revised and adapted. Tables under Section 5.2 include Priority Actions tracking and Priority Actions listed by subwatershed. It is recommended that these tables be built upon as the various Committees continue to meet. For example, data gaps and constraints can be identified on these tables for future reference and are important in organizing remedial works and action plans.

5.1 Works Completed to Date

The following table lists the stewardship projects completed as of 2008. It comprises the best available inventory information from Rural Lambton Stewardship Network, St. Clair Region Conservation Authority and Ducks Unlimited. The projects are georeferenced and mapped accordingly on Map 24.



Table 14: Works Completed to Date

Agency	Geo Twp	Lot	Con	Project Year	UTM X Coordinate	UTM Y Coordinate	Project Name
SCRCA	Sarnia	2	10	1980	381082	4727768	SCRCA Tree Planting
SCRCA	Dover	2 and 3	18	1983	384453	4712308	SCRCA Tree Planting
SCRCA	Dover	24	17	1983	386360	4712887	SCRCA Tree Planting
SCRCA	Sombra	1	8	1984	380224	4725736	SCRCA Tree Planting
SCRCA	Sombra	9	12	1985	384962	4730615	SCRCA Tree Planting
SCRCA	Moore	25	6	1985	384422	4742865	SCRCA Tree Planting
SCRCA	Moore	E 19	6	1986	387545	4743102	SCRCA Tree Planting
SCRCA	Dover	42	16	1986	386124	4711017	SCRCA Tree Planting
SCRCA	Dover	17 & 18	14 & 15	1986	386066	4707496	SCRCA Tree Planting
SCRCA	Dover	PL 208 Lo	BDF	1986	383142	4714723	SCRCA Tree Planting
SCRCA	Sombra	1	10	1986	380261	4728443	SCRCA Tree Planting
SCRCA	Sombra	1	10	1986	380261	4728443	SCRCA Tree Planting
SCRCA	Dover	26	11	1987	383572	4749733	SCRCA Tree Planting
SCRCA	Chatham	9	2	1987	384606	4717707	SCRCA Tree Planting
SCRCA	Sombra	5	8 & 9	1987	382592	4726950	SCRCA Tree Planting
SCRCA	Moore	52	Front	1987	381627	4747523	SCRCA Tree Planting
SCRCA	Moore	51 & 52	Front	1987	381619	4747297	SCRCA Tree Planting
SCRCA	Dover	13	13	1988	385131	4704068	SCRCA Tree Planting
SCRCA	Moore	52	Front	1988	381627	4747523	SCRCA Tree Planting
SCRCA	Sombra	A	6	1988	379305	4722945	SCRCA Tree Planting
SCRCA	Sombra	6	12	1988	383379	4731013	SCRCA Tree Planting
SCRCA	Sombra	1	10	1988	380261	4728443	SCRCA Tree Planting
SCRCA	Sombra	B	11	1989	379101	4729553	SCRCA Tree Planting
SCRCA	Sombra	6	12	1989	383379	4731013	SCRCA Tree Planting
SCRCA	Sombra	1	10	1989	380261	4728443	SCRCA Tree Planting
SCRCA	Sombra	1	10	1989	380261	4728443	SCRCA Tree Planting
SCRCA	Sombra	3	12	1990	381542	4731086	SCRCA Tree Planting
SCRCA	Moore	25/6	1/15	1990	383596	4736496	SCRCA Tree Planting
SCRCA	Sombra	25,6	1,15	1990	382907	4734890	SCRCA Tree Planting
SCRCA	Moore	25, 6	1,15	1990	383680	4735880	SCRCA Tree Planting
SCRCA	Sarnia	Var	Var	1990	385611	4759631	SCRCA Tree Planting
SCRCA	Dover	8, 9	11	1990	384505	4700141	SCRCA Tree Planting
SCRCA	Sombra	A & B	13	1991	379736	4732613	SCRCA Tree Planting
SCRCA	Sombra	7,8	10	1991	383918	4728352	SCRCA Tree Planting
SCRCA	Sombra	25,6	1,15	1991	382907	4734890	SCRCA Tree Planting
SCRCA	Caradoc	13	8	1991	385304	4733102	SCRCA Tree Planting
SCRCA	Sarnia	Var	Var	1991	385611	4759631	SCRCA Tree Planting
SCRCA	Sombra	A,B	10	1992	379659	4728387	SCRCA Tree Planting
SCRCA	Sarnia	Var	Var	1992	385611	4759631	SCRCA Tree Planting
SCRCA	Camden	Var	Var	1992	385983	4716996	SCRCA Tree Planting
SCRCA	Moore	22, 23, 2	6	1993	385720	4743139	SCRCA Tree Planting
SCRCA	Moore	21	7	1993	386385	4744286	SCRCA Tree Planting

Project Details	Ownership	BUIs Potentially Impacted	Trees Planted
Block/She	Private - Individual		700
Shelterbelt	Private - Individual		6750
Shelterbelt	Private - Individual		700
Shelterbelt	Private - Individual		500
Block/She	Private - Individual		1600
Shelterbelt	Municipal		650
Shelterbelt	Private - Individual		550
Shelterbelt	Private - Individual		750
Shelterbelt	Private - Individual		750
Shelterbelt	Private - Individual		1200
Block	Conservation Authority		1350
Block	Conservation Authority		1800
Shelterbelt	Private - Individual		1150
Shelterbelt	Private - Individual		600
Shelterbelt	Private - Individual		3050
Block/She	Private - Individual		500
Block/She	Private - Individual		1950
Shelterbelt	Private - Individual		900
Shelterbelt	Private - Individual		2250
Shelterbelt	Private - Individual		600
Shelterbelt	Private - Individual		550
Block	Conservation Authority		3650
Shelterbelt	Private - Individual		450
Shelterbelt	Private - Individual		500
Block	Conservation Authority		9989
Block	Conservation Authority		3350
Shelterbelt	Private - Individual		650
Block	Private - Individual		2750
Shelterbelt	Private - Individual		2500
Shelterbelt	Private - Individual		2750
	Other		233
Shelterbelt	Private - Individual		632
Shelterbelt	Private - Individual		1050
Block	Conservation Authority		20450
Shelterbelt	Private - Individual		1000
Block	Municipal		500
	Other		225
Block	Conservation Authority		2500
	Other		259
	Other		89
Shelterbelt	Private - Individual		1450
Shelterbelt	Private - Individual		500

Agency	Geo Twp	Lot	Con	Project Year	UTM X Coordinate	UTM Y Coordinate	Project Name
SCRCA	Sombra	A & B	13	1993	380055	4732631	SCRCA Tree Planting
SCRCA	Sombra	5	15	1993	382907	4734890	SCRCA Tree Planting
SCRCA	Sombra	A,B	10	1993	379659	4728387	SCRCA Tree Planting
SCRCA	Sombra	7,8	10	1993	383918	4728352	SCRCA Tree Planting
SCRCA	Sarnia	Var	Var	1993	385611	4759631	SCRCA Tree Planting
SCRCA	Camden	Var	Var	1993	385983	4716996	SCRCA Tree Planting
SCRCA	Sombra	7,8	10	1993	383918	4728352	SCRCA Tree Planting
SCRCA	Sombra	9	14	1994	385304	4733102	SCRCA Tree Planting
SCRCA	Sarnia	Var	Var	1994	385611	4759631	SCRCA Tree Planting
SCRCA	Camden	Var	Var	1994	385983	4716996	SCRCA Tree Planting
SCRCA	Sombra	1	10	1994	380198	4728262	SCRCA Tree Planting
SCRCA	Sombra	5	15	1995	382907	4734890	SCRCA Tree Planting
SCRCA	Sombra	1	10	1995	380261	4728443	SCRCA Tree Planting
SCRCA	Sombra	1	10	1995	380261	4728443	SCRCA Tree Planting
SCRCA	Sombra	1	10	1995	380198	4728262	SCRCA Tree Planting
SCRCA	Sombra	1	10	1995	380261	4728443	SCRCA Tree Planting
SCRCA	Sarnia	Var	Var	1995	385611	4759631	SCRCA Tree Planting
SCRCA	Camden	Var	Var	1995	385983	4716996	SCRCA Tree Planting
SCRCA	Sombra	11	8	1996	380687	4725723	SCRCA Tree Planting
SCRCA	Dover	16	15	1996	384305	4707764	SCRCA Tree Planting
SCRCA	Sombra	1	10	1996	380261	4728443	SCRCA Tree Planting
SCRCA	Sarnia	Var	Var	1996	385611	4759631	SCRCA Tree Planting
SCRCA	Camden	Var	Var	1996	385983	4716996	SCRCA Tree Planting
SCRCA	Moore	12,13	Front	1997	380647	4738489	SCRCA Tree Planting
SCRCA	Moore	28	3	1997	381880	4739081	SCRCA Tree Planting
SCRCA	Sombra	1	10	1997	380261	4728443	SCRCA Tree Planting
SCRCA	Sombra	B	10	1997	379005	4728386	SCRCA Tree Planting
SCRCA	Moore	43	Front	1997	381312	4745494	SCRCA Tree Planting
SCRCA	Moore	28	8	1997	382352	4745675	SCRCA Tree Planting
SCRCA	Moore	22	7	1997	385732	4744274	SCRCA Tree Planting
SCRCA	Moore	E 23	7	1997	385200	4744262	SCRCA Tree Planting
SCRCA	Moore	23	7	1997	384950	4744298	SCRCA Tree Planting
SCRCA	Moore	24	7	1997	384587	4744540	SCRCA Tree Planting
SCRCA	Moore	24	7	1997	384587	4744540	SCRCA Tree Planting
SCRCA	Moore	45	Front	1997	385732	4744274	SCRCA Tree Planting
SCRCA	Moore	26	8	1997	383403	4745699	SCRCA Tree Planting
SCRCA	Moore	25	7	1997	383959	4744515	SCRCA Tree Planting
SCRCA	Sombra	24	7	1997	384587	4744540	SCRCA Tree Planting
SCRCA	Sarnia	Var	Var	1997	385611	4759631	SCRCA Tree Planting
SCRCA	Camden	Var	Var	1997	385983	4716996	SCRCA Tree Planting
SCRCA	Moore	25	4	1998	384104	4747281	SCRCA Tree Planting
SCRCA	Sombra	1	10	1998	380261	4728443	SCRCA Tree Planting
SCRCA	Sombra	C	10	1998	380261	4728443	SCRCA Tree Planting
SCRCA	Sombra	1	10	1998	380261	4728443	SCRCA Tree Planting
SCRCA	Moore	5	4	1998	384104	4747281	SCRCA Tree Planting

Project Details	Ownership	BUIs Potentially Impacted	Trees Planted
Shelterbelt	Private - Individual		600
Block	Private - Individual		6300
Block	Conservation Authority		8200
Block	Conservation Authority		9500
	Other		199
	Other		93
Block	Conservation Authority		8200
Shelterbelt	Private - Individual		600
	Other		237
	Other		97
Block	Conservation Authority		5150
Block	Private - Individual		1550
Block	Conservation Authority		400
Block	Conservation Authority		1050
Block	Conservation Authority		200
Block	Conservation Authority		14000
	Other		241
	Other		118
Block	Private - Individual		750
Shelterbelt	Private - Individual		900
Shelterbelt	Conservation Authority		2500
	Other		263
	Other		79
Block	Private - Individual		11700
Shelterbelt	Private - Individual		550
Block	Conservation Authority		12450
Block	Municipal		3500
Block	Private - Individual		900
Block	Private - Individual		1110
Block	Private - Individual		750
Block	Private - Individual		550
Shelterbelt	Private - Individual		605
Block	Private - Individual		955
Shelterbelt	Private - Individual		225
Block	Private - Individual		900
Block	Private - Individual		460
Block	Private - Individual		325
Shelterbelt	Provincial		150
	Other		240
	Other		85
Shelterbelt	Private - Individual		780
Block	Conservation Authority		9350
Block	Conservation Authority		1650
Block	Conservation Authority		1030
Shelterbelt	Private - Individual		1400

Agency	Geo Twp	Lot	Con	Project Year	UTM X Coordinate	UTM Y Coordinate	Project Name
SCRCA	Var	Var	Var	1998	385611	4759631	SCRCA Tree Planting
SCRCA	Camden	Var	Var	1998	385983	4716996	SCRCA Tree Planting
SCRCA	Moore	5	4	1998	384104	4747281	SCRCA Tree Planting
SCRCA	Sombra	D	9	1999	377750	4727064	SCRCA Tree Planting
SCRCA	Moore	25	12	1999	385000	4751868	SCRCA Tree Planting
SCRCA	Moore	25	9	1999	384104	4747281	SCRCA Tree Planting
SCRCA	Sombra	6	15	1999	383560	4735458	SCRCA Tree Planting
SCRCA	Moore	27	6	1999	382678	4743139	SCRCA Tree Planting
SCRCA	Moore	W1/2 22	7	1999	385732	4744274	SCRCA Tree Planting
SCRCA	Moore	E 23	7	1999	385200	4744262	SCRCA Tree Planting
SCRCA	Moore	E1/2 W1/2	7	1999	384950	4744298	SCRCA Tree Planting
SCRCA	Moore	24	7	1999	384587	4744540	SCRCA Tree Planting
SCRCA	Moore	28	8	1999	382352	4745675	SCRCA Tree Planting
SCRCA	Moore	24	7	1999	384587	4744540	SCRCA Tree Planting
SCRCA	Moore	34,35	Front	1999	380002	4743405	SCRCA Tree Planting
SCRCA	Moore	13	12	1999	391540	4750963	SCRCA Tree Planting
SCRCA	Moore	5	4	1999	382283	4720478	SCRCA Tree Planting
SCRCA	Var	Var	Var	1999	385611	4759631	SCRCA Tree Planting
SCRCA	Camden	Var	Var	1999	385983	4716996	SCRCA Tree Planting
SCRCA	Sombra	6	15	2000	383560	4735458	SCRCA Tree Planting
SCRCA	Sombra	A&B	13	2000	380055	4732631	SCRCA Tree Planting
SCRCA	Sombra	2	7	2000	380681	4724240	SCRCA Tree Planting
SCRCA	Walpole Island			2000	381919	4710169	SCRCA Tree Planting
SCRCA	Var	Var	Var	2000	385611	4759631	SCRCA Tree Planting
SCRCA	Camden	Var	Var	2000	385983	4716996	SCRCA Tree Planting
SCRCA	Camden	Var	Var	2000	385983	4716996	SCRCA Tree Planting
SCRCA	Moore	21	7	2001	386385	4744286	SCRCA Tree Planting
SCRCA	Moore	20	6	2001	386977	4743115	SCRCA Tree Planting
SCRCA	Sombra	C	5	2001	378072	4721676	SCRCA Tree Planting
SCRCA	Moore	28	6	2001	382049	4743127	SCRCA Tree Planting
SCRCA	Moore	25	6	2001	380442	4743771	SCRCA Tree Planting
SCRCA	Sombra	4	6	2001	381789	4722859	SCRCA Tree Planting
SCRCA	Sombra	3	7	2001	381253	4724253	SCRCA Tree Planting
SCRCA	Moore	10&11	Front	2001	380189	4738170	SCRCA Tree Planting
SCRCA	Sombra	D	7	2001	377708	4724432	SCRCA Tree Planting
SCRCA	Sombra	C,D,E	8	2001	377654	4725723	SCRCA Tree Planting
SCRCA	Moore	6	7	2001	383306	4744503	SCRCA Tree Planting
SCRCA	Var	Var	Var	2001	385611	4759631	SCRCA Tree Planting
SCRCA	Camden	Var	Var	2001	385983	4716996	SCRCA Tree Planting
SCRCA	Sombra	6	15	2002	383560	4735458	SCRCA Tree Planting
SCRCA	Moore	10&11	Front	2002	380189	4738170	SCRCA Tree Planting
SCRCA	Dover	13	12	2002	385334	4703722	SCRCA Tree Planting
SCRCA	Dover	19	13	2002	387499	4706825	SCRCA Tree Planting
SCRCA	Dover	16	15	2002	385137	4707853	SCRCA Tree Planting
SCRCA	Sombra	D	6	2002	377836	4723608	SCRCA Tree Planting

Project Details	Ownership	BUIs Potentially Impacted	Trees Planted
	Other		264
	Other		99
Block	Private - Individual		600
Block	Private - Individual		1000
Block	Private - Individual		1500
Shelterbelt	Private - Individual		125
Shelterbelt	Private - Individual		750
Shelterbelt	Private - Individual		425
Block	Private - Individual		100
Block	Private - Individual		450
Shelterbelt	Private - Individual		250
Block	Private - Individual		275
Shelterbelt	Private - Individual		900
Shelterbelt	Private - Individual		200
Block	Private - Individual		1000
Shelterbelt	Private - Individual		300
Shelterbelt	Private - Individual		275
	Other		271
	Other		126
Block/She	Private - Individual		1850
Block/She	Private - Individual		4200
Block/She	Private - Individual		2000
Block	Private - Individual		1050
	Other		264
	Other		126
	Other		194
Block/She	Private - Individual		450
Block/She	Private - Individual		1150
Block	Private - Individual		825
Block	Private - Individual		500
Block	Private - Individual		1600
Shelterbelt	Private - Individual		570
Shelterbelt	Private - Individual		478
Shelterbelt	Municipal		11500
Block/She	Private - Individual		2000
Shelterbelt	Private - Individual		675
Shelterbelt	Private - Individual		150
	Other		296
	Other		87
Block	Private - Individual		500
Block	Municipal		10050
Shelterbelt	Private - Individual		750
Shelterbelt	Private - Individual		1400
Shelterbelt	Private - Individual		550
Block/She	Private - Individual		1400

Agency	Geo Twp	Lot	Con	Project Year	UTM X Coordinate	UTM Y Coordinate	Project Name
SCRCA	Moore	1	15	2002	380490	4734914	SCRCA Tree Planting
SCRCA	Sombra	1	13	2002	380205	4733065	SCRCA Tree Planting
SCRCA	Moore	24	12	2002	384744	4751402	SCRCA Tree Planting
SCRCA	Moore	25	12	2002	384468	4750425	SCRCA Tree Planting
SCRCA	Moore	25	12	2002	384098	4751757	SCRCA Tree Planting
SCRCA	Sombra	25	10	2002	384128	4748586	SCRCA Tree Planting
SCRCA	Var	Var	Var	2002	385611	4759631	SCRCA Tree Planting
SCRCA	Camden	Var	Var	2002	385983	4716996	SCRCA Tree Planting
SCRCA	Sombra	7	11	2003	383956	4729608	SCRCA Tree Planting
SCRCA	Sombra	E	6	2003	376958	4722591	SCRCA Tree Planting
SCRCA	Sombra	3	15	2003	381822	4735170	SCRCA Tree Planting
SCRCA	Sombra	6	15	2003	383721	4735793	SCRCA Tree Planting
SCRCA	Sombra	25	10	2003	384128	4748586	SCRCA Tree Planting
SCRCA	Sombra	4	9	2003	381987	4726973	SCRCA Tree Planting
SCRCA	Dover	16	15	2003	384565	4707906	SCRCA Tree Planting
SCRCA	Dover	19	13	2003	387499	4706825	SCRCA Tree Planting
SCRCA	Moore	24	12	2003	384761	4751643	SCRCA Tree Planting
SCRCA	Moore	24	12	2003	385061	4750350	SCRCA Tree Planting
SCRCA	Dover	13	12	2003	385334	4703722	SCRCA Tree Planting
SCRCA	Moore	25	12	2003	384468	4750425	SCRCA Tree Planting
SCRCA	Moore	25	12	2003	384098	4751757	SCRCA Tree Planting
SCRCA	Sombra	D	6	2003	377836	4723608	SCRCA Tree Planting
SCRCA	Sombra	1	13	2003	380205	4733065	SCRCA Tree Planting
SCRCA	Moore	25	12	2003	384501	4751930	SCRCA Tree Planting
SCRCA	Camden	Var	Var	2003	385983	4716996	SCRCA Tree Planting
SCRCA	Sarnia			2003	385781	4761261	SCRCA Tree Planting
SCRCA	Moore	var	var	2003	380396	4744272	SCRCA Tree Planting
SCRCA	Moore	24	12	2003	384761	4751643	SCRCA Tree Planting
RLSN	Dover	19	16	2004	385067	4709972	
RLSN	Dover	19	15	2004	385667	4709015	
RLSN	Dover	40	BDW	2004	386557	4710127	
RLSN	Chatham	A	3 Gore	2004	379068	4719062	
RLSN	Sombra	D	9	2004	378004	4727599	
RLSN	Sombra	9	10	2004	384922	4728659	
RLSN	Sombra	7	15	2004	384208	4735074	
RLSN	Sarnia	14	1	2004	390996	4752468	
RLSN	Sarnia	12	4	2004	392422	4756596	
SCRCA	Sombra	B	11	2004	379111	4729878	SCRCA Tree Planting
SCRCA	Moore	24	12	2004	385103	4751144	SCRCA Tree Planting
SCRCA	Moore	W1/2,1	Front	2004	380548	4736000	SCRCA Tree Planting
SCRCA	Moore	25	12	2004	384468	4750425	SCRCA Tree Planting
SCRCA	Moore	1	Front	2004	380189	4738170	SCRCA Tree Planting
SCRCA	Dover	15	15	2004	383883	4707325	SCRCA Tree Planting
SCRCA	Dover	15	14	2004	384386	4706654	SCRCA Tree Planting
SCRCA	Moore	25	12	2004	384098	4751757	SCRCA Tree Planting

Agency	Geo Twp	Lot	Con	Project Year	UTM X Coordinate	UTM Y Coordinate	Project Name
SCRCA	Dover	13	14	2004	383996	4705057	SCRCA Tree Planting
SCRCA	Chatham	12,13	4	2004	386529	4720396	SCRCA Tree Planting
SCRCA	Moore	24	12	2004	384732	4751013	SCRCA Tree Planting
SCRCA	Sombra	6	15	2004	383721	4735793	SCRCA Tree Planting
SCRCA	Moore	13	Front	2004	380587	4738718	SCRCA Tree Planting
RLSN	Moore	27	9	2005	382706	4747275	
RLSN	Moore	22	7	2005	385971	4744845	
RLSN	Moore	21	6	2005	386230	4743489	
RLSN	Sombra	4	8	2005	381976	4725396	
RLSN	Sombra	5	8	2005	382552	4725985	
RLSN	Moore	10	12	2005	393529	4750785	
RLSN	Sarnia	13	2	2005	391658	4753770	
RLSN	Sombra	B	8	2005	378740	4725169	
RLSN	Sombra	9	15	2005	385393	4735043	
RLSN	Dover	8	11	2005	384319	4700346	
RLSN	Sombra	2	9	2005	380611	4726616	
RLSN	Sombra	5	6	2005	382398	4722849	
RLSN	Sombra	D	9	2005	377820	4727156	
RLSN	Sombra	C	9	2005	378325	4727131	
RLSN	Sombra	D	8	2005	377644	4725864	
RLSN	Sombra	E	8	2005	377143	4725628	
RLSN	Moore	26	2	2005	383080	4737931	
SCRCA	Dover	19	13	2005	387557	4707165	SCRCA Tree Planting
SCRCA	Dover	16	15	2005	384565	4707906	SCRCA Tree Planting
SCRCA	Sombra	6	15	2005	383721	4735793	SCRCA Tree Planting
SCRCA	Moore	4	Front	2005	380497	4736707	SCRCA Tree Planting
SCRCA	Moore	W 1,2,3,4	Front	2005	380511	4736154	SCRCA Tree Planting
SCRCA	Sombra	6	10	2005	383051	4728070	SCRCA Tree Planting
SCRCA	Sombra	C	10	2005	378713	4728340	SCRCA Tree Planting
SCRCA	Sombra	D	9	2005	377982	4727785	SCRCA Tree Planting
SCRCA	Sombra	19	15	2005	385968	4708313	SCRCA Tree Planting
SCRCA	Moore	24	12	2005	385103	4751144	SCRCA Tree Planting
SCRCA	Sombra	3	8	2005	381194	4726067	SCRCA Tree Planting
SCRCA	Sombra	3	8	2005	381228	4726088	SCRCA Tree Planting
RLSN	Dover	9, 10	11	2006	384960	4700988	Winterline Wetlands
RLSN	Sombra	1	7	2006	380048	4724318	
RLSN	Sombra	B	8	2006	378866	4725732	
RLSN/SCRCA	Sombra	1	5	2006	379934	4721634	
RLSN/SCRCA	Sombra	4	5	2006	381689	4721512	
RLSN/SCRCA	Sombra	5	9	2006	382867	4726937	
RLSN/SCRCA	Moore	19	7	2006	387539	4744308	
RLSN/SCRCA	Moore	?	1	2006			
SCRCA	Moore	21	6	2006	386433	4743630	SCRCA Tree Planting
SCRCA	Moore	22	7	2006	385809	4744823	SCRCA Tree Planting

Agency	Geo Twp	Lot	Con	Project Year	UTM X Coordinate	UTM Y Coordinate	Project Name
SCRCA	Moore	27	9	2006	382917	4747669	SCRCA Tree Planting
RLSN	Dover	18	16	2007	384809	4709228	Pigeon Marsh
RLSN	Moore	25	1	2007	383855	4736501	Hwy 40 Wildlife Corridor
SCRCA	Dover	37	10	2007	387511	4709183	SCRCA Tree Planting
SCRCA	Chatham	AB	4	2007	379111	4720758	SCRCA Tree Planting
SCRCA	Chatham	8 + AB	1 + 4	2007	384201	4715720	SCRCA Tree Planting
SCRCA	Sombra	AB	6	2007	379196	4722864	SCRCA Tree Planting
SCRCA	Sombra	4	5	2007	381763	4720890	SCRCA Tree Planting
SCRCA	Sombra	5	9	2007	382554	4726830	SCRCA Tree Planting
SCRCA	Moore	27	9	2007	382601	4746752	SCRCA Tree Planting
SCRCA	Moore	21,22	7	2007	386027	4744900	SCRCA Tree Planting
SCRCA	Moore	21	6	2007	386238	4743271	SCRCA Tree Planting
SCRCA	Moore	W1/2 1,2,	Front	2007	380511	4736154	SCRCA Tree Planting
SCRCA	Moore	6,9	1	2007	384945	4736006	SCRCA Tree Planting
SCRCA	Moore	25	4	2007	383721	4735793	SCRCA Tree Planting
SCRCA	Chatham	6	4	2007	383721	4735793	SCRCA Tree Planting
SCRCA	Sombra	C	10	2007	378358	4728462	SCRCA Tree Planting
SCRCA	Sarnia	0	69	2007	384067	4761380	SCRCA Tree Planting
RLSN	Dover	11	11	2007	385709.2696	4701829.738	
RLSN	Moore	3	Front	2007	380511.1325	4736477.049	
RLSN	Sombra	1	7	2007	379741.9024	4724031.64	
RLSN	Sombra	5	9	2007	382868.6662	4727140.307	
RLSN	Sombra	3	5	2007	381385.5996	4721724.415	
RLSN	Sombra	1	5	2007	380110.3294	4721686.536	
RLSN	Sombra	B	6	2007	378979.0006	4723229.486	
RLSN	Chatham	1	1 Gore	2007	383433.6193	4716150.834	
RLSN	Chatham	A	4 Gore	2007	379244.4396	4720340.332	
RLSN	Moore	22	7	2007	385782.6619	4744396.968	
SCRCA	Moore	25	12	2008	384456	4751944	SCRCA Tree Planting
SCRCA	Moore	21	9	2008	386787	4747529	SCRCA Tree Planting
SCRCA	Dover	37	10	2008	387511	4709183	SCRCA Tree Planting
SCRCA	Moore	63	Front	2008	381867	4750069	SCRCA Tree Planting
SCRCA	Sombra	B	11	2008	379111	4729878	SCRCA Tree Planting

Personal information has been omitted from this table to be in compliance with the Municipal Freedom of Information and Protection of Privacy Act, R.S.O., 1990.

Project Details	Ownership	BUIs Potentially Impacted	Trees Planted
Shelterbelt	Private - Individual		500
Burn and Manage	Public	Enhance Fish and Wildlife Habitat	
Prairie Planting and Manage	Public		
Shelterbelt	Private - Individual		2200
Shelterbelt	Private - Individual		1150
Shelterbelt	Private - Individual		400
Shelterbelt	Private - Individual		975
Shelterbelt	Private - Individual		275
Block/She	Private - Individual		1300
Shelterbelt	Private - Individual		250
Shelterbelt	Private - Individual		1260
Shelterbelt	Private - Individual		850
Block	Private - Individual		4300
Shelterbelt	Other		1350
Shelterbelt	Provincial		850
Shelterbelt	Provincial		600
Block	Conservation Authority		92
Shelterbelt	Municipal		22
Block	Private - Individual		8000
Block	Private - Individual		0
Shelterbelt	Private - Individual		730
Block	Private - Individual		500
Shelterbelt	Private - Individual		25