DISCUSSION PAPER

THE STATUS OF THE BENEFICIAL USE IMPAIRMENT
RESTRICTIONS ON DRINKING WATER CONSUMPTION OR TASTE AND ODOUR PROBLEMS
ST. CLAIR RIVER AREA OF CONCERN

PREPARED FOR THE CANADIAN RAP IMPLEMENTATION COMMITTEE
ST CLAIR RIVER AREA OF CONCERN

AVANTI INSIGHT CONSULTING SERVICES, MAY, 2016

CONTENTS

TABLE OF FIGURES

LIST OF TABLES

DISCUSSION PAPER
THE STATUS OF THE BENEFICIAL USE IMPAIRMENT
RESTRICTIONS ON DRINKING WATER CONSUMPTION OR TASTE AND ODOUR PROBLEMS
ST. CLAIR RIVER AREA OF CONCERN

1. Purpose

In 1985, the St. Clair River was declared one of 43 "Areas of Concern" (AOCs) around the Great Lakes due to highly degraded water quality that impaired one or more "beneficial uses" of the river. In response, the Canadian and U.S. governments committed to restoring water quality by implementing Remedial Action Plans (RAPs) in these specific areas. The Canadian Remedial Action Plan Implementation Committee (CRIC) for the St. Clair River has primary responsibility to coordinate and implement the Remedial Action Plan for the St. Clair River in order to restore the aquatic environment and beneficial uses of the river, including the provision of drinking water. Drinking water drawn from the St. Clair River is a "beneficial use" that has been deemed *impaired* due to frequent industrial spills which have caused taste and odour problems and interrupted the supply of drinking water of two communities.

Acknowledging the importance of the river as a source of drinking water to two communities, the spiritual importance of water to the two First Nation communities within the AOC, the history of spills in the AOC, and the potential concerns that may arise if/when a *not impaired* status is recommended by the CRIC, the CRIC has commissioned this discussion paper to:

a. review facts related to the frequency of spills over time,
b. outline improvements since the AOC was listed (such as the changes in legislation),
c. identify infrastructure improvements relate them to the protection of drinking water sources in the St. Clair River; and
d. promote thought on several questions (identified in Section 14), including whether the current delisting criteria is acceptable.

This paper is intended to stimulate discussion among the public, First Nations, stakeholders, and agencies. Questions, comments and concerns will be collected by the CRIC to help assess next steps to restore and ultimately re-designate the St. Clair River AOC BUI *Restrictions on Drinking Water Consumption or Taste and Odour Problems* (hereafter referred to as Drinking Water BUI*)* to *not impaired* status.

Much of this paper contains conclusions by those who studied the occurrence of spills[1] to the river and the related effects. Among the reports, a number of data assessment issues were identified. The analytical issues relate to different data being collected for different purposes, incomplete entries, difficulties in determining volumes spilled and volumes recovered, duplicate reports, and incompatible databases.

[1] In Ontario, spills are defined as *releases of pollutants into the natural environment from or out of a structure, vehicle or other container and that is abnormal in quality or quantity in light of all the circumstances of the discharge* (Ontario Environmental Protection Act, RSO, 1990).

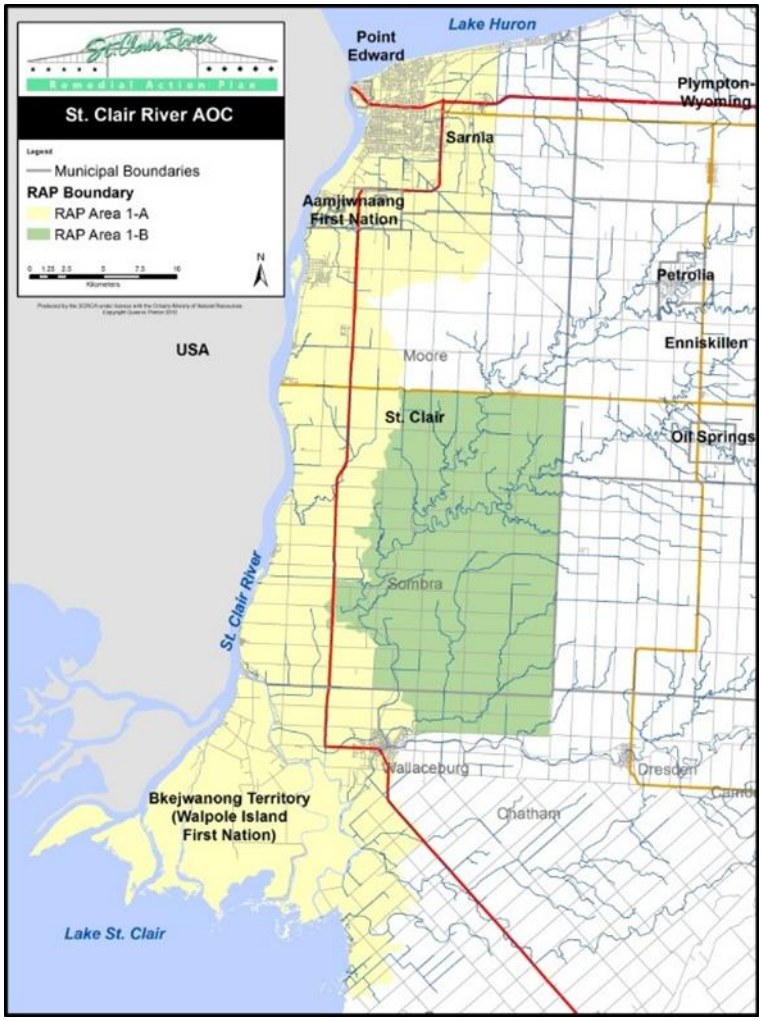
Despite these data management issues, however, the conclusion of the referenced studies was that spills have decreased significantly over the past 20 years (International Joint Committee, 2006; Li & Cheng, 2010).

2. Overview of the St. Clair River Area of Concern

An AOC is a site where water and the environment have been severely degraded, affecting common uses or the area's ability to support aquatic life. There are 14 use impairments and the existence of one or more could result in an AOC designation.

The St. Clair River flows approximately 64 kilometers connecting Lake Huron to Lake St. Clair. Historically, industrial and municipal point sources (originating primarily from Sarnia, Ontario and Port Huron, Michigan) have impacted the river. The Canadian St. Clair River AOC covers an area of approximately 3,350 km^2 (Figure 1).

Figure 1: Location of the Canadian St. Clair River Area of Concern (AOC)



Note: The AOC is divided into two areas: Area 1-A (delineated by yellow shading) and Area 1-B (delineated by green shading).

In 1987, the Great Lakes Water Quality Agreement (GLWQA) was amended by the governments of Canada and the United States. The St. Clair River was designated as one of 43 AOCs identified under its *Annex 2: Great Lakes Areas of Concern and Remedial Action Plans* (United States & Canada, 1987). The Agreement was updated in 2012, and commits both countries to restore and protect water bodies within the Great Lakes Basin. As the St. Clair River is a bi-national AOC, both countries work cooperatively to remediate the area and share responsibilities to delist it from the list of AOCs under the Agreement.

Remedial Action Plans (RAPs) are developed to address the specific environmental challenges identified in each AOC. The ultimate goal of a RAP is to restore water quality and beneficial uses of the aquatic environment to a condition found outside the boundaries of the AOC.

The 1991 *Stage 1* RAP Report for the St. Clair River AOC described the causes and extent of environmental degradation to the St. Clair River, while the 1995 *Stage 2* RAP Report recommended remedial actions to address the environmental impairments identified (Ontario Ministry of the Environment (OMOE)[2]/Michigan Department of Environmental Quality (MDEQ)). Many of the recommended actions to address the drinking water BUI involved improving spill prevention and response capability for point source discharges and spills. A subsequent work plan for the St. Clair River AOC was published in 2007, building on the actions outlined in the *Stage 2* RAP report (CRIC, 2007). The latest work plan was completed in 2013 (CRIC, 2013).

A report summarizing the progress made in addressing the action items recommended in the 2007-10 work plan period was published in 2012 (CRIC, 2012b). Some of the highlights of that report and recent developments were: (a) 85% of the 114 recommended activities were completed; (b) research on contaminated sediments proposed three options to clean it up; (c) several degraded habitat sites were rehabilitated; and (d) two BUIs were re-designated to unimpaired. Since 2012, two additional BUIs (degradation of aesthetics and beach closures) have been recommended for re-designation as unimpaired.

Once all remedial actions are completed or addressed, an AOC can be removed from the list of AOCs in the Great Lakes Basin.

Presently, three AOCs in Canada and four AOCs in the US have been delisted. Another two AOCs in Canada are classified as “Areas in Recovery.” This term reflects the concept that all possible measures have been taken to address the cause(s)of impairments but more time is needed for the recovery of one or more BUIs. The AOC in recovery classification incorporates long-term monitoring to determine the progress towards the recovery of the BUIs remaining. When recovery is determined, the AOC can proceed with delisting.

[2] Ontario Ministry of the Environment became Ontario Ministry of the Environment and Climate Change, June, 2014.

3. Drinking Water Systems within the St. Clair River Area of Concern

In Ontario, there are two water treatment plants within the St. Clair River AOC that draw raw water from the St. Clair River, downstream of the Sarnia industrialized zone. One water treatment plant is located within the Walpole Island First Nation community and the other is located in Wallaceburg. The communities served by these facilities are Walpole Island First Nation (WIFN) and Wallaceburg, within the municipality of Chatham-Kent. These plants, along with several private water intakes along the St. Clair River, are typically impacted by upstream spills. Other communities within the AOC, such as Point Edward, Sarnia and Mitchell's Bay, draw their raw drinking water from either Lake Huron (Lambton Area Water Supply System (LAWSS) or Lake Erie (Chatham Water System) and are not impacted by spills to the St. Clair River so these communities and their water supply system are not the focus this report

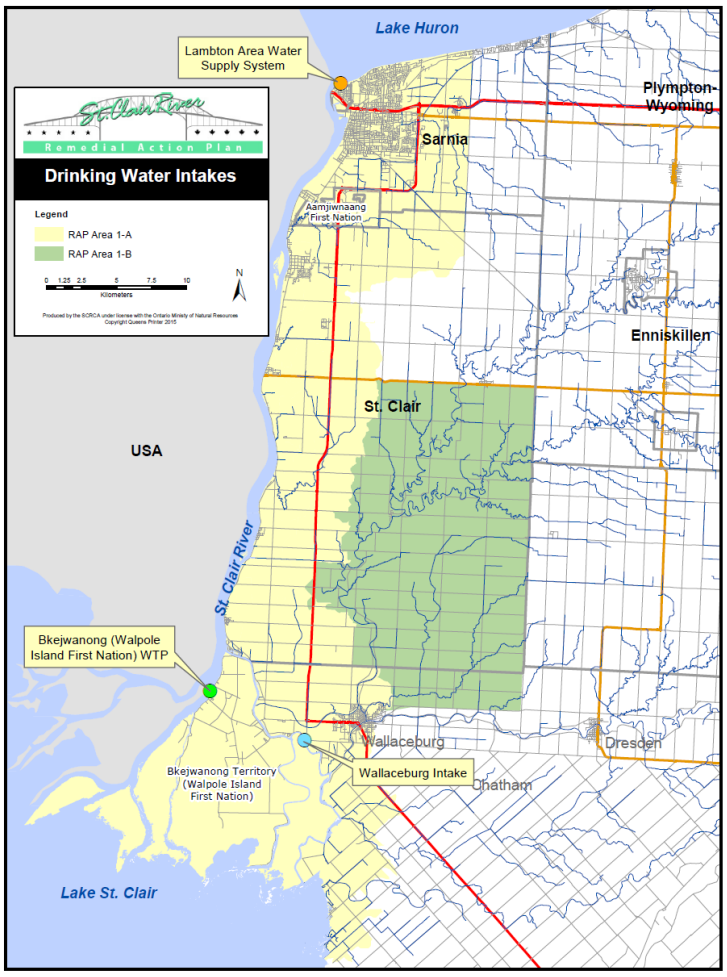
3.1 Walpole Island Water Treatment Plant

The water treatment plant is located within the Walpole Island First Nation (WIFN) community on the St. Clair River. It is approximately 40 kms downstream of the outlet of Lake Huron and is the first water intake downstream of the Sarnia industrial area (Figure 2) that serves a community. Others in between are private users. The WIFN facility, commissioned in 2007, replaced the original plant that had been in operation from 1979 until 2007. Drinking water is provided to the community of WIFN through 860 service connections and a water standpipe/reservoir serving a population of over 2,300 people (Kicknosway, S., personal communication, April 15, 2014). The intake opening is in the St. Clair River approximately 61 metres (200 feet) from the shore in front of the plant at a depth of 8.5 metres (28 feet). The plant uses membrane filtration technology supplied by PALL Corporation--a microfiltration system approved for use in Ontario. It provides an effective barrier to physically separate contaminants from the water. Following filtration, the water is irradiated with ultra violet (UV) light that eradicates organisms (e.g., viruses, bacteria) that may be present in the water. Chlorine is then added to ensure any viruses and/or bacteria that bypassed the previous processes are eliminated and to prevent bacterial growth within the distribution system.

The plant can produce 40 litres of drinking water per second in full operation. It is regularly operated for eight hours a day during the week from 07:00 to 15:00 hours and for four hours per day on weekends. The community reservoir and a 760 cubic metre standpipe take six hours to fill to capacity. If the water treatment plant operator receives notice that the plant should close, the operator usually has sufficient advance warning to "top up" the reservoirs and can then store approximately two days of drinking water (based on average daily use) and preserving ¼ of the reserve volume for fire suppression.

Since there are only two operators qualified to operate the WIFN plant, the community has developed a cooperative arrangement with City of Chatham-Kent. WIFN can request support from Chatham-Kent for operational staff to operate the system when required (e.g., backup for WIFN operational staff during extended absences).

Figure 2: Locations of the Walpole Island and Wallaceburg Water Intakes, St. Clair River AOC



3.2 Wallaceburg Water Treatment Plant

Constructed in 1946, the Wallaceburg Water Treatment plant is located approximately 51 kilometres downstream from the Sarnia industrial area (Figure 2). Raw water is taken from the Chenal Ecarte, a channel of the St. Clair River, for the Wallaceburg Water Treatment Plant. The facility provides municipal water to the community of Wallaceburg and surrounding area. It is a conventional treatment system that has undergone four major upgrades--most recently in 2009.

The system consists of raw water intake, low-lift pumping station, treatment plant, ground-level storage, high-lift pumping station, emergency power generator, elevated storage tower, and distribution system. The distribution system is also inter-connected to the Lambton Area Water Supply System (LAWSS). The treatment process at this facility involves pumping raw water into pre-treatment tanks where the addition of polyaluminum chloride promotes coagulation and settling. Then the water is filtered through gravel,

sand and anthracite after which, chlorine is added for disinfection. Hydroflurosilic acid is added to prevent tooth decay (Galbraith, D., Chatham-Kent PUC, personal communication, July 31, 2015).

Over the years, the water intake has been shut down numerous times in response to spills upstream and local water conditions. The water treatment plant is also influenced by high turbidity during wet weather events. Typically, turbidity levels in the raw water are five Turbidity Units (TU). These levels can increase up to 300 TU within an hour during storms or during the spring freshet due to storm water flows from the north branch of the Sydenham River. Levels such as these have the potential to affect the water treatment plant and disrupt service. The intake may be closed under these high turbidity conditions. Supply disruptions to consumers have been avoided due to ground level storage, the elevated storage tower, and the interconnection with the LAWSS and the North Kent water system at Base Line Road. Staff report that if a prolonged intake closure was predicted, they would immediately open the LAWWS interconnect, in consultation with that operating authority, to ensure continued secure water supply service to Wallaceburg.

Much of the existing infrastructure at the water treatment plant and distribution system is aging and requires upgrades. The *2012 Water and Wastewater Master Plan* (Dillion Consulting Limited, 2012) for Chatham-Kent recommended an alternate water supply for the community of Wallaceburg. An Environmental Assessment was initiated in 2013, to consider alternative solutions for servicing the Wallaceburg community. At the time this report was prepared, based on the results from an updated EA process, rehabilitation of the existing Wallaceburg Water Treatment Plant was determined to be the preferred alternative. Further technical review will address the preferred design (Chatham-Kent PUC, 2016).

3.3 Lambton Area Water Supply System (LAWSS)

The LAWSS facility is located in the City of Sarnia where Lake Huron meets the headwaters of the St. Clair River. The facility's intake is located at the outlet of Lake Huron into the St. Clair River. It is above the industrial complex in the Sarnia area so it is not impacted by the spills that have impacted the two downstream water treatment plants in Walpole Island and Wallaceburg. The LAWSS water treatment plant services the following systems and/or communities:

a. City of Sarnia Distribution System (serving the City of Sarnia and 15 homes in the Township of St. Clair),
b. West Lambton Shores Distribution System,
c. Village of Point Edward Water Distribution System,
d. Alvinston Distribution System,
e. Plympton-Wyoming Water Distribution System,
f. Chatham-Kent Drinking Water System–Wallaceburg,
g. St. Clair Water Distribution System (including Fawn Island and Stag Island), and the
h. Township of Warwick Distribution System.

The system also services the existing shoreline development along the Chenal Ecarte along the St. Clair Parkway and Payne Road, northwest of Wallaceburg. As previously noted, the LAWSS is interconnected with the Wallaceburg system as an emergency backup source of drinking water if needed. This

interconnection reduces the risk of interruptions to the community when the Wallaceburg water treatment plant is shut down for an extended period of time.

3.4 Private River Water Intakes

Presently, there are eight known private water intakes supplying homes or cottages along the St. Clair River. Lambton Public Health, the Sarnia Lambton Environmental Association (SLEA) and OMOECC attempt to maintain an accurate accounting of contact information for the residents served by these systems, in case there is a need to notify them of an event that may impact water quality (e.g., spills, combined sewer overflows). Despite best efforts, maintaining an accurate list is challenging, especially when the residents move or change their contact information without notifying the above organizations and agencies.

4. Drinking Water BUI Designation

4. **Listing Criteria**

More than 80% of Ontario's population relies on the Great Lakes for drinking water (Government of Ontario, 2015). The Government of Ontario considers this to be a vital and valued use of the Great Lakes (OMOECC, 2015); a sentiment shared by residents of the St. Clair River AOC. More specifically, Lake Huron and the St. Clair River are the sources of drinking water for more than 88% of Lambton County (Thames-Sydenham Source Protection Region, 2008) as well as the community of Walpole Island First Nation (WIFN). Although Lake Huron and the St. Clair River provide reliable sources of water, there have been occasions when spills to the river have interrupted the supply of local drinking and/or caused concerns regarding taste and odour.

In the mid- to late-1980s, about 100 spills per year (OMOE/MDEQ, 1991) occurred in the St. Clair River. Due to the nature of the spills, many of them required the closure of downstream water treatment plant intakes to protect the water supplies. The closures protected the quality of local drinking water produced and distributed to the residents, but they also caused stress on the supply of potable water available to the communities. During a water intake closure, potable water stored within the system was all that was available (e.g., reservoirs and standpipes). Consequently, lengthy water intake closures exhausted water reserves, causing significant inconvenience and expense to the residents and municipality. On several occasions, drinking water had to be transported into the community to satisfy consumption and domestic needs.

The issue underlying the 1991 *Stage 1* declaration of impairment for drinking water was the frequency of spills impacting the supply of water to local water treatment plants (not the ability of treatment plants to safely treat and provide drinking water under normal circumstances). Spills on the Canadian side were more frequent than on the US side and were predominantly from industrial sources. In Ontario, these disruptions were caused by spills in the Sarnia industrial area--particularly frequent in the late 1980s into the 1990s (OMOE/MDEQ, 1991). In addition, frequent combined sewer overflow events from the City of Sarnia's sewage treatment system contributed to concerns for bacterial contamination and taste and odour problems of local drinking water (OMOE/MDEQ, 1991).

The International Joint Commission (IJC) is an organization which (a) monitors the progress of the US and Canadian governments to protect and restore the Great Lakes; (b) provides advice; and, (c) makes recommendations for improvement as required. It provided guidance on how to assess whether the drinking water beneficial use was impaired ("listing "criteria) or not impaired ("delisting" criteria) (IJC, 1991). The IJC recommended deeming the Drinking Water beneficial use as impaired if: (a) contaminants or disease-causing organisms in treated drinking water exceed human health guidelines; (b) taste and odour problems are present; and/or, (c) treatment needed to make raw water suitable for drinking is beyond standard treatments used in comparable areas in the Great Lakes.

The guidance applies to communal drinking water supplies and not private individual supplies. There are eight known homes in the AOC which are served by private domestic drinking water intakes from the St. Clair River.

The communities of Walpole Island First Nation and Wallaceburg (Municipality of Chatham-Kent) were most affected by these closures. There were multiple impacts to the communities. The effects were of a monetary nature because drinking water had to be trucked in or bottled water was used. They were also of a social nature as life in these affected communities was disrupted and residents were concerned for the safety of their water supply. There has been an additional impact to the Walpole Island First Nation community owing to their cultural attachment to water.

Numerous water intake closures, both mandatory and precautionary, had been reported for the Wallaceburg and Walpole Island First Nation Water Treatment Plants at the time the AOC was established and during the development of the RAP. An intake closure could last for a few hours or up to a few days. The length of a closure depended on the volume and nature of the material spilled, the duration of the spill, river flow conditions, the effectiveness of emergency response measures, the effectiveness of notification, and the ability to model and predict the concentration of contaminants reaching downstream water treatment plant intakes.

This BUI is also considered impaired on the Michigan side of the St. Clair River (OMOE/MDEQ, 1991). There has been a history of water intake disruptions similar to those experienced in Ontario although the frequency and severity of the plant closures have been less acute. A significant cause of the disruptions in Michigan was related to municipal sewage overflows emanating from combined sewers located in the City of Port Huron. Since the AOC was listed, the City of Port Huron has essentially eliminated combined sewers in its jurisdiction and, therefore, considerably ameliorated the problem (City of Port Huron, 2014). However, there have been a few recent occasions when spills from industrial sources have caused water treatment interruptions--most recently in July, 2011.

4.1 Delisting Criteria

The *Stage 2 RAP* report, released in 1995, reiterated the justification for the impaired status and recommended 38 remedial actions to restore the impaired beneficial uses in the St. Clair River and to undertake further research on those that required it (OMOE/MDEQ, 1995). The delisting criteria developed for the St. Clair River states that this BUI can be considered not impaired when *no treatment plant shutdown is caused by the exceedance of a drinking water guideline over a two-year period* (OMOE/MDEQ, 1995).

Since 2000, this criterion has been met several times. In fact, the delisting criteria was met prior to 2000 (Environment Canada, 2005), however, the CRIC did not recommend re-designation of it to unimpaired as there had been reports that facilities in Sarnia had allowed potentially harmful chemicals to spill (but did not cause closures) following the two-year period during which there were no closures. Based on this situation, and concerns that the criterion is not perceived to be sufficiently robust as one intake closure could resurface the question of a renewed impairment, the CRIC and stakeholders felt that the delisting criteria should be re-assessed.

From 2010 to 2012, a CRIC committee conducted a review of all of the original BUI delisting criteria which were considered impaired, including the drinking water BUI (CRIC, 2012a).

The review included stakeholder, First Nation, and public consultation and took into consideration that some participants in the AOC program considered the two-year period to be arbitrary. A common question raised by stakeholders, the public and agencies was "How long between spills that require a water intake closure is long enough to declare that the issues surrounding the Drinking Water BUI have been resolved?" The perceived arbitrary time-period resulted in concern and controversy in assessing the status of this BUI.

After considering the input, once more, the CRIC was unable to improve the criteria so did not propose any significant changes to them. The current delisting criteria for this BUI remains unchanged and states: "This BUI will be considered restored when there are no treatment plant shutdowns due to exceedances of drinking water guidelines over a two-year period" (CRIC, 2012a).

The 2012 Delisting Report concluded that, given the sensitivity and complexity of this impairment and its causes, the ultimate goal is eliminating all spills to the river. However, CRIC recognizes that human error cannot be eliminated as a contributing factor to accidental spills and considered it unreasonable to use the elimination of all spills as the delisting criteria. Rather, reducing spill risks, sources, and causes is deemed to be more achievable, and therefore considered a more practical approach to safeguarding drinking water. Subsequently, the CRIC decided that any future status assessment for the Drinking Water BUI would consider both the period during which no intakes were closed due to spills, as well as an assessment of the risk management factors that are considered most important in addressing the causes of the impairment, including the following

e. spill prevention and contingency initiatives implemented at facilities adjacent to the river;
f. the effectiveness of spill warning systems;
g. all related systemic improvements (legislative, regulatory, compliance) contributing to reductions in the risk of spills; and,
h. frequency of spills over time resulting in intake closure.

The CRIC has emphasized that although all factors would be included in a BUI assessment report, emphasis on spill prevention, management and response capacity are the most critical factors to address. In addition, the assessment would consider the Province's new drinking water source protection initiatives because local Source Water Protection Plans add another layer of protection for existing and future drinking water sources. They create policies that help ensure activities carried out near surface water intakes do not threaten the quality and quantity of drinking water supplies.

Given that the St. Clair River AOC is a bi-national AOC, the Canadian and US partners cooperate and approach delisting strategies in a similar manner, when it is appropriate. The Michigan state-wide BUI Removal Criteria are similar to the criteria developed for the Canadian St. Clair River AOC. The State's Guidance for removal of this impairment also refers to a two-year period where public water supplies meet all current standards and where treatment needed to make raw water potable and palatable do not exceed standard methods. In the event that plant intakes need to be closed due to contamination, standard treatment methods are considered to have been exceeded (Government of Michigan, 2008). In 2014, BPAC recommended to the Michigan Department of Environmental Quality that the delisting criteria be amended to require documented confirmation that prevention, notification and response plans and monitoring programs are in place and effective (BPAC, 2014). The MDEQ is considering the recommendation.

4.2 Water Intake Closure Procedures

It is important to note that there are two intake closure procedures in place. The first relates to a shutdown commonly referred to as a *mandatory* closure. A mandatory closure occurs when the Medical Officer of Health (MOH) or equivalent authority issues an order or advisory to a water treatment operator to close a municipal water system to protect the health of users. This order is declared when an MOH receives information typically from the OMOECC or plant operator that a spill or other water quality condition (e.g. bacterial contamination, turbidity) has occurred that is likely to reach local water intakes at concentrations that are predicted and/or measured to exceed Ontario Drinking Water Objectives. The municipal operating authority must comply with the order. The jurisdiction of an MOH, however, does not apply to First Nation communities. Rather, water system managers/intake operators in First Nation communities receive the same notice and information from the OMOECC as the MOH, but any actions to be taken are determined by the First Nation community.

The second intake closure procedure is known as a *precautionary* closure. This occurs when a municipal or First Nation water treatment plant operator or authority is alerted of a contamination incident or water quality condition that is not predicted to be a health risk but he/she chooses to close the water intake on a precautionary basis without receiving an order from the local MOH. Typically, these closures occur when details of a spill are still being collected (e.g., volume, material, etc.), and there are concerns that contaminants may reach an intake at a level that may be harmful to the treatment system or may degrade the aesthetic quality of drinking water (i.e., taste and odour). Lastly, some water intake precautionary closures are planned to avoid any potential impacts to the drinking water system caused by regular upstream maintenance or construction activities (e.g., dock repairs, buoy maintenance, etc.).

5. Spills Monitoring Data

CRIC, as the responsible body for providing oversight of the AOC, makes use of three primary data monitoring sources where spills are concerned: Spills Action Centre (SAC), the Sarnia Lambton Environmental Association (SLEA) and information gathered by the drinking water plant operators, who record water quality data, relevant events and any actions that are required to protect drinking water quality.

5.1 Spills Action Centre

There is a legal requirement for any person or corporation who spills, has control over, or causes a spill in Ontario to report it immediately to the OMOECC Spills Action Centre (SAC) and the local municipality. SAC maintains records of all incidents and discharges that are reported. In addition, SAC personnel will liaise with the owner of the spilled material and notify other ministries, response agencies and the public to provide information and guidance to prevent negative impacts to the local communities and environment. If a spill occurs on the St. Clair River, notifications are provided to the owners/operators of downstream drinking water intakes, local health agencies, First Nation communities, and other federal and provincial agencies, as required (i.e., Environment Canada, Health Canada).

The Canadian Coast Guard, a federal government department mandated to ensure safe and accessible waterways, can also be a source of information as it requires that all pollution or threats of pollution to the marine environment, including the Great Lakes, be reported to them by the spiller.

5.2 Sarnia-Lambton Environmental Association

In the St. Clair River AOC, the Sarnia-Lambton Environmental Association (SLEA), a non-profit cooperative of local industries, monitors environmental conditions in the Sarnia-Lambton area. A fully automated water quality monitor located south of the Sarnia industrial complex in Courtright, collects and analyses river water 24 hours per day every day of the year. Samples are tested for a suite of 20 different chemical compounds associated with the refining of petroleum and manufacturing of chemicals. Should a targeted chemical be detected at an unexpected concentration, there is a multi-tiered alarm system that is triggered which provides warning to the SLEA. Results are shared with SLEA member companies and the OMOECC when a chemical is detected at reportable levels. This continuous monitoring is an on-going reminder to SLEA members and others that there is on-going surveillance and that the goal is zero discharges to the river (SLEA, 2011).

5.3 Water Treatment Plant Operators Water Intake Closure Records

Water treatment plant operators also maintain a record of when their intakes close due to raw water quality concerns. These records include the length of the closure, related operational issues and incident information received from the OMOECC and the MOH. As input to this report, operators at both the

Wallaceburg and Walpole Island First Nation water treatment plants were interviewed and provided information on intake closures between 2000 and 2013 for their respective facilities.

The Municipality of Chatham-Kent and the WIFN water treatment plant operators record all available information about all spill events resulting in water intake closures at their facilities. Of all of the data sources that are available, the data from the Wallaceburg plant are considered reliable in maintaining a list of drinking water closures due to spills along with other important information: the date of the spill, reported material spilled and whether the intake closure was mandatory or precautionary and related details.

Table 1 summarizes data from the Wallaceburg water treatment plant for the period of 2000 to 2015 (Galbraith, D., personal communication, 2015). The table distinguishes between mandatory and precautionary shutdowns. Since 2000, there have been numerous time-periods during which no mandatory water intake closures were recorded: 2000–2003 inclusive, 2005–2007 inclusive, 2009–2011 inclusive, and 2014 to early 2016. Four mandatory shutdowns occurred in 2004, while single mandatory shut downs were required in 2008, 2012, and 2013. Precautionary shutdowns occurred in 2008, 2009, and 2013

The data for the WIFN plant were unavailable.

Table 1: Water Intake Closures and Spill Events Since 2000 for Wallaceburg Water Treatment Plant

Year	Date	Spill Details	Source	Shut Down Type
2000				None
2001				None
2002				None
2003	August 14	Vinyl Chloride	Royal Polymers	None*
2004	February 1	Methyl Ethyl Ketone and Methyl Isobutyl Ketone	Imperial Oil	Mandatory
	March 5	High pH Wastewater	Lambton Generating Station	Mandatory
	April 30	Benzene and Toluene	Sunoco	Mandatory
	May 23	Hydrocarbons, Volatile Organic Compounds (VOCs), Oily Water	Various St. Clair River Companies	None
	June 17	Hydrocarbons	Suncor	None
2005	July 17	Hydrocarbons	Suncor	None
2006				None
2007				None
2008	March 15	Oil Sheen (Chenal Ecarte)	Unknown	Mandatory
	May 14	Spill on Bickford Line	clay particles caused by erosion	Precautionary
2009	March 1	Phenol	Imperial Oil	Precautionary
	March 7	Storm water	Imperial Oil	Precautionary
	March 8	Sewage Overflow	Sarnia Wastewater Treatment Plant	Precautionary
	August 18 -21	Dye Testing Release Project	Great Lakes Observing System	Precautionary
2010				None
2011				None
2012	July 19	Diesel Fuel	Barge and Tugboat in Lake Huron	Precautionary
	August 18	Ethyl Benzene	Spill during ship loading	Mandatory
2013	September 10	Diesel Fuel	Sun Canadian Pipeline	Mandatory
	September 25	Biodegradable Cleaning Product	Suncor	Precautionary
2014				None
2015				None

*Note: Due to improper notification during the Royal Polymers spill event, the water treatment plant was not shut down. If appropriate notification had occurred, an intake closure would have resulted (Galbraith, D., personal communication, 2015).

6. Overview of Recent Spill-Related Reports and Actions

6.1 The St. Clair River Area of Concern Remedial Action Plan Progress Report (2005)

The 2005 AOC Progress Report stated that there were no OMOECC or MDEQ-issued drinking water advisories or mandated water treatment shutdowns for several years prior to 2000, thus meeting the delisting criteria. However, the authors concluded that the status of the BUI required re-assessment given reports that since 2000, a number of facilities in the Sarnia industrial sector had allowed potentially harmful chemicals to spill into the St. Clair River.

6.2 The Industrial Pollution Action Team (IPAT) and OMOECC SWAT Team Reports (2004)

A significant spill occurred in February, 2004, at which time 157,500 litres of industrial solvents (methyl ethyl ketone and methyl isobutyl ketone) were spilled by Imperial Oil Limited into the St. Clair River. As a result, the OMOECC and MOH advised the closure of both the WIFN and Wallaceburg water intakes. These closures continued for a period of three to four days. Two other serious spills caused the closure of both water intakes near the same timeframe.

IPAT was created by MOE in April, 2004 after several spills occurred along the St. Clair River that resulted in impacts to the local communities and the environment. IPAT was tasked to look into the causes of industrial spills and recommend preventative measures that industry could take.

The Minister of the Environment and Climate Change also deployed its Sector Compliance Branch (SCB; formerly called SWAT) to undertake in-depth inspections of the area facilities to find and correct sources of potential spills that could pose a risk to the health of humans and the environment.

IPAT released its findings in July 2004 regarding the causes of industrial spills and dangerous air emission. It made several recommendations on preventive measures that industry and others could undertake. IPAT found that Ontario's environmental management framework was "largely reactive, not preventive" and that there were no regulatory requirements for pollution and spill prevention plans, although MOE had attempted to develop pollution prevention plans with several industry sectors in the 1990s.

The "SWAT Team" took action against all non-compliance issues found during their inspections and published its findings in the Spring of 2005.

These spills, the SWAT Team report and the IPAT recommendations triggered the introduction of Ontario's *Environmental Enforcement Statute Law Amendment Act* (EESLAA) (SO 2005, c. 12), also known as the *Spills Bill* and related regulations (Section 7.1.1). The new Act contained a number of significant provisions: expanded liabilities for corporate directors, higher fines, more stringent spill reporting, power to require spill prevention and spill contingency plans, new powers for the province and municipalities to recover costs and means to facilitate easier convictions in water pollution prosecutions.

6.3 Report on Spills in the Great Lakes Basin with a Special Focus on the St. Clair-Detroit River Corridor (2006)

In 2006, the IJC published a report on spills in the Great Lakes Basin, with a special focus on the St. Clair-Detroit River corridor (IJC, 2006). The report was prepared in response to growing public concern over the perceived increase in industrial spill frequency to the St. Clair-Detroit River corridor in the early 2000s. The objective of this report was to examine the spill incidents in the St. Clair-Detroit River corridor and determine if, in fact, trends in spill frequencies were increasing. The IJC also reviewed spills data for the St. Clair-Detroit River corridor and compared them to other areas of the Great Lakes. Data sources included: (a) Environment Canada, (b) the OMOECC SAC, (c) the Canadian Coast Guard, (d) the United States Coast Guard, (e) United States National Response Centre, and (f) the United States Environmental Protection Agency (USEPA).

The IJC experienced considerable difficulty in analysing the information as it discovered that the definition of a reportable spill was not consistent between jurisdictions. In addition, the data were not collected in similar manners and were not comparable due to differing mandates, definitions, and purposes for which they were collected. Despite these challenges, they were able to conclude:

a. Between 1990 and 2004 the number of spills on the Canadian side of the St. Clair River decreased by more than 50%.
b. The contribution of industrial spills to the St. Clair-Detroit River corridor was similar to the Great Lakes basin as a whole, with industry accounting for 63% of all spills. Industrial sources accounted for 70% of total spills across the Great Lakes Basin.
c. The number of spill incidents originating from Canadian sources in the St. Clair River was greater compared to other Great Lakes corridors (i.e., St. Lawrence, Niagara, Detroit and St. Mary's Rivers).
d. Commercial and recreational marine traffic contributed similarly to the total number of spills in both the St. Clair-Detroit River corridor and the entire Great Lakes Basin (17% and 16%, respectively).

6.4 The Development of Risk-based Spill Management Criteria Related to Beneficial Use Impairments for the St. Clair River AOC (2010)

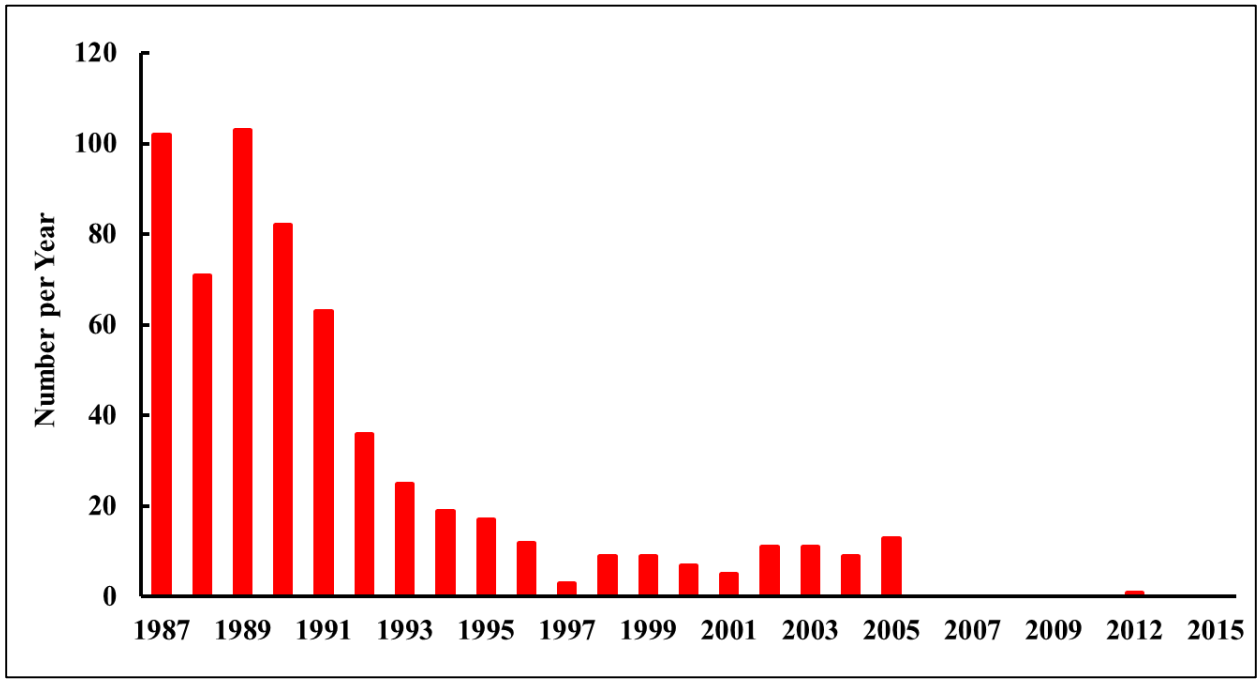
In 2010, Environment Canada commissioned a study with the purpose of developing a risk-based spill management criteria related to water intake shutdowns during a two-year period in the St. Clair River AOC (Li & Cheng, 2010). The researchers used data obtained by the SLEA and the OMOECC's SAC. The SLEA only documented spills originating from member companies that were significant enough to impact downstream water intakes (Figure 3). In contrast, the SAC database included all major and minor spills to roads, parking lots, curbs, soil and surface water originating from among others tanks, trucks, rail cars, pipes and hoses. Li & Cheng (2010) experienced similar challenges to the IJC in comparing the spill data. They attributed these difficulties to differences in spill definitions and data organization, inconsistencies in data inputs, and the short time period selected for analysing spill and shutdown records.

Li &Cheng (2010) reported a comparable reduction in spill frequency (similar to the earlier IJC study). Their analysis found that between 1988 and 1999, the annual number of spills decreased significantly from over 100 to below 20, based on SAC data, which includes reports of all major and minor spills to land, air,

and water. In 2007, the annual number of spills reported by SAC had stabilized to just below 40. The authors suggested that improved operating practices and employee training at the facilities contributed to the reduction in spills, consistent with expected improvements from the introduction of new and improved legislation and regulations (e.g., spill prevention and contingency plans legislation).

In addition to the above, Li & Cheng (2010) attempted to develop a quantified risk level of a spill occurring over different time intervals (2 years, 3 years, 4 years and 6 years) for two separate time periods (1988-1997 and 1998-2007). They used the occurrence of benzene as a surrogate in their risk calculations. Results for the risk of a benzene spill indicated that the level of risk was greater between 1988-1997 than between 1998-2007.

Figure 3: Number of Spills to St. Clair River Originating from SLEA Member Industries that Required a Water Intake Closure Due to the Exceedance of a Provincial Water Quality Objective (original SLEA, 2012; updated by Edwardson, D., SLEA, personal communications, 2015)



6.5 Assessing the Potential Hazards to the River Associated with Vessel Discharges (2013)

In 2013, Environment Canada commissioned another study that analysed vessel spills and discharges within the St. Mary's River AOC and the St. Clair River AOC (French & Sutton, 2013). The purpose of the study was to determine if spill frequencies from vessels between 2001 and 2011 were similar to other areas and AOCs within the Great Lakes Basin. The report also provided an overview of vessel discharge regulations currently in place.

Results indicated that overall the discharges from vessels in both AOCs represented about 15% of the total incidents reported for the Great Lakes. This contribution of spills from marine sources is similar to that

previously found by the IJC in 2006. Further, they found that vessel discharges in the St. Clair River were greater than in the St. Mary's River AOC but were relatively low (11%) when compared to the rest of the Great Lakes. No clear trend in vessel discharges with time of year was detected.

7. Improvements to Reduce the Risk and Consequences of Spills to Drinking Water

For over 20 years, there has been a significant effort by government, First Nations, industry and stakeholders to restore the general environmental quality of the St. Clair River and its ecosystem. These environmental improvements have also supported the dramatic decline in the frequency of spills and subsequent interruptions as well as taste and odour problems associated with drinking water supplied from the St. Clair River. Strategies used to achieve these gains have included improvements in industrial and municipal wastewater management systems design and facilities, new legislation and regulations to prevent and manage spills, and improved industrial and municipal operation, maintenance and performance of sewage treatment systems. The substantial decline in spills over the past 10 years in particular, provides evidence in the effectiveness of infrastructure investment, legislative tools and technological improvements.

7.1 Systemic Improvements to Reduce the Risk of Spills and Their Consequences

Since the RAP was published in 1995, there have been substantial changes to Ontario's environmental protection legislation and regulations. Some laws were enacted shortly after the AOCs came into being; while others came in the early 2000s. Highlights are presented below. In short, the legislation now emphasizes prevention and the consequences to those responsible for spills have become much more serious and timely.

The amendments to the laws for environmental protection were changed most significantly by the *Environmental Enforcement Statute Law Amendment Act* (SO 2005, c. 12). It was a significant part of an evolution of environmental law in Ontario. It expanded the MOECC's powers to deal with industrial polluters and it expanded on the provisions in the *Environmental Protection Act* (*EPA*) (RSO 1990, c. 19) that require directors and officers of corporations to take "all reasonable care" to prevent the corporation from causing or permitting the discharge of a contaminant into the natural environment. For example, industry is required to notify MOE of discharges of contaminants in contravention of the *EPA*, its regulations or an approval under the *EPA*. Similar amendments were also made to the *Ontario Water Resources Act* (*OWRA*) (RSO 1990, c. O.40).

The *EESLAA* also included many other amendments, such as: (a) expanding on the criteria for determining if water is impaired under the *OWRA*, (b) increasing the maximum daily penalties for offences, and (c) shifting the burden of proof to the polluters. As a result of the *EESLAA*, MOECC can impose financial penalties, called environmental penalties (EPs) for contraventions related to the *EPA* and/or the *OWRA,* without going through lengthy court proceedings. All of these changes and more resulted in reduced contaminant loads to surface waters, greater prevention and reduction of spills, and improved spill response.

The following section provides a summary of spill prevention tools currently in place.

7.1.1 Legislation

The Municipal-Industrial Strategy for Abatement (MISA) program under the *EPA* and related regulations came into effect in the early 1990s, at about the same time that the AOC program was established. MISA comprises a group of nine regulations that regulate the industrial discharges of contaminants from prescribed industrial sectors into surface water. Many of the facilities in the Sarnia area are captured within the sectors that are regulated and must adhere to these rules. These regulations have led to major improvements in surface water quality throughout the province and especially in Sarnia. They are still in effect.

As previously discussed, the spill events in 2003 and 2004 were factors that triggered the *Spills Bill*. This Act strengthened spill reporting requirements and introduced environmental penalties. The *Spill Prevention and Contingency Plans* Regulation (OR 224/07) required major industrial sources to proactively prevent spills. It also required that if a spill did occur, the responsible company must respond to it efficiently and effectively to minimize environmental damages. The attributes of this legislative framework follow.

7.1.2 Spill Prevention Plans

A spill prevention plan unique to an industrial facility is required either through the Spill Prevention and Contingency Plan regulation or Environmental Compliance Approval conditions. The regulation requires an analysis of the likelihood of a spill occurring along with potential consequences. The risk assessment must:

a. assess and document the risk of spills,
b. analyse the likelihood of a spill occurring,
c. consider potential adverse effects,
d. assess risk and rank priorities, and
e. develop risk management measures to prevent or reduce potential spills that have a significant risk of occurring and of causing adverse effects.

The plan obliges owners and managers of regulated facilities to develop steps to prevent or reduce the risk of a spill occurring. The next step in development of a spill prevention plan requires that a company consider whether the following actions to reduce the risks need to be taken:

a. installing containment structures;
b. installing and maintaining equipment to monitor operations (e.g., monitors and alarms);
c. changing industrial processes; and/or
d. implementing preventative maintenance programs.

If any of the above actions are found to be necessary, the company is obligated to implement them. Spill prevention plans must be maintained, updated and be available at any time for inspection and compliance with the general requirements of the regulation or Environmental Compliance Approval conditions by OMOECC inspectors.

7.1.3 Spill Contingency Plans

In addition to the spill prevention requirements above, the regulation requires that spill contingency plans be developed addressing spill preparedness and spill response. The plans must be tested regularly and they must be reviewed both annually and after a spill. The spill contingency plan documents the procedures and actions required to prevent, eliminate and ameliorate the adverse effects of a spill and to restore the natural environment. Spill contingency plans must include the following:

a. notification procedures within the plant,
b. agency notification procedures and contact information,
c. prompt response procedures to spills with lists and contacts for appropriate resources,
d. timely liaison with regulatory authorities, and
e. response structure with decision-making authority.

The legislation also requires a high degree of corporate accountability associated with the plans. Annually, an officer or director of the corporation must sign a statement of accuracy and effectiveness.

7.1.4 Modelling and Spill Warning Systems

If a spill occurs, reducing human and ecosystem impacts involves a coordinated response from multiple agencies. It includes: (a) gathering accurate information about the details of the spill such as, what was discharged, from where, when it occurred, how much was spilled, and where it has gained entry to the river; (b) was the spill contained; and (c) many other important factors that aid in assessing the response. The information is entered into models that incorporate (a) the chemical(s) spilled; and (b) key characteristics of the river and the contaminant such as, river bathymetry, current velocity, depth and solubility of the spilled material. Using this information, a model is developed which can predict how the spill will behave in the river. A model can predict when, where, and at what concentration, the spill will travel downstream. This helps responders predict potential effects, warn downstream users, and implement effective impact prevention and clean up strategies.

In-stream monitoring helps confirm the model predictions. During an emergency, responders may be deployed to (a) sample and analyse the water quality at several locations in the river; (b) to monitor the path of the contaminants; and (c) to determine where, when and how the spill has travelled.

The real-time monitoring is available on the St. Clair River and operates on a 24-hour seven days per week basis throughout the year through the SLEA monitoring station at Courtright. The monitoring station incorporates sensitive analytical equipment that detects organic pollutants at low concentrations. This analyser supports an early warning system for downstream users and the data can be used to fine-tune or help confirm the projections of models. The results from this station produce almost real-time information and have been extremely helpful in detecting, responding to, monitoring spill events, and in verifying model predictions.

A basic model for predicting the time of travel and concentration of contaminants was developed by the OMOE in the 1980s for the St. Clair River. It has since been updated and improved. It is a tool that is used routinely to assess spill situations. Anytime a spill is reported, it is used to determine if a response is warranted. The model outputs are communicated to all the stakeholders, including the Medical Officer of Health and the water plant operators, informing them about the spill, if it is necessary to close their water plant intakes, and if required, when to reopen them once the spill has cleared at their location.

An example of a spill scenario at multiple locations along the river is provided in Appendix A. The calculations were produced by the OMOE based on typical mean river conditions. A map and table of distances, and a time-of-travel chart were created from the calculations. It represents scenarios for a 15-minute spill for a variety of sources in the upper part of the river near Sarnia. Depending on the material spilled, flow conditions and other factors, a contaminant spilled from the upper part of the river may typically reach the WIFN intake in just over 12 hours. In these scenarios the contaminant(s) would be at peak concentration in 15 hours. The spill would reach Wallaceburg plant about six hours later.

In the scenario where a spill takes place much further downstream, near the Murphy drain for example, with similar flow conditions, the contaminants could typically reach WIFN intake in 2.5 hours with a peak concentration at 4.5 hours. The same spill would reach Wallaceburg about 6 hours later (Nettleton, P., June 25, 2004). This model has since been updated and improved, but provides a reasonably accurate depiction.

Detailed modelling is also a component of source protection assessments. Sophisticated models have been developed to establish zones where protection is required to prevent contamination of surface waters. This information and the policies related to special protection areas have greatly enhanced the ability to protect drinking water sources in spill situations and to assess risks and prevent threats.

7.1.5 Compliance

Legislation and regulations are always more effective when there is diligent oversight. The MOECC is responsible for ensuring compliance with provincial environmental regulations and acts. As part of their compliance program, the OMOECC conducts proactive inspections of regulated facilities to determine if requirements of acts, regulations, and conditions of Environmental Compliance Approvals are being met. The frequency and sites inspected are determined using a risk-based framework using current information (spills, previous inspection reports, compliance history, etc.). Where deficiencies are noted, facilities are required to come into compliance and follow-up actions are undertaken to ensure that compliance has been achieved.

Most recently, in response to spills in 2013 in the Sarnia area, the MOECC reviewed 35 local industrial facilities in 2013 and 2014 to assess whether they are covered by the Spill Prevention and Contingency Plan (SPCP) regulation or if their Environmental Compliance Approvals require spill prevention and contingency plans. The review showed 25 sites captured under the SPCP regulation.

As a result of the review, the MOECC conducted focused field SPCP inspections at 14 facilities that had not been inspected in the last two years. 10 of those facilities were captured under the SPCP regulation. The other 4 had SPCP conditions in their ECA. The MOECC identified administrative non-compliance issues for 11 out of the 14

inspections. The inspections did not identify any immediate or potential environmental impacts. The facilities that were in non-compliance were promptly brought into compliance (McCharles, S., personal communication, 2015).

7.1.6 Environmental Penalties

In addition to the Spill Prevention and Contingency Act, the Environmental Enforcement Statute Law Amendment Act also introduced the Environmental Penalties (EP) regulations (OR 222/07 and OR 223/07). The EP regulations allow the OMOECC to impose monetary penalties for unlawful spills and discharges under the Environmental Protection Act and the Ontario Water Resources Act without laying charges. The EP regulations apply to facilities in the nine Municipal Industrial Strategy for Abatement (MISA) industrial sectors, and similar facilities that discharge sewage to surface waters. Penalties of up to $100,000 per day may be imposed by the OMOECC in addition to possible future prosecutions for the same violation. Further, due diligence cannot be used as a defence and will only be considered in determining the amount of the penalty.

There are numerous types of violations subject to EP, including

a. causing a spill that may cause an adverse effect or impair water quality,
b. failure to report a spill,
c. failure to develop and implement spill prevention and spill contingency plans, and
d. exceedances of a discharge limit.

The total amount charged to a company or person who violates the regulation is dependent upon the severity of the spill, impacts and the facility's past history (e.g., previous convictions or spills causing impacts). Monetary contributions from imposed EP fines are made available for environmental rehabilitation projects in the area in which the spill occurred. Resources from this Ontario Community Environment Fund have been made available and used in the St. Clair River AOC. The MOECC reports that there have been no charges laid for spills since 2010.

The OMOECC has established an investigation and enforcement branch that investigates all spill events to determine if all due diligence was followed and if charges are warranted.

7.1.7 Source Controls

Through previous work plans under the RAP, the OMOECC committed to a number of actions to reduce contaminants being discharged to the river. These actions were reported in the Work Plan 2007-2010 Report of Accomplishments (CRIC, 2012b). A summary of these actions includes:

a. Maintain and review point source regulatory monitoring (MISA) and Environmental Compliance Approvals (formerly Certificate of Approvals) to ensure reporting and information dissemination.
b. Ensure that Water Pollution Control Plants (WPCPs) continue to meet current regulations.
c. Work closely with industries to improve spill prevention, prediction, and response.

8. Industrial Risk Reduction Initiatives

Industrial plants have also made significant changes to their facilities and procedures to reduce spills to the river. Ranging from infrastructure improvements to enhanced spill warning systems, industrial facilities have responded to the need to reduce spills to the river. Some plants have gone beyond the regulatory requirements, setting an example for others to follow. In fact, the major companies/facilities that operate in the Sarnia area have invested over $100 million in spill prevention over the past 10-15 years. The recent investments in improvements installed at major facilities include: new containment ponds, increased storm water retention, improved monitoring, and expanded treatment plants. Once-through-cooling water systems (OTCW) have been replaced or enhanced. As well, leak detection and prevention technologies have been installed.

The following are examples of improvements undertaken at selected facilities which have connections to the river.

8.1 Suncor

a. A new $3 million storm water containment pond built in 2008 increased rainwater retention capacity to handle a 1-in-25-year type of storm.
b. Optimization of sewage treatment facilities were implemented in 2010 and 2011, reducing the number of plant upsets and generally improving treatment effectiveness.
c. Storm water is continuously analyzed and is treated before being discharged to the river.
d. OTCW system now includes regular inspections and leak detection monitoring. Only one leak has occurred during the period of 2005 to 2011.

8.2 Imperial Oil

a. An OTCW spill prevention plan was initiated in 2005 and completed in 2009.
b. In 2006, eight heat exchangers were moved from OTCW and are now connected to cooling towers; thus reducing the plants connection to the river.
c. Leak detection and diversion capabilities were improved for the remaining OTCW lines.

8.3 Shell Oil

a. In 2011, a nine-million-gallon storm water management facility was constructed in addition to the existing six-million-gallon facility.
b. Each cooling water stream has two sets of continuous online monitoring of cooling water effluent.
c. Their waster water treatment plan has been improved and expanded.

8.4 NOVA

a. Heat exchangers are inspected regularly to ensure equipment integrity.
b. Analyzers have been installed on sewer systems and process ponds to allow for early detection of leaks.
c. Additional spill containment is used for portable equipment.

CRIC plans to survey major Sarnia industrial facilities during the consultation period for this discussion paper. The results will address the full extent of industry investment in spill prevention/spill reduction since 2005, and planned for the near future. The survey outcomes will be made public when available.

9. Municipal Improvements

Municipal investment in wastewater management and treatment has been significant in the past 10 years and has dramatically improved water quality in the St. Clair River. Historically, wastewater treatment facilities could not treat all sewage during wet conditions and bypassing of sewer and/or storm water was often necessary. These bypasses to the river were unsightly and posed a potential health risk as elevated levels of bacteria in raw water has the potential to cause illnesses such as nausea and diarrhea. Taste and odour of drinking water can also be affected. Modern drinking water treatment plants can effectively treat these contaminants and there have been no waterborne diseases that have been attributable to these sewage bypasses, however reducing this risk and improving general water quality for recreational uses requires better treatment.

The City of Sarnia owns and operates two wastewater treatment plants; one located in the City proper and a second located in the hamlet of Bright's Grove, St. Clair Township. The Township of St. Clair also operates sewage treatment facilities discharging to the river. The following are highlights of some of the recent improvements to those facilities:

a. In 2001, the City completed a $39 million Sewage Treatment Plant (STP) upgrade from primary to secondary treatment.
b. In 2009, the City undertook an assessment of its wastewater treatment facility. The report recommended that a Master Plan for sewage treatment be initiated to review all treatment and conveyance facilities. The City is continuing the planning process to develop the plan.
c. St. Clair Township owns and operates a recently upgraded wastewater treatment plant. In 2013, a $35 million project converted the Corunna wastewater treatment plant to a pumping station and upgraded the wastewater treatment plant in Courtright. The new Corunna pumping station conveys sewage from the Corruna and Courtright communities to the expanded Courtright facility. As part of the project, the remaining unserviced areas of Courtright were connected to the municipal sewers. The plant expansion provides sufficient capacity to support future population growth (Young, 2013).

9.1 Separating Combined Sewers

Currently, work is continuing in Sarnia and Wallaceburg to separate the combined sewers that discharge to the St. Clair River. Presently, 95% of the combined sewer overflow (CSO) projects in Wallaceburg have been completed (Dudley, R., Chatham-Kent PUC, personal communication, 2015).

In Sarnia, about 15 kilometres of combined sewers have been separated between 2006 and 2014. Sewer separation and plant upgrades total a $65-million-dollar investment since 2000. CSO discharges (including wastewater treatment plant bypasses) were reduced by 40%, with no CSO events into the St. Clair River occurring since 2010. Approximately 24 kilometers of the original 39 kilometers of combined sewers remain to be separated. Most recently, the combined sewers at Exmouth and Christina Streets have been separated with future work focusing on Cromwell and Devine Streets (City of Sarnia Engineering Department, 2014). The City has a 10-year capital plan that identifies $67 million for future sewer separation projects. (Rawat, P., City of Sarnia, email, Jan. 14, 2016).

Bypasses from pumping stations or the sewage treatment plant continue to be reduced but have not been eliminated. Most recently, Sarnia initiated a $700,000 project that will enable the city to monitor and manage wastewater flows into all of the City's 56 pumping stations. This automated system will further reduce bypasses to the river.

9.2 Chatham-Kent Drinking Water Treatment Plant Future Considerations

Water Treatment plant owners in Ontario continuously monitor and assess the status of their facilities. Chatham-Kent has recently completed a Water and Wastewater (W&WW) Master Plan (Dillon Consulting Limited, 2012). The purpose of the plan is to identify a long-term servicing strategy covering the next 20 years. The 2012 edition was based on previous long-term planning documents prepared by Chatham-Kent. A Class Environmental Assessment for this water treatment plan was initiated in 2013. The Public Utilities Commission Board recently elected to rehabilitate the existing facility as the preferred alternative. The 10-year capital program will address the upgrades (Chatham-Kent PUC, 2016).

10. Spill Response in the Sarnia Area

Many improvements in prevention and response to spills have been made since the St. Clair River AOC was listed, including the creation of the provincial Spills Action Centre (SAC) in 1985.

The government of Ontario, (MOECC) has a legislative-based mandate for spills and emergencies in the province. Reports of spills are communicated to the MOECC's district offices by the Spills Action Centre (SAC) 24/7. Since 1985, SAC is the one window for initial advice and direction to companies, first responders and individuals reporting a spill. SAC may also advise other agencies or communities that may be involved or affected by a spill. MOECC provides field response, as required, and enforces legislated responsibilities. When a spill occurs in Ontario, the company or individual responsible for the spill is required by law to take prompt action to address the spill, notify the MOECC, clean up the spill, and restore the environment.

The MOECC has field response personnel stationed across the province who receive notifications from SAC and/or the public. Staff in Sarnia District respond to spills and other environmental emergencies 24/7. The response required by the District will depend on a number of factors such as contaminant involved, amount spilled, location of discharge, source of spill, duration of incident, and media impacted (land, air, water). For spill sources that fall under MOECC mandate (e.g. industrial discharges), the MOECC ensures actions are taken by a responsible party to contain and clean-up a spill in accordance with environmental legislation and that preventive measures are implemented to reduce risk of re-occurrence. The Sarnia District will consult with the Technical Standards and Safety Authority and/or the National Energy Board to confirm the lead in the event of a pipeline spill. The District will also consult with Transport Canada and the Canadian Coast Guard to confirm the lead for ship based spills, including spills during transfer of materials from land to ship or ship to land. The MOECC will act as a resource to these agencies to assess spill containment, clean–up, and protection of downstream drinking water supplies.

Other resources include first responders (fire, police and municipal public works), local and centrally located scientific support staff, and drinking water specialists. The ministry can require actions to be taken by a company or individual responsible for a spill. They can also provide varying degrees of sampling, modelling, and monitoring support to ensure that the spill is addressed by responsible parties in the most effective manner. The regional office in London has surface water scientists who can provide expert local knowledge. Drinking water specialists and Standards Development toxicologists are available to assist with spills or related emergencies that threaten drinking water supplies. The MOECC will document all findings, actions, and recommendations.

The federal government also plays an important role in emergency response. Environment and Climate Change Canada, the Department of Fisheries and Oceans, including the Canada Coast Guard, Health Canada, and Indigenous and Northern Affairs Canada may all play a role in responding to spills. Many of the departments have scientific specialists who can provide advice for response or protection issues. A Canadian Coast Guard Base is located in Sarnia.

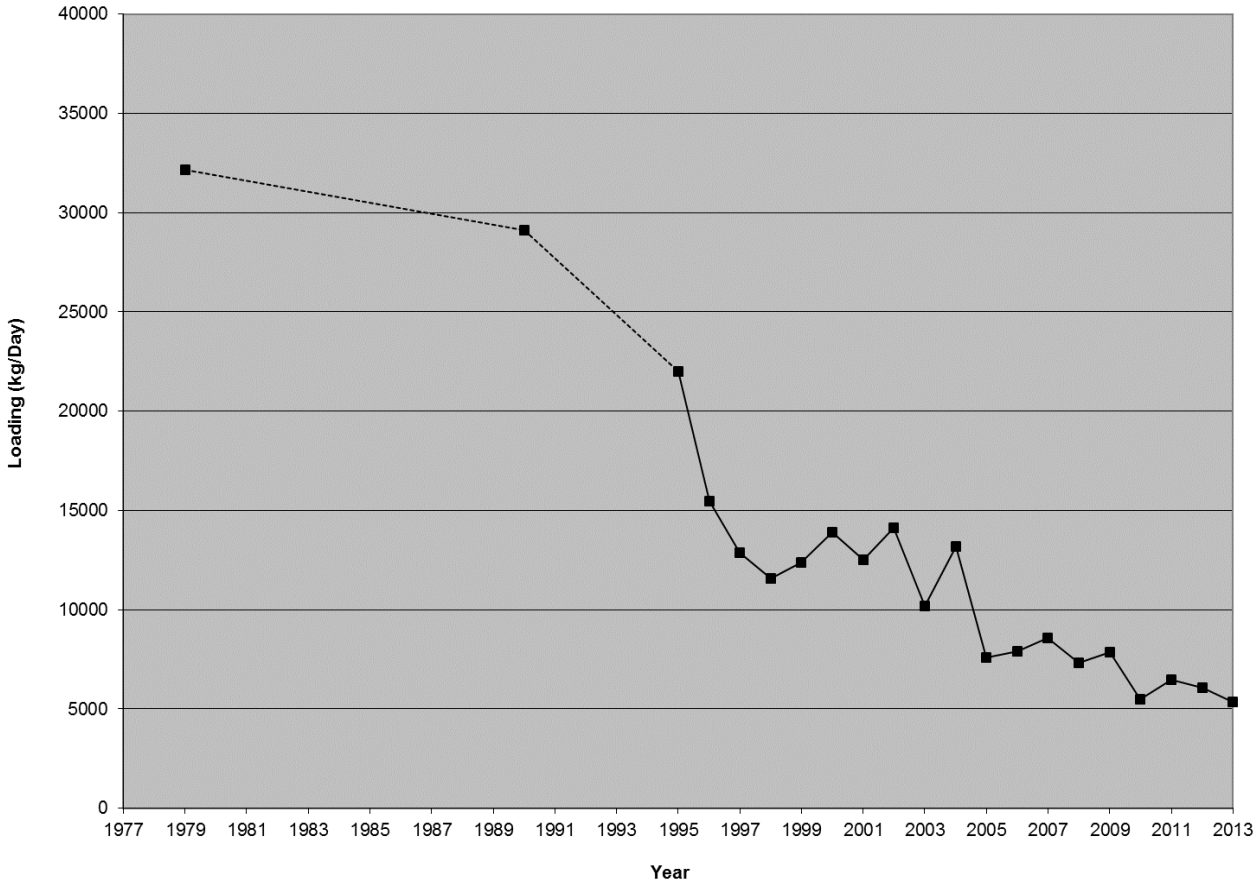
Owing to the considerable industrial activity and infrastructure in the Sarnia area, several of the corporations have developed advanced levels of environmental response capabilities. They have created cooperative approaches and structures to respond to emergencies with local resources and expertise.

The Chemical Valley Emergency Coordination Organization and the Community Awareness and Emergency Response (CAER) Committee also serve to provide coordinated emergency responses in the Sarnia area. Through these organizations, industries and municipalities work together to ensure public safety during an emergency through advanced communications systems, established networks and trained professionals with state-of-the-art equipment that can respond quickly. Over the years, local expertise and private businesses have developed a significant presence and infrastructure to respond to emergencies in the Sarnia area. Equipment and personnel who have local knowledge and partners are available to respond at all times. The government and private sector expertise, experience, local knowledge, and capacity to respond to emergencies are quite strong in the Sarnia area.

11. Improvements in the Reduction of Discharges

As discussed earlier, the MISA legislation was introduced by the Provincial government in 1988. The MISA program regulates the discharge of pollutants from industrial facilities into Ontario's waterways and enforces penalties for non-compliance. It required that best available technology be used by industry to reduce the discharge of contaminants to the river. Trends related to the discharge of contaminants have been steadily decreasing since MISA implementation, with an 81% loading reduction between 1990 and 2013 (Figure 4).

Figure 4: Chemical Loadings* Between 1990 and 2013 for 17 Industrial Facilities with Point Source Discharges in the St. Clair River Area of Concern (OMOECC, personal communications, 2015)



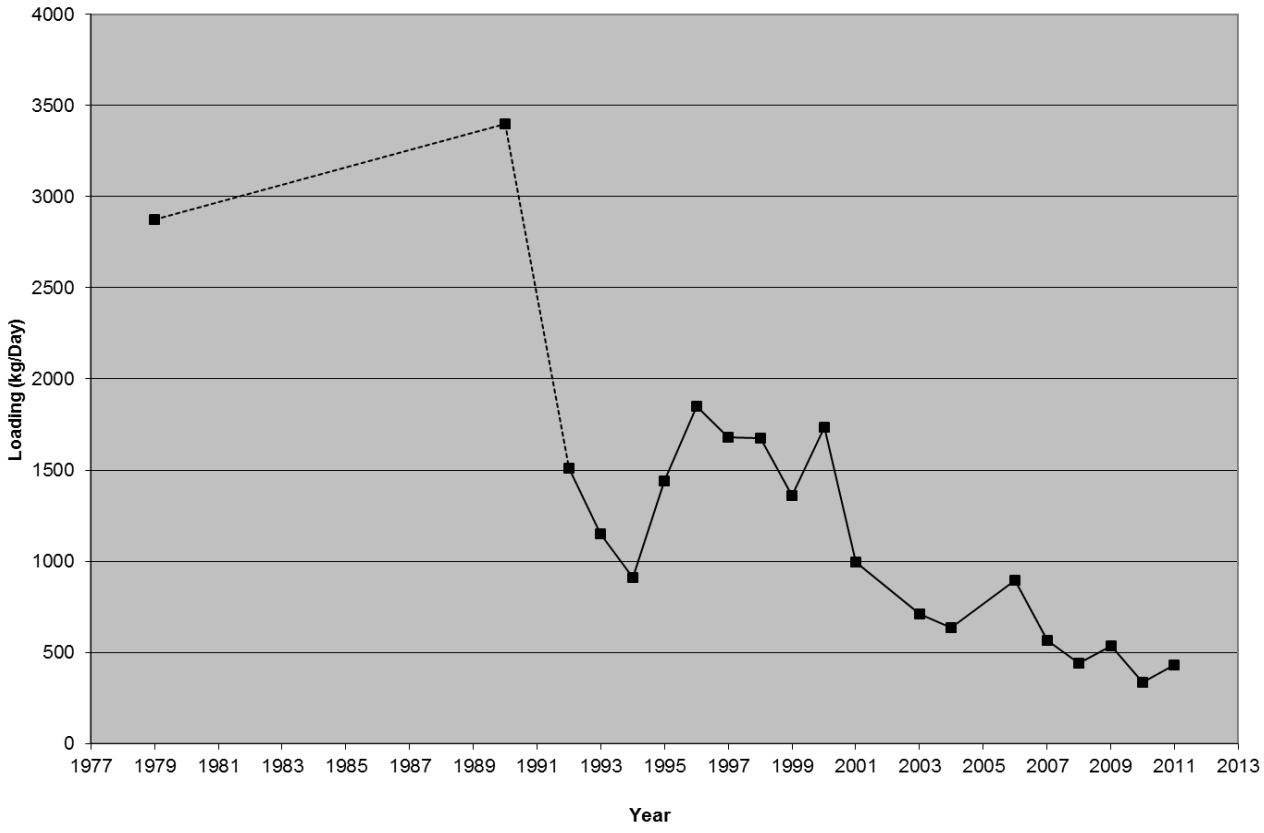
*Note: 19 parameters--suspended solids, solvent extractables, biological oxygen demand (BOD), chemical oxygen demand (COD), total organic carbon (TOC), ammonia, phenolics, phosphorus, copper, chromium, iron, lead, nickel, zinc, chlorides, fluoride, arsenic, cyanide and sulphates

Since 2007, seven industrial discharge points to the river originally regulated by MISA have been decommissioned and are no longer a source of contaminants to the river. The closures have reduced the

pollution load to the river and have eliminated the risk of spills from the facilities. Examples of industries that have closed include: Dow Chemical, Ethyl Canada Inc., Royal Polymers Co., and Ontario Power Generation's Lambton Generating Station.

Improvements to water pollution control plants in Sarnia and St. Clair Township described earlier resulted in a reduction of approximately 85% in loading of sewage-related contaminants to the river between 1990 and 2011 (Figure 5).

Figure 5: Loadings* from Seven Municipal Facilities with Point Source Discharges into the St. Clair Concern (AOC) Between 1990 and 2011 (OMOECC, personal communications, 2014)



*Note: 3 parameters (BOD5, Suspended Solids, Total Phosphorus)

12. Drinking Water Protection

Prior to Ontario's Walkerton tragedy in 2000, the provincial government had in place general measures to protect the environment, reduce contaminants, prevent spills to the river, and react efficiently and effectively to emergencies when they occurred. In response to Walkerton, the province proclaimed *Ontario's Safe Drinking Water Act* (SDWA) and the *Clean Water Act* (CWA)—SO 2002, c. 32; and SO 2006, c. 22 respectively, to substantially improve the protection of water sources and water treatment plant operations. With the introduction of a series of related regulations, a source-to-tap program that safeguards drinking water quality across the province was established. The Province has become a leading jurisdiction in the world in producing safe drinking water and protecting drinking water sources.

12.1 Ontario's Safe Drinking Water Act (SDWA)

The purpose of the *Safe Drinking Water Act* is to protect human health through the control and regulation of drinking-water systems, drinking water testing, and Water Treatment Plants (WTP) operations. The Act regulates the issuance of Operating Authority Permits and Licenses (e.g., Drinking Water Works Permit), specifies standards that for potability, treatment, monitoring, testing, reporting adverse results and distribution of drinking water. It sets training and licensing standards for the operation and maintenance of water treatment facilities and public water supply systems.

All water treatment plants (including Wallaceburg's) must meet the relevant requirements of the SDWA and its regulations. However, First Nations' water plants, such as the water treatment plant located on Walpole Island, do not fall under the jurisdiction of the Province and are not obliged to follow the OMOECC requirements. The WIFN community, however, has voluntarily implemented a policy to strive to meet equivalent standards and operating procedures as provincially-regulated facilities.

12.2 Ontario Clean Water Act

Under the 2006 Clean Water Act, Source Water Protection for drinking water has been strengthened. The purpose of the CWA is to protect sources of drinking water for now and into the future.

The CWA requires that local Source Water Protection Committees for designated areas develop science-based assessment reports and source protection plans for the water sources in their local area. An assessment report identifies risks and threats to the drinking source. In the case of the surface water sources, Intake Protection Zones (IPZ) were developed. An Intake Protection zone is an area of water or land around a municipal water intake where care must be taken to avoid spills or leaks from potential contamination sources. Each IPZ has three areas within it: IPZ-1, IPZ-2, and IPZ-3. IPZ-1 is a predetermined distance from the intake; IPZ-2 zone is delineated using the time of travel from a potential source of contaminant to the water intake. The IPZ-2 is designed to provide sufficient notification for the operator to close the plant before a release of contaminants reaches the intake. A third zone, IPZ-3, is delineated through events-based modelling and vulnerability assessments. The modelling simulates a spill arising at specific fixed locations.

Committees were required to look at existing and potential threats and set out plans to address them. The Thames-Sydenham Source Protection Committee (TSSPC) was established in 2007, consisting of 25 stakeholders from the region. The Upper Thames River, Lower Thames Valley, and St. Clair Region Conservation Authorities worked together with the Source Protection Committee to develop a plan for the watersheds.

The TSSPC worked under the Ministry of the Environment and Climate Change's guidelines and rules related for the development of Source Protection documents and created its science-based plans that reflected local conditions, expertise, and authorities. Technical studies were completed to inform the assessment report and the resulting protection plans. The TSSPC recently approved the Thames–Sydenham Source Protection Plan. It came into effect on December 31, 2015 (Thames-Sydenham and Region Source Protection Committee, 2015). IPZ-1, IPZ- 2, and IPZ-3 for the Wallaceburg plant are also available in the TSSPC technical studies. In the case of the IPZ-2 for Wallaceburg intake, operators determined that they could close the plant within two hours of being notified of a spill. There is no detailed information for Intake Protection Zones specifically for the WIFN water plant, as it was not assessed under the CWA. However, much of the information collected on the watershed and developed for modelling spills will be applicable to the WIFN intake.

12.3 Federal Safe Drinking Water for First Nations Act

In 2013, the federal government introduced the *Safe Drinking Water for First Nations Act* (SC 2013, c. 21). The intent of the legislation is to provide comparable levels of health and safety protection for drinking water as exists at facilities across Canada. Regulations under this new Act will be developed together with First Nations communities on a regional basis. The regulations will focus on 11 components including protection of water sources, facilities design, construction, distribution systems, and many of the operational aspects of systems, including operator training certification and standards. These improvements are intended to close the regulatory and drinking water protection gaps between provincial and First Nations jurisdictions.

13. Discussion

13.1 Risk Reduction Summary

In summary, the following tools and actions have been employed as part of a multi-barrier approach to protecting the St. Clair River from contamination and ensuring safe drinking water:

a. enforcing regulations and applying penalties or other compliance promotion tools as appropriate;
b. requiring Environmental Compliance Approvals for wastewater treatment facilities;
c. imposing monitoring and reporting requirements for wastewater discharges;
d. mandatory monitoring of drinking water quality;
e. inspecting industrial facilities and drinking water treatment facilities to ensure compliance with all relevant requirements;
f. applying environmental penalties as appropriate;
g. timely, efficient, and effective response to spill incidents; and
h. efforts by industry (and other stakeholders) to reduce spill potential and to improve containment and collection of polluted waters before it enters the St. Clair River.

13.2 Spills Frequency and Severity Decreased

Despite data management issues referred to in Section 1, the conclusion of all the referenced studies was that spills have decreased significantly over the past 20 years. This reduction was particularly evident since 2005. From 2005 to the 2015, seven corporations (some with multiple sources of industrial spills), including, all of the Dow facilities, Royal Polymers, Praxair Mooretown, Chinook, Welland Chemical and the Lambton Generating Station have ceased operation and are no longer a risk (threat) to the drinking water facilities.

As referenced earlier, facilities located adjacent to the river have reduced their connection to the river by replacing several once-through-cooling (OTC) water connections, improving monitoring and spill detection and response systems, expanding, and improving water treatment facilities. Decreases in the number and frequency of spills from member industries of the SLEA have been observed over the last decade. Three spills have occurred in the last seven years that have resulted in mandatory water intake closures.

Based on our assessment of the information and the conclusions of the referenced reports, the additional regulatory requirements of spill prevention improvements, spill response, and the spills prevention measures implemented by local facilities have had a significant effect on the frequency and severity of spills.

13.3 Fewer Water Intake Closures

Observations made by operational staff at the two water treatment plants (Walpole Island First Nation and Wallaceburg) supported the finding of a significant reduction in spills with the potential to cause the closure of a water intake. They reported that the frequency and severity of chemical spills from industry

have decreased considerably over the past 20 years. When compared to the *Stage 1* RAP, spills that closed water plants have been reduced by one hundred times.

There have been four periods of more than two years long, between 2000 and 2015, when no spills occurred that caused a closure of the water intake. An analysis of the sources of recent spills also revealed a difference in the sources of spills compared to previous years. From 2006 to 2014, a period of eight years, there were three spills that required the WIFN and Wallaceburg drinking water plants to close their intake. These spills were related to: (a) an unknown source in 2008, which has never been identified, (b) an accidental release from a vessel being loaded with product at a commercial dock in 2012 and (c) an underground pipeline rupture that released diesel fuel in 2013. None of these closures was caused by the in-plant industrial process spills or upsets, which were historically the main source of the spills.

13.4 Systemic Improvements

The regulatory initiatives, which came into effect following the introduction of the Spills Bill in 2005, represent a systemic improvement in the protection against spills. It is a system as opposed to a single or multiple acts. These systems of prevention, response, compliance, and enforcement have greatly improved the protection of the St. Clair River from spills. The comprehensive and robust framework that has resulted in reduced spills to the river and better responses when they do occur includes

a. mandatory spill prevention plans,
b. mandatory spill contingency plans,
c. increased government oversight,
d. mandatory spill response plans,
e. higher automatic penalties for breaching the regulations,
f. stronger accountability for the directors of companies who spill; and
g. enhanced environmental ethic by companies along the St. Clair River.

Compliance and enforcement activities by the OMOECC have assured that the plans are in place and being respected, lending greater credibility to the long-term effectiveness of the regulations. However, although spills have been reduced to very few occurrences over the past several years, they have not been eliminated.

Since 2000, not only has Ontario's source water protection been significantly enhanced, the province is now among the world leaders in this field. These improvements in source water protection can be attributed to:

a. legislation and regulations requiring some of the highest standards in drinking water production and protection in the world,
b. a separate division of inspectors to ensure compliance and enforce the drinking water protection rules,
c. improved water treatment research,
d. enhanced Water Treatment Plant (WTP) operator training and certification,
e. more efficient and reliable WTP operation,
f. identification of local risks to source water,

g. delineation of intake protection areas through advanced modelling techniques, and
h. implementation and enforcement of site-specific plans to eliminate risks to water sources.

The environmental regulations related to spill prevention and water source protection have established one of the best drinking water protection frameworks in the world.

The Walpole Island water treatment plant, however, does not benefit to the full extent possible from the Source Water Protection initiatives. The community did not participate in the Source Water Protection work and thus does not have source water protection plans in place compared to the rest of the Province. However, much of the work done to protect the Wallaceburg intake will also help to protect WIFN (improved modelling, upstream source identification, threat assessments, etc.) once the community begins its process. Future initiatives, which are part of the federal Safe Drinking Water for First Nations Act should result in enhanced protection as well.

13.5 Drinking Water Risk Reduction Summary

The following table summarizes major changes that have occurred since the RAP *Stage 1* report related to the factors associated with the removal of the Drinking Water BUI. It compares the occurrence of spills, water intake closures, improvements in infrastructure, legislation, source water protection, monitoring, and modelling.

Table 2: Drinking Water Risk Reduction Summary

Drinking Water Risk Reduction Summary		
Issue	**Stage 1 RAP Status**	**Status (2015)**
Spills with the potential to affect water plants frequency	Average >100 per year, 1986–1989	Average < 1 per year (2006-2015)
Number of industrial facilities	27	19 (excludes closure of Lambton Generating Station and Ethyl Corp.)
Wallaceburg Water plant closures due to spills	Frequent, long duration	3 mandatory and 6 precautionary intake closures in 10 years (2006–2015). Current backup connections with the secure LAWWS systems ensures continuous water supply even when the intake is closed.
Spill prevention legislation	Only general requirements of the acts and regulations	Specific spills-related amendments and related regulations
Spill prevention plans	Only voluntary, no regulated requirement or content	Detailed plans required for specific sectors by regulation, including senior levels of corporate accountability. Plans inspected regularly.
Spill contingency plans	Only voluntary, no regulated requirement or content	Detailed plans required by regulation, regularly inspected by OMOECC
Government oversight/compliance	Reactionary to spills, complaints and reports. No dedicated investigation and enforcement resources.	Systematic, comprehensive and planned inspections carried out on a risk management basis. Dedicated and trained investigation and enforcement resources. Greater enforcement powers including an administrative penalty system
Monitoring	Infancy of MISA regulated industry effluent monitoring requirement and start of SLEA monitor (1987)	MISA and Environmental Compliance Approval industrial discharge monitoring, track industrial discharges. SLEA monitor at Courtright, downstream of major spill sources provides alarms to SLEA members and OMOECC.

Drinking Water Risk Reduction Summary		
Issue	**Stage 1 RAP Status**	**Status (2015)**
Spill modeling	Rudimentary	Highly developed, tested and accurate
Source water protection plans	Non-existent for both WIFN and Wallaceburg	World class for Wallaceburg intake. The federal Safe Drinking Water for First Nations Act is expected to result in a plan for WIFN.

14. Proposed Questions for First Nation and Public Engagement

What other changes, short of a complete elimination of spills, would result in the re-designation of the Drinking Water BUI to unimpaired? In spite of the many improvements described in this paper to reduce spills to the river, ranging from legislation to 24-hour water quality monitoring protection, and the 100 times reduction in the number of spills between the late 1980s and present, the residents who are dependent upon the St. Clair River continue to express concerns for the impact of spills on their local drinking water quality and supply.

It is hoped that this information will provide a catalyst for public discussion sessions, regarding the Drinking Water BUI. We expect many questions and issues to be raised through the public input process. The following sample questions are proposed to elicit input to the future status assessment report of this beneficial use impairment.

a. Given the significant reduction in the number of spills to the St. Clair River over the past several years, and the systemic improvements in place that reduce the risks of spills and protect drinking water sources into the future--have there been sufficient improvements in the AOC to conclude that the risks of impairment are no greater than other Great Lakes locations?

b. What level of risk is acceptable in order to re-designate the BUI to unimpaired?

c. Are there any other actions required before we can re-designate the BUI?

d. How long is long enough without an intake closure, to declare that the impairment has been resolved?

e. Are the delisting criteria for this beneficial use impairment acceptable?

f. If the delisting criteria are inadequate, what alternate criteria could be suggested?

The CRIC looks forward to hearing the concerns of the residents, stakeholders and First Nation communities through an open and transparent public input process. The results of the public consultation process will be published and will be taken into account when the final review of this BUI is undertaken.

REFERENCES

Bi-national Public Advisory Council (BPAC). (2011). *Minutes of October Meeting*. Retrieved from Friends of the St. Clair River website: http://www.friendsofstclair.ca/www/pdf/minutes/2011/BPAC%20Minutes%20Oct%2027,%202011.pdf

Bi-national Public Advisory Council (BPAC). (2014). *Minutes of June Meeting*. Retrieved from Friends of the St. Clair River website: http://www.friendsofstclair.ca/www/pdf/minutes/2014/Final%20Draft%20BPAC%20Minutes%20-%20June%2010%202014.pdf.

Canadian Remedial Action Plan Implementation Committee (CRIC). (2007). *Work Plan 2007-2010*. Retrieved from Friends of the St. Clair River website: http://www.friendsofstclair.ca/www/pdf/rap/workplan.pdf.

Canadian Remedial Action Plan Implementation Committee (CRIC). (2012a). *St. Clair River Area of Concern Revised Delisting Criteria*. Retrieved from Friends of the St. Clair River website: http://www.friendsofstclair.ca/www/pdf/resources/Final%20Delist%20Criteria%20Report%20May%202012.pdf.

Canadian Remedial Action Plan Implementation Committee (CRIC). (2012b). *2012 Workplan Accomplishments Report.* Retrieved from Friends of the St. Clair River website: http://www.friendsofstclair.ca/www/pdf/resources/WorkPlanAccomplishments%20-%20LowRez.pdf.

Canadian Remedial Action Plan Implementation Committee (CRIC). (2013). *St. Clair River Area of Concern 2012-2017 Workplan*. Retrieved from Friends of the St. Clair River website: http://www.friendsofstclair.ca/www/pdf/resources/St.%20Clair%20River%20AOC%202012-2017%20Work%20Plan.pdf.

Chatham-Kent Public Utilities Commission. (2016). *Wallaceburg and Area Water Supply System Municipal Class EA*. Presentation retrieved from City of Chatham-Kent website: http://www.chatham-Kent.ca/SiteCollectionDocuments/Water_Wastewater_Services/Wburg%20Class%20EA/Presentation%20PIC%204%20-%2018feb2016%20Rev3.pdf.

City of Port Huron. (2014). *Capital Improvement Program City of Port Huron 2014-2015 Through 2019-2020* (Draft). Retrieved from City of Port Huron website: http://www.porthuron.org/pdfs/finance/Capital_Imp_2014-2015.pdf.

Clean Water Act, SO (2006, c. 22). Retrieved from Government of Ontario website: https://www.ontario.ca/laws/statute/06c22?search=Clean+Water+Act.

Dillon Consulting Limited. (2012). *Municipality of Chatham-Kent Water and Wastewater Master Plan Final Report*. Retrieved from City of Chatham-Kent website: http://www.chatham-kent.ca/WaterandWastewaterServices/Pages/WaterWastewaterMasterPlan.aspx.

Environment Canada. (2005). *The St. Clair River Area of Concern Remedial Action Plan Progress Report. Volume 1 –Synthesis Report Environmental Conditions and Implementation Actions (1998 – 2003)*. Retrieved from Friends of St. Clair River website: http://www.friendsofstclair.ca/www/pdf/rap/progress.pdf.

Environmental Penalties (OR 222/07). Under Environmental Protection Act RSO (1990, c. E. 19). Retrieved from Government of Ontario website: https://www.ontario.ca/laws/regulation/070222?search=Environmental+Penalties&use_exact=on.

Environmental Penalties (OR 223/07). Under Environmental Protection Act RSO (1990, c. E. 19). Retrieved from Government of Ontario website: https://www.ontario.ca/laws/regulation/070223?search=Environmental+Penalties&use_exact=on.

Environmental Protection Act, RSO (1990, c. 19). Retrieved from Government of Ontario website: https://www.ontario.ca/laws/statute/90e19?search=Environmental+Protection+Act.

French, R. and J. Sutton. (2013). *Assessing the Potential Hazards to the River Associated with Vessel Discharges – St. Mary's River AOC, St. Clair River AOC*. Report prepared for Environment Canada by French Planning Services, Inc., Bracebridge, Ontario.

Government of Ontario. (2015). *About Ontario*. Retrieved from Government of Ontario website: http://www.ontario.ca/page/about-ontario#section-4.

International Joint Commission (IJC). 1991. Commission Approves List/Delist Criteria for Great Lakes Areas of Concern. Focus on International Commission Activities, Vol. 16, Issue 1. Retrieved from IJC website: http://www.ijc.org/rel/focus/listdelist/lidemain.html.

International Joint Commission (IJC). (2006). *Report on Spills in the Great Lakes Basin with a Special Focus on the St. Clair-Detroit River Corridor*. Retrieved from IJC website: http://www.ijc.org/files/publications/ID1594.pdf.

Li, J. and Cheng, V. (2010). *The development of risk-based spill management criteria related to beneficial use impairments for the St. Clair River AOC*. Report to Environment Canada by Ryerson University, Department of Civil Engineering, Toronto, Ontario.

Michigan Department of Environmental Quality. (2008). Guidance for Delisting Michigan's Great Lakes Areas of Concern. Retrieved from Government of Michigan website: http://www.michigan.gov/documents/deq/wb-aoc-delistguide_247421_7.pdf.

Ontario Drinking Quality Water Standards, OR 169/03. Under Safe Drinking Water Act, SO (2002, c. 32). Retrieved from Government of Ontario website: https://www.ontario.ca/laws/regulation/030169?search=Safe+Water+Drinking+Act+.

Ontario Ministry of the Environment (OMOE)/Michigan Department of Environmental Quality (MDEQ). (1991). *The St. Clair River Area of Concern Environmental Conditions and Problem Definitions,*

Remedial Action Plan Stage 1. Retrieved from Friends of St. Clair River website: http://www.friendsofstclair.ca/www/pdf/rap/rap2.pdf.

Ontario Ministry of the Environment (OMOE)/Michigan Department of Environmental Quality (MDEQ). (1995). *The St. Clair River Area of Concern Water Use Goals, Remedial Measures and Implementation Strategy, Stage 2 Remedial Action Plan.* Retrieved from Friends of St. Clair River website: http://www.friendsofstclair.ca/www/pdf/rap/rap2.pdf.

Ontario Ministry of the Environment and Climate Change (OMOECC). (2015). *Minister's Annual Report on Drinking Water*. Retrieved from Government of Ontario website: https://www.ontario.ca/page/ministry-environment-and-climate-change-ministers-annual-report-drinking-water-2015.

Ontario Water Resources Act RSO (1990, c. O.40). Retrieved from Government of Ontario website: https://www.ontario.ca/laws/statute/90o40?search=Ontario+Water+Resources+Act.

Safe Drinking Water Act SO (2002, c. 32). Retrieved from Government of Ontario website: https://www.ontario.ca/laws/statute/02s32?search=Safe+Drinking+Water+Act&use_exact=on.

Safe Drinking Water for First Nations Act, SC (2013, c. 21). Retrieved from the Government of Canada website: http://laws-lois.justice.gc.ca/PDF/S-1.04.pdf.

Sarnia-Lambton Environmental Association. (2011). *2011 Progress Review Technical Summary*. Retrieved from the Sarnia-Lambton Environmental Association website: http://www.sarniaenvironment.com/wp-content/uploads/2013/12/SLEA-2011.pdf.

St. Clair Region Conservation Authority. (2014). Status of the Degradation of Aesthetics Beneficial Use Impairment. Retrieved from Friends of the St. Clair website: http://www.friendsofstclair.ca/www/pdf/Degradation%20of%20Aesthetics%20-%20SCR%20AOC%20-%20BUI%20Assessment%20Report%20-%20February%2016,%202016.pdf.

Spill Prevention and Contingency Plans Regulation (OR 224/07). Under the Environmental Protection Act RSO (1990, c. E. 19). Retrieved from the Government of Ontario website: https://www.ontario.ca/laws/regulation/070224?search=spill+contingency+plans&use_exact=on.

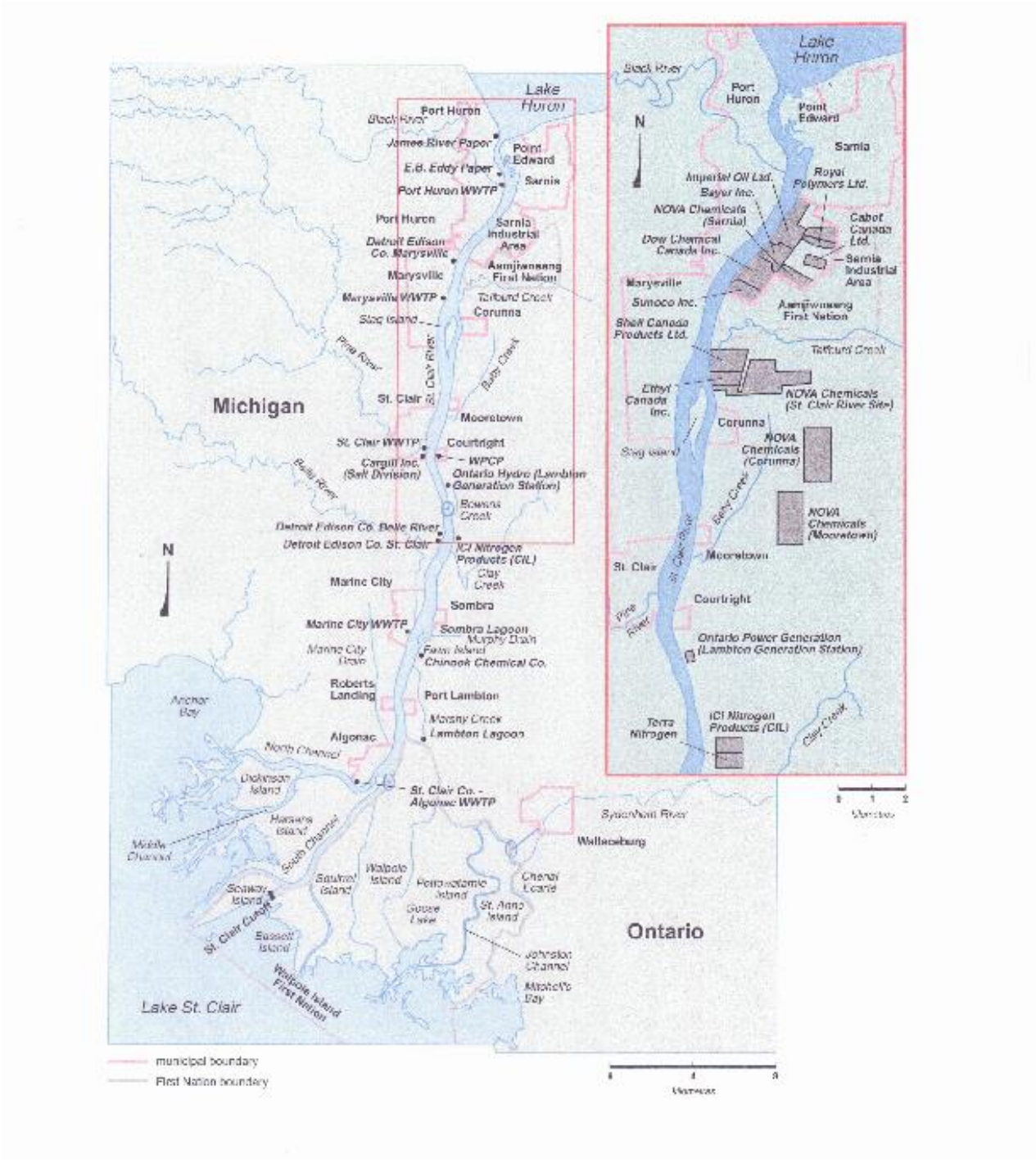
Thames-Sydenham and Region Source Protection Committee. (2015). *Drinking Water Source Protection Act for Clean Water – Thames-Sydenham and Region*. Retrieved from the Thames-Sydenham Source Protection Region website: http://www.sourcewaterprotection.on.ca/source-protection-plan/approved-source-protection-plan.

Thames-Sydenham Source Protection Region. (2008). *Thames-Sydenham and Region Watershed Characterization Report – St. Clair Region Source Protection Area – Volume 1*. Retrieved from Thames-Sydenham Source Protection Region website: http://www.sourcewaterprotection.on.ca/wp-content/uploads/sp_plan3/SupDocs/WCR/SClair_Characterization_Report/StClair-Summary.pdf.

United States and Canada. (1987). *Great Lakes Water Quality Agreement, 1978* (amended 1987). Retrieved from International Joint Commission website: http://www.ijc.org/en/activitiesX/consultations/glwqa/agreement.php.

Young, Heather. (2013, July 2). Treatment Plant Officially Opens. *Sarnia and Lambton County This Week.* Retrieved from Sarnia and Lambton County This Week website: http://www.sarniathisweek.com/2013/07/07/treatment-plant-officially-opens.

APPENDIX A: SPILL STUDY MODEL RESULTS (PART 1)



APPENDIX A: SPILL STUDY MODEL RESULTS (PART 2)

Times of spill impacts, based upon a St. Clair River flow-rate of about 5,100 cms [1] :

Source of spill	Wallaceburg Intake		Walpole Island Intake	
	Arrival time [2] (hours : minutes)	Peak time [3] (hours : minutes)	Arrival time [2] (hours : minutes)	Peak time [3] (hours : minutes)
Imperial Oil # 3 Separator outfall	**18:15**	23:45	**12:15**	15:15
Cole Drain outfall	**17:15**	22:30	**11:15**	14:15
Dow 1st Street (2004 dredging)	**17:30**	23:00	**11:30**	14:45
Dow 4th Street	**17:15**	22:45	**11:15**	14:15
Sunoco	**17:00**	22:30	**11:00**	14:00
Talfourd Creek (Shell)	**15:45**	21:15	**10:00**	12:45
Novacor	**14:00**	19:30	**08:15**	11:00
CIL	**12:15**	18:00	**06:15**	09:30
Murphy Drain (Chinook)	**08:00**	12:45	**02:30**	04:30

Notes:

(1). This St. Clair River flow-rate is the approximate long-term average-daily value. However, it represents about the 95-percentile average-daily flow-rate, during the last 3 years , (owing to lower lake-levels).

(2). "Arrival time" is the elapsed time, between when the spill begins to enter the river, and when the impact concentration (at the intake) , initially equals the lesser of : 1 ng/L or 1/1000 of the (subsequent) peak plume concentration. (Rounded-off to the nearest 15-minutes).

(3). "Peak time" is the elapsed time between when the spill begins to enter the river, and when the impact concentration (at the intake) reaches its peak value. (Rounded-off to the nearest 15-minutes).
(For this assessment, it is approximately equal to the mean hydraulic flow-time of the portion of the river through which the plume travels between the outfall and intake).

Peter Nettleton
MOE-EMRB
(416) 235-6233
June 25, 2004