

RE-DESIGNATION REPORT

Assessment of Restrictions on Dredging Activities
(BUI #7) Detroit River Canadian Area of Concern



EXECUTIVE SUMMARY

Regular dredging occurs every three to four years within one area of the Detroit River Area of Concern in the Lower Livingstone Channel in order to maintain required water depth for commercial navigation. The Canadian Coast Guard division of Fisheries and Oceans Canada currently assumes responsibility for these dredging projects.

The *Restrictions on Dredging Activities* Beneficial Use Impairment (BUI) was designated 'impaired' in the 1991 Stage 1 Remedial Action Plan Report because disposal of sediment on the Michigan side of the Detroit River and in the lower section of the Canadian side were not suitable for open water disposal because of heavy metals, PCBs, and contaminants. Consequently, the sediment was disposed of in confined disposal facilities, which would have been more costly at the time than open water disposal. In the 2010 Stage 2 Remedial Action Plan Report, the Delisting Criteria for the *Restrictions on Dredging Activities* BUI states that "this BUI will be considered restored when there is no limitation on the disposal of dredging spoils from routine dredging in the Detroit River" and recommended analysis of routine maintenance dredging sediment data be conducted.

Sediment analysis from 2002 and 2007 shows that the sediment quality of the dredged material from the Detroit River has remained consistent from year to year, with minor exceedances of Provincial Sediment Quality Guidelines Lowest Effect Levels (LEL) for arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, zinc, Total Organic Carbon, Total Kjeldahl Nitrogen, and Total Phosphorus. In 2002, six samples showed LEL exceedances for several PAHs, as well as traces of PCBs. No contaminants approached the Severe Effect Levels. The dredged sediment is disposed of in a confined disposal facility.

The relevancy of the *Restrictions on Dredging Activities* BUI has been questioned as it was initially considered an economic BUI (i.e. it was less expensive to dispose of sediment in the open water than at a confined disposal facility). The Provincial Sediment Quality Guidelines came into effect in the mid-1980s after this BUI was identified in most AOCs and, as a result, the practices for management of dredged material have evolved and improved significantly. Furthermore, many jurisdictions now recognize that open water disposal is not without adverse environmental impacts. In 2013, draft guidance from the Canada Ontario Agreement federal and provincial RAP management was produced. The following guidance from that document is applied in this BUI assessment report:

"Restrictions on Dredging Activities" BUI may be considered "not impaired" in AOCs where dredging for commercial navigation ... may be undertaken and the agency responsible for the dredging activities requires that the dredged material be disposed of in an existing, regulated management facility in accordance with provincial and/or federal guidelines and regulations."

It is therefore recommended that the *Restrictions on Dredging Activities* BUI be re-designated to '**NOT IMPAIRED**' in the Detroit River Canadian AOC.

INTRODUCTION

Lake Erie's declining condition and the resulting public outcry in the 1970s led Canada and the United States to sign the Great Lakes Water Quality Agreement (GLWQA) in 1972, which was a binational cooperative effort to protect water quality. Both countries committed to revising legislation and guidelines for water quality, penalizing polluting industries, and investing in better sewage treatment. The agreement was amended by protocol in 1987 to include the identification of Areas of Concern (AOCs), which were locations deemed more degraded than other locations in the Great Lakes. Many of the severe water quality problems in the Detroit River had previously been linked to industrial pollution and sewage pollution and the Detroit River was identified as one of five binational AOCs. The GLWQA amendment included a list of 14 potential beneficial use impairments (BUIs) related to ways humans and wildlife may be impacted by changes in the chemical, physical and biological integrity of water in an AOC. The GLWQA requires that all of these impairments be assessed and designated 'not impaired' before an AOC can be removed from the list of Great Lakes Areas of Concerns.

In 1991, the Binational Stage 1 Remedial Action Plan (RAP) report was released, which identified the environmental issues for the Detroit River Area of Concern. Since 1996, the implementation of the Detroit River RAP has functioned separately on the Canadian and American sides. The Canadian Detroit River Area of Concern is a 51 km connecting channel, comprised of the Canadian waters of the Detroit River proper (Figure 1). The watershed on the Canadian side of the river is not part of the AOC but has been identified as a potential source of impairment to the AOC (Green et al. 2010).

In many of the Great Lakes Areas of Concern, contaminated sediments were identified as one of the origins of the beneficial use impairments (IJC 1987). Toxic substances from industrial, municipal, and non-point sources, such as metals, pesticides, and PCBs, accumulate and persist in bottom sediments of the Great Lakes and its connecting channels (Fletcher et al. 2008). As well as degrading water quality, these contaminated sediments may also cause an impairment to the surrounding community of benthic invertebrates, impose restrictions on the consumption of fish and wildlife, cause tumours or reproductive problems in fish, birds, and other animals, and restrict dredging activities (Krantzberg and Montgomery 2007).

Currently, *Restrictions on Dredging Activities* remains a BUI in the Detroit River AOC. The purposes of this report are to summarize the current dredging locations and practices in the Detroit River AOC, to summarize the results of the sediment analysis from these locations, to describe the contaminated

sediment clean-up activities in the AOC, and to make a recommendation regarding the current status of GLWQA BUI #7, *Restriction on Dredging Activities*, for the Canadian side of the AOC only.



Figure 1. Map of the Detroit River Canadian Area of Concern and its watersheds.

Restriction on Dredging Activities Beneficial Use Impairment

Dredging is a common activity in the Great Lakes and this practice of removing sediment to clean, deepen, or widen a channel for commercial or recreational navigation began as early as 1876 in the Detroit River (IUGLS 2009). Today, maintenance dredging for commercial navigation is carried out in certain locations to remove accumulated sediment from channel beds to allow ships on the Great Lakes St. Lawrence Seaway unrestricted, safe, and efficient passage between the lower and upper Great Lakes.

The 'restrictions' part of the BUI refers to the increased cost of dredging a navigational channel due to the requirement for special handling and disposal of any contaminated sediments. Historically, the most cost effective way to dispose of dredged sediments was to deposit it in a location where it would not impede navigation, called open water or open lake disposal. However, if dredged sediments are contaminated with PCBs or heavy metals, open water disposal is not permitted and the dredged sediment must be disposed of in an environmentally acceptable manner. To date, these sediments have been disposed of in a Confined Disposal Facility (CDF), however new developments and technologies are expected to expand on methods that provide more material for beneficial re-use.

With the development of guidelines, technology and new options for management of sediment, as well as the current understanding of the potentially negative habitat impacts of open water disposal, recently the relevancy of this BUI has been questioned. This will be addressed later in this report.

Detroit River RAP Stage 1 Status and Stage 2 Delisting Criteria and Rationale

The Detroit River Stage 1 RAP Report designated the *Restrictions on Dredging Activities* BUI as 'impaired' because dredge spoils on the Michigan side of the Detroit River and in the lower section of the river were not suitable for open water disposal (MDNR and OMOE 1991). Additionally, sediment concentrations of PCBs, arsenic, chromium, copper, iron, lead, zinc, cyanide, and mercury at several locations along the Ontario shoreline exceeded levels suggested in the 1976 Ontario Ministry of the Environment (OMOE) report, "Evaluating Construction Activities Impacting on Water Resources by the Ontario Ministry of the Environment". The status of this BUI remained 'impaired' in the Detroit River Canadian RAP Stage 2 Report (2010) because some areas on the Canadian side of the river exceeded sediment quality guidelines. The Stage 2 Report recommended that an analysis of recent routine maintenance dredging data should be conducted. The delisting criterion was revised at this time to state

that this beneficial use would no longer be considered impaired “when there are no limitations on the disposal of sediments removed for routine navigational dredging” (Green et al. 2010).

CURRENT DREDGING ACTIVITIES, DREDGED SEDIMENT DISPOSAL, AND RELEVANT REGULATIONS IN THE DETROIT RIVER AREA OF CONCERN

Since the 1930s, routine navigational maintenance dredging is conducted every three to four years in the Lower Detroit River (PWGSC 2008). Since approximately 90% of the navigational channel is in US waters, the US Army Corps of Engineers (USACE) played a major role in the original deepening and widening of the commercial channel in the St. Lawrence Seaway. They also continued with required maintenance dredging of the Canadian side of the navigational channel of the Lower Detroit River up until the early 1980s. At that time, the USACE began contracting out dredging services to private companies and Canada was forced to undertake the maintenance dredging that was required in Canadian waters. The Canadian Coast Guard division of Fisheries and Oceans Canada now assumes responsibility for dredging the Canadian sections of the Upper Great Lakes Connecting channels.

The Canadian dredge location on the Detroit River, is approximately 10 km downstream from Amherstburg, Ontario, and each dredging event removes approximately 50,000 to 80,000 cubic metres of sediment from the, Amherstburg and Livingstone Channels.(Figure 2, Area A). Dredging also occurs in the nearby Canadian Coast Guard base (~2000m²; Figure 2, Area B). It should be noted that dredging in the Coast Guard Base is not ‘navigational’ dredging, as described in the delisting criteria, however sediment analysis results are taken into consideration in this report as it is routinely completed as part of the Lower Detroit River dredging project.

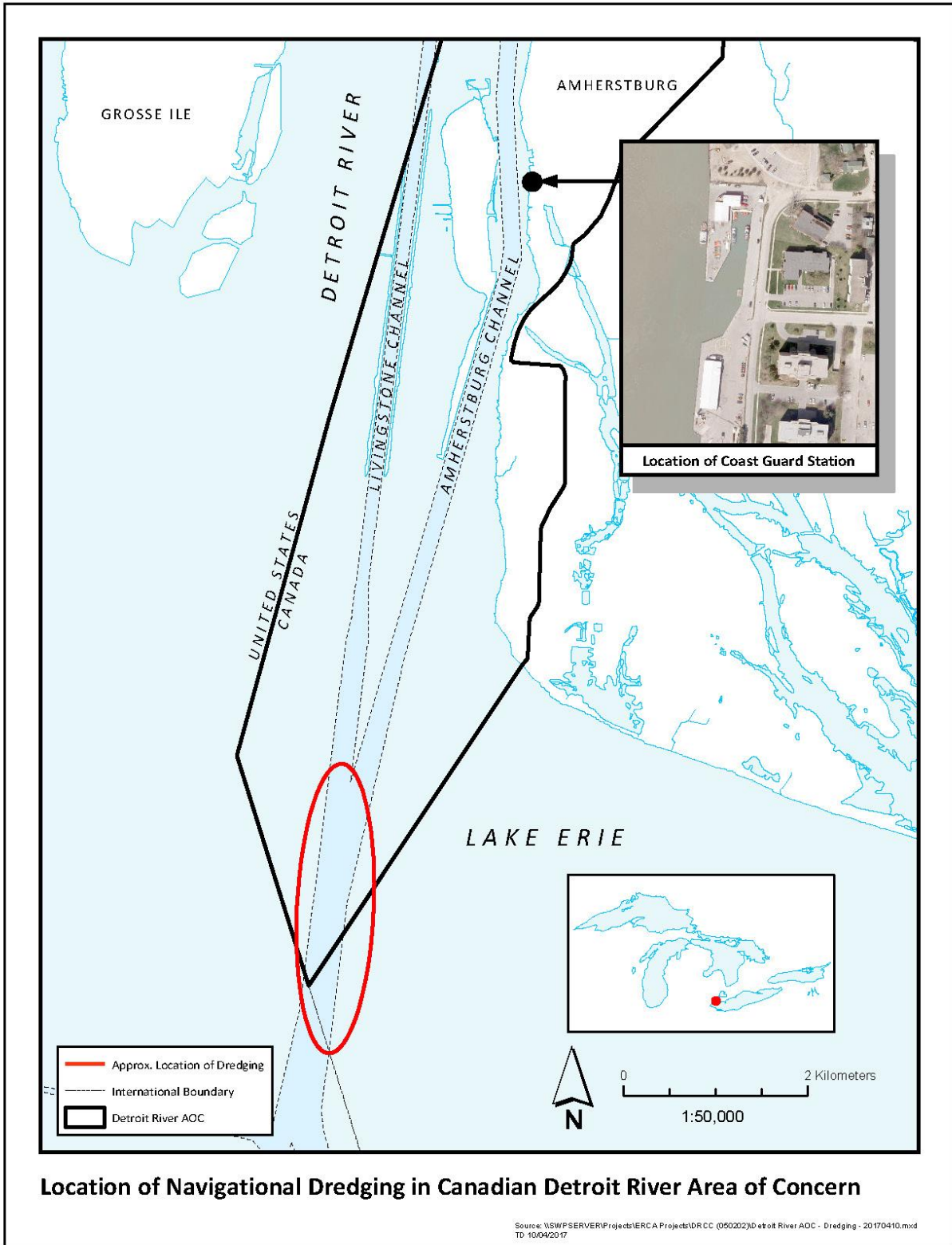


Figure 2. Locations of Detroit River Navigational Dredging Projects in 2003, 2008, and 2011.

The Lower Detroit River has been dredged three times between 2000 and 2015. Sediment samples are typically obtained and analyzed the year prior to the dredge project occurring. The 2011 dredge project used the screening report and sediment samples from the 2008 dredge project, which is not uncommon, as confirmatory samples would then be obtained directly from the dredge scow in 2011 and included in an addendum to the project documents. (Al Beaucage, DFO, pers comm. 2015). Historically, dredged sediments from the Lower Detroit River have a high percentage of silt (80% to 95%) and elevated levels of several contaminants (see below), which eliminated both beach nourishment and open water disposal as options for disposal of dredged sediments. Therefore, sediment removed from this particular location was transported by a sealed dump scow and placed at Pointe Mouillee Confined Disposal Facility (CDF), which is located approximately 5 km from the dredge site on the south shore of Lake Erie at Pointe Mouillee, Michigan. As there is no Canadian CDF in the vicinity, after Canadian authorities took over the dredging of the Lower Detroit River in the 1980s, materials continue to be disposed of at the Pointe Mouillee CDF. (Al Beaucage, DFO, pers comm. 2015).

Comparison of Sediment Chemistry Data with PSQG

All results of the contaminant analyses of dredged sediments are compared against Provincial Sediment Quality Guidelines (PSQGs). The guidelines, which are outlined in Persaud et al. (1992), were developed to protect benthic invertebrate communities from the harmful impacts of contaminants, which can accumulate and persist in sediment. The PSQGs outline three contaminant levels, based on their effect on aquatic biota: No Effect Level (NEL), Lowest Effect Level (LEL) and Severe Effect Level (SEL) (Fletcher et al. 2008). Contaminated sediments below the LEL are considered “clean to marginally polluted” and the majority of sediment-dwelling organisms can tolerate this level of contamination; sediments exceeding the SEL are considered “heavily polluted” and are expected to be detrimental to benthic organisms (Fletcher et al. 2008). The project proponent is required to submit the results of sediment analysis to Public Work and Government Services of Canada and the Ontario Ministry of Environment and Climate Change.

In 2002 (for the 2003 dredge project), nine sediment samples were collected in the Lower Livingstone Channel location. In 2007 (for the 2008 project), 15 sediment samples were collected in the Lower Livingstone Channel and then combined to create a total of eight samples. In the Canadian Coast Guard

Base area, four samples were collected in 2003 and again in 2007. See Appendix 1 for sediment contaminant data from dredging projects for the Detroit River Area of Concern (Riggs Engineering 2007).

Lower Livingstone Channel

The 2003 analysis of nine sediment samples collected in the Lower Livingstone Channel indicated LEL exceedances for cadmium, chromium, copper, iron, lead, manganese, mercury, zinc, Total Organic Carbon, Total Kjeldahl Nitrogen, and Total Phosphorus. There were also LEL exceedances for PAHs, though they did not approach the SEL and there were traces of PCBs identified.

Similarly, in 2007, comparison of results for the Lower Livingstone Channel with the PSQGs indicates that all eight samples exceeded an associated LEL. Exceedances were observed for arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, zinc, Total Organic Carbon, Total Kjeldahl Nitrogen, and Total Phosphorus. Despite the LEL exceedances, none of the measured levels approached SELs. Lowest Effect Level exceedances of four of the measured contaminants are shown in Figure 3. Additionally, four samples showed a minor LEL exceedance for the PAH, Benzopyrene. There were no LEL exceedances of pesticides or PCBs.

Canadian Coast Guard Base

The 2003 analysis of four sediment samples collected within the Canadian Coast Guard Base showed levels of copper elevated slightly above background levels for all samples. There were also minor exceedances of the mercury LEL for all four samples, and one sample showed an elevated level of silver. Total Organic Carbon, Total Kjeldahl Nitrogen, and Total Phosphorus also exceeded the LEL. There were no LEL exceedances of PAHs, pesticides, or PCBs.

The 2007 sediment analysis conducted for the 2008 dredge project in the Canadian Coast Guard Base showed minor LEL exceedances for arsenic, copper, lead, mercury, zinc, Total Organic Carbon, Total Kjeldahl Nitrogen, and Total Phosphorus. One sample showed slightly elevated levels of PAHs, including benzopyrene, fluoroanthene, phenanthrene, and pyrene. There were no LEL exceedances of pesticides or PCBs.

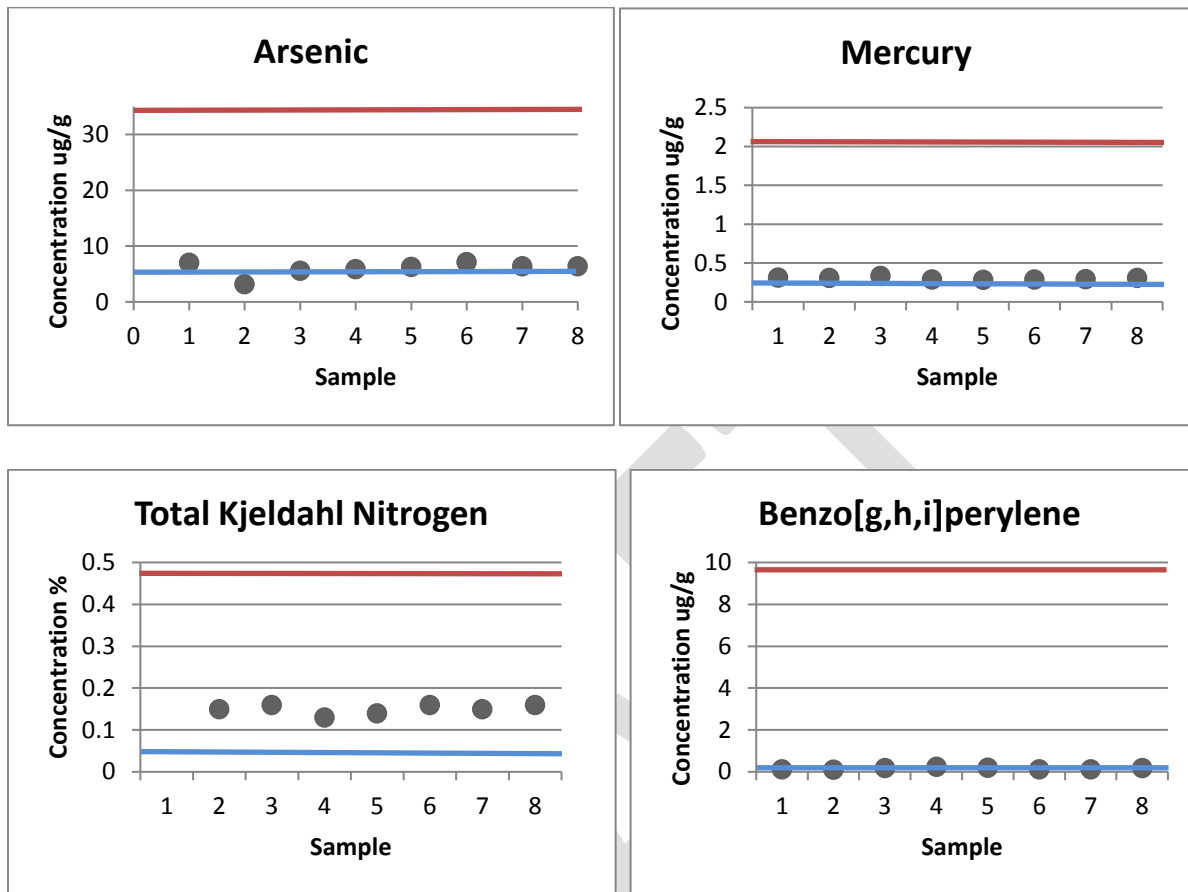


Figure 3. Concentrations of four contaminants showing exceedances in sediment samples collected in 2007 from the Lower Livingstone Channel in the Detroit River Area of Concern (Riggs Engineering Limited 2007). The blue line represents the Provincial Sediment Quality Guideline (PSQG) Lowest Effect Level and the red line represents the PSQG Severe Effect Level. Full sediment contaminant data can be found in Appendix 1.

Sediment Analysis Overview

The analysis of 25 sediment samples from 2002 to 2008 for dredging projects in the Detroit River AOC indicate that there were PSQG LEL exceedances of some contaminants. However, in all cases, the magnitude of exceedance was low. All dredged sediments for both projects were transported and placed at Pointe Mouillee CDF in accordance with provincial guidelines.

COMPLETED PROJECTS IN DETROIT RIVER AOC THAT RELATE TO THIS BUI

The distribution and stability of contaminated sediments have been monitored in the Detroit River AOC since 1994. Sediment and benthic invertebrate sampling has been conducted along the Huron-Erie corridor by Dr. Ken Drouillard at the Great Lakes Institute for Environmental Research (GLIER) at the University of Windsor to provide information about changes in historic monitoring results. The project aided in identifying priority areas for sediment contamination remediation. No sites were identified by the DRCC Monitoring and Research Work Group for remediation on the Canadian side of the Detroit River.

The DRCC partnership continues to work towards remediation and mitigation of point and non-point sources of pollution in order to ensure additional contaminants are not entering the Detroit River. In 2008, a remediation project took place in Turkey Creek to remove PCB contamination in the Grand Marais Drain (Windsor). Sediment that contained concentrations above 1ppm was removed and disposed of at the regional landfill in Essex. A total of 975m³ of contaminated sediments were removed from the drain and additional soil was removed to improve the drain's hydrology, and to protect it from becoming re-contaminated during heavy rain events. Post-remediation monitoring took place in 2012 and results show that there are no on-going sources of contamination and there is no re-suspension of PCBs during rain events.

Additionally, the significant upgrades that took place at the City of Windsor and Amherstburg wastewater treatment plants, as well as the installation of the City of Windsor's Retention Treatment Basin, have reduced combined sewer overflows. Environment Canada conducts water quality assessments at the head and mouth of the Detroit River, which provides updates on contaminant data, aiding in the assessment of remedial action effectiveness. Additionally, on-going monitoring of caged freshwater clams and benthic invertebrates by GLIER and the City of Windsor continue to be used to

determine if there are any bioaccumulative substances in wastewater effluent and sediment in the Detroit River AOC.

The DRCC has undertaken a number of public outreach and education initiatives since 2004, including conducting a household mercury and chemical waste collection. Through this program, over 90kg of mercury from local households was collected, eliminating the potential for improper disposal of mercury into the environment. Fact sheets and brochures have also been developed and distributed.

RELEVANCY OF THE RESTRICTIONS ON DREDGING ACTIVITIES BUI

As early as 1998, the relevancy of the *Restrictions on Dredging Activities* BUI had been questioned. When AOCs and BUIs were first identified in the mid-1980s, it was economically advantageous to dispose of dredged material in the open lake. Therefore, this BUI evolved to mitigate economic pressures, not necessarily environmental ones. The term “Restrictions on Dredging Activities” is actually a misnomer in that it does not relate to dredging activities being restricted due to the presence of contaminated sediment; rather, the presence of contaminants restricts the open water disposal.

Provincial Sediment Quality Guidelines were introduced after this BUI was identified in most AOCs (OMOE 1993) and, as a result, the practices for management of dredged material have evolved and improved significantly. New options for sediment management, such as use of dredged sediments for beach nourishment and disposal in upland sites or conveniently located confined disposal facilities, have recently become more practical and economical options both within and outside Areas of Concern. Today, open water disposal is viewed differently and consequently, the relevance of this BUI has diminished to a great extent. For example, many jurisdictions now recognize that open water disposal is not without adverse environmental impacts, particularly to fish and fish habitat. Although Ontario permits open water disposal under certain conditions (sediment must meet No Effect Level), other considerations are taken into account and proponents are generally discouraged from using this disposal option and are encouraged to find other beneficial uses for the material (e.g. use of clean dredged material as fill or beach nourishment).

CONCLUSION AND RECOMMENDATIONS

Regular dredging occurs within one area of the Lower Detroit River to maintain required water depth for commercial navigation. The sediment quality of the dredged material remains consistent from year to year, with minor exceedances of Lowest Effect Levels and no exceedances of Severe Effect Levels.

Ultimately, the sediment is disposed of in an existing confined disposal facility in accordance with provincial guidelines. Due to changes in sediment management quality guidelines and regulations, the use of a confined disposal facility is no longer considered a restriction on dredging, while open water disposal is a much more restrictive option. Hence, it is not a viable option for the Detroit River and in most places in the Great Lakes it is not allowed or actively discouraged.

Remedial Action Plan efforts in the Detroit River AOC will continue to resolve the environmental impacts of contaminated sediment on ecosystem health in the Detroit River AOC through the monitoring and assessment of other BUIs, such as the *Degradation of Benthos* and *Restrictions on Fish and Wildlife Consumption* BUIs.

In 2010, a thorough review of this BUI was conducted (Matos 2010) and draft guidance from the Canada Ontario Agreement federal and provincial RAP management was produced (EC and MOE 2013). This guidance is applied in this BUI assessment report. The guidance that is relevant to the Detroit River AOC is:

“Restrictions on Dredging Activities” BUI may be considered “not impaired” in AOCs where dredging for commercial navigation ... may be undertaken and the agency responsible for the dredging activities requires that the dredged material be disposed of in an existing, regulated management facility in accordance with provincial and/or federal guidelines and regulations.”

It is therefore recommended that the *Restrictions on Dredging Activities* BUI be re-designated from ‘impaired’ to ‘not impaired’ in the Detroit River Canadian AOC.

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APPENDIX A

Table 1.1: Contaminant concentrations found in the sediment sampled in 2008 from the Lower Livingstone Channel in the Detroit River Area of Concern (units ug/g, except as noted). Highlighted boxes indicate exceedance of LEL. (Data from Riggs Engineering Limited 2007)

Parameter	SEDIMENT SAMPLE NUMBER OR MIX OF SAMPLES								PSQG LEL 1993	PSQG SEL 1993
	#1&2	#3&4	#5&6	#7&8	#9&10	#11&12	#13&14	#15		
Arsenic	7	3.2	5.6	5.86	6.3	7.16	6.4	6.4	6	33
Cadmium	0.7	0.7	0.8	0.7	0.7	0.6	0.7	0.7	0.6	10
Chromium	25.3	26.4	27.2	28	26.7	25.2	26.7	26	26	110
Copper	32.8	34.3	35.1	38.9	34.5	32.9	34.2	32.3	16	110
Iron	25900	26500	25200	26000	25100	25400	25500	26400	20000	40000
Lead	28.9	29.9	30.2	31.6	40.1	28.3	28.6	29.7	31	250
Manganese	547	532	532	524	505	521	515	529	460	1100
Mercury	0.313	0.308	0.333	0.288	0.284	0.287	0.289	0.306	0.2	2
Nickel	31.5	33.1	32.9	33.1	31.8	31.7	32.6	32.2	16	75
Zinc	103	107	109	116	109	101	108	105	120	820
TOC (%)	N/A	3.3	2.99	3.02	2.96	3.02	2.84	3	1	10
TKN (%)	N/A	0.15	0.16	0.13	0.14	0.16	0.15	0.16	0.055	0.48
TP	774	765	708	684	966	700	644	678	600	2000
Benzo[g,h,i]perylene **	0.12	0.11	0.18	0.24	0.2	0.13	0.12	0.18	0.17	9.7

PSQG= Provincial Sediment Quality Guidelines, August 1993.

TOC = Total Organic Carbon

TKN = Total Kjeldahl Nitrogen

TP = Total Phosphorus

** Severe Effect Levels from the MOE Guidelines were converted from (ug/g organic carbon) to (ug/g bulk sediment by multiplying the average TOC, 3.02%

Table 1.2. Contaminant concentrations found in the sediment sampled in 2002 from the Lower Livingstone Channel in the Detroit River Area of Concern (units ug/g, except as noted). Highlighted boxes indicate exceedance of LEL.

Parameter	SEDIMENT SAMPLE NUMBER									PSQG LEL 1993	PSQG SEL 1993
	1	2	3	4	5	6	7	8	9		
Arsenic	3	3	4	5	5	6	6	6	4	6	33
Cadmium	0.9	1.1	0.8	2.1	2.0	1.6	1.4	1.3	1.9	0.6	10
Chromium	20.1	18.5	19.7	38.4	34.2	30.5	25.1	28.4	34.8	26	110
Copper	33.9	33.9	34.4	48.4	46.1	44.3	34.2	45.5	46.8	16	110
Iron	19,700	19,000	19,900	20,800	21,000	22,400	19,100	24,200	21,000	20000	40000
Lead	21.1	20.5	20.5	45.4	36.1	29.7	19.4	27.2	38.3	31	250
Manganese	478	470	486	431	443	496	365	595	437	460	1100
Mercury	0.23	0.23	0.25	0.43	0.35	0.34	0.32	0.30	0.41	0.2	2
Nickel	25.8	25.0	26.6	31.7	30.5	31.2	25.4	32.4	31.2	16	75
Zinc	90.9	84.6	89.9	161	151	127	103	127	142	120	820
TOC	31,600	26,500	25,700	37,400	44,100	30,800	30,000	35,200	30,000	10000	100000
TKN	2,970	2,090	2,820	1,650	2,010	1,700	1,690	2,650	1,690	550	4800
TP	570	554	548	912	812	714	574	749	740	600	2000
Phenanthrene ug/kg	298		272	742	764		293	226		560	950,000
Anthracene ug/kg	192		206	396	519		142	91.4		220	370,000
Fluoranthene ug/kg	852		952	1570	2180		624	491		750	1,020,000
Pyrene ug/kg	818		956	1620	2300		616	473		490	850,000
Benzo[a]anthracene ug/kg	523		651	1300	2130		554	323		320	1,480,000
Chrysene ug/kg	548		760	1540	2320		761	437		340	460,000
Benzo[k]fluoranthene ug/kg	221		284	901	1050		220	109		240	1,340,000
Benzo[a]pyrene ug/kg	558		736	1290	2040		448	239		370	1,440,000
Ideno[1,2,3-cd]pyrene ug/kg	217		330	458	710		181	123		200	320,000
Dibenzo[a,h]anthracene ug/kg	65		102	139	225		51	35		60	130,000
Benzo[g,h,i]perylene ug/kg	236		366	512	746		185	134		170	320,000
Aroclor 1248	0.03		0.03	0.13	0.08		0.05	0.06			
Aroclor 1254	0.02		0.02	0.07	0.06		0.03	0.08			
Aroclor1260	0.03		0.03	0.08	0.10		0.05	0.07			
Total PCB	0.08		0.08	0.28	0.24		0.13	0.21			

Table 2.1: Contaminant concentrations found in the sediment sampled in 2008 from the Canadian Coast Guard Base in the Detroit River Area of Concern (units ug/kg). Highlighted boxes indicate exceedance of LEL.

Parameter	SEDIMENT SAMPLE NUMBER				PSQG LEL 1993	PSQG SEL 1993
	1	2	3	4		
Arsenic	7	6	6	7	6	33
Copper	32	30	37	27	16	110
Lead	25	27	27	49	31	250
Mercury	0.3	0.3	0.4	0.2	0.2	2
Zinc	120	110	130	110	120	820
TOC (%)	2	2	2	2	1	10
TKN	2800	2700	2800	2600	550	4800
TP	720	680	690	560	600	2000
Benzo[g,h,i]perylene	<0.02	0.2	<0.02	<0.02	0.17	
Fluroanthene	0.04	0.8	0.1	0.08	0.75	
Phenanthrene	0.04	0.6	0.1	0.05	0.56	
Pyrene	0.03	0.7	0.1	0.07	0.49	
PAH (Total)	0.1	4	0.6	0.4	4	

Table 2.2: Contaminant concentrations found in the sediment sampled in 2002 from the Canadian Coast Guard Base in the Detroit River Area of Concern (units ug/kg). Highlighted boxes indicate exceedance of LEL.

Parameter	SEDIMENT SAMPLE NUMBER				PSQG LEL 1993	PSQG SEL 1993
	1	2	3	4		
Copper	33	33	32	34	16	110
Mercury	0.3	0.3	0.3	0.3	0.2	2
Silver	15	0.2	0.2	0.2		
TOC (%)	4	5	3	4	1	10
TKN	2500	2900	3510	2300	550	4800
TP	740	720	720	790	600	2000