Remediation Work Plan for Chedoke Creek – Targeted Dredging – FINAL (Version 4)

City of Hamilton

Prepared for:

City of Hamilton

5/21/2021

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Chedoke Creek Work Plan
City of Hamilton
Project #WW20101062

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City of Hamilton

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5/21/2021

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Revision History

Version	Document Date	Submitted	Description of Revisions
1.0	February 19, 2021	February 22, 201	None – Original Document
2.0	March 26, 2021	March 26, 2021	Updated report in response to comments provided by MECP on March 4, 2021 and March 12, 2021. The first set of comments largely involved Species at Risk clarifications. A response matrix was submitted for the SAR clarifications with the updated Workplan. The second set of comments covered the balance of the workplan, and a second response matrix was submitted to cover the report modifications.
3.0	April 23, 2021	April 23, 2021	Updated report in response to MECP comments issued April 8, 2021. The responses to the comments were addressed in a response matrix dated April 23, 2021.
4.0	May 21, 2021	May 21, 2021	Updated report in response to MECP comments issued May 7, 2021. The responses to the comments were addressed in a response matrix dated May 21, 2021.

Note: all response Matrices have been added and included in Appendix C to the final version of the report.

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1.0 Introduction

This report, referred to as the "Chedoke Creek Work Plan", has been prepared by Wood Environment & Infrastructure Solutions (Wood) on behalf of the City of Hamilton to address the requirements outlined in the MECP Director's Order: 1-PE3L3 (the "Order", December 4, 2020), specific to the Targeted Dredge Plan for the Lower Chedoke Creek. The Order has numerous components (ref. Appendix A) which are addressed in the report sections which follow. Notably, Order requirements #1 and 2, have been fulfilled by the City retaining Wood and providing the MECP with confirmation of same on January 15, 2021 (ref. Email Girt-Burt). As such, Wood is acting as the City's representative in the capacity of Qualified Person (QP). Wood has not included its experience or credentials to support this title, however the City and MECP are familiar with its capabilities through the preparation of earlier reporting to address the requirements associated with the initial Order (ref. Provincial Officer's Order, #1-J25YB), including:

- Chedoke Creek Natural Environment and Sediment Quality Assessment and Remediation Report, Wood, January 24, 2019
- Chedoke Creek – Implementation and Costing Report, Wood, January 24, 2019

The following maps out the Order requirements (in ***bold italics***) and highlights the section in the reporting which follows, where the information has been provided to address the specific needs of the MECP.

3. ***By February 22, 2021, submit to the Director, for approval, a remediation workplan for Chedoke Creek that is developed by the Qualified person to undertake the targeted dredging of Chedoke Creek based on the recommendation identified in section 5.2.5 of the Wood report entitled "MECP Order # 1-J25YB Item 1b – Chedoke Creek Natural Environment and Sediment Quality Assessment and Remediation Report" dated January 24, 2019 ("Chedoke Creek Workplan"). The Chedoke Creek Workplan shall be prepared in accordance with the requirements set out in Items 4 and 5 below.***

This item constitutes the subject work plan documented herein prepared by the Wood Team with the City of Hamilton, based on consultation with MECP (ref. Appendix B). With specific reference to the recommendations identified in Section 5.2.5 of the Wood report entitled "MECP Order # 1-J25YB Item 1b – Chedoke Creek Natural Environment and Sediment Quality Assessment and Remediation Report" dated January 24, 2019, the following is the relevant excerpt from the subject report:

"Direct Removal

Physical removal of the organic sediment within Chedoke Creek will directly address the three primary sources of potential impairment including nutrient contamination, bacteriological contamination, and habitat loss. Dredging can be accomplished either through mechanical means or by use of hydraulic dredge equipment. Hydraulic dredging is recommended in Chedoke Creek over mechanical means for several reasons. Mechanical dredging would not be practicable due to the limited width of the creek, the density of riparian vegetation, and lack of continuous access. Hydraulic dredging provides nearly complete containment of the dredge slurry along the pumping route, which reduces exposure of the sediments to the atmosphere that could cause odour or other problems, if the material were to be handled by an excavator. Additionally, the dredge slurry from a hydraulic dredge can be easily routed to the wastewater system for dewatering and ultimate treatment and disposal, thus avoiding potential issues related to dredged material storage, dewatering, and handling operations, which are generally space intensive and costly. Complete removal of this material by hydraulic dredging is recommended as the primary means of remediation. The recommended hydraulic dredge concept plan is further discussed in the following sections."

Table 1.1. Alternatives Assessment Summary

Alternative	Functional Effectiveness	Environmental Effectiveness	Economics	Social Benefits
No Action	Long-term breakdown or burying of organic sediment resulting in downstream transport and dilution	Existing contaminants may be transported downstream to Cootes Paradise and further downstream where they will be diluted but may still support excessive algal growth and other impairments	No capital cost	The City intends to restrict access to Chedoke Creek so there will be no direct social benefits from the no action alternative
Physical Capping	Possibly effective but depends on fluidity of soft sediments. May not remain in place.	Provides a barrier which limits contact with the water column and could provide stable substrate	Relatively expensive because this involves transportation and placement of large quantities of clean fill	The City intends to restrict access to Chedoke Creek so there will be no direct social benefits
Chemical Inactivation	Only effective at reducing phosphorus release	Promotes indirect water quality response as a result of decreased phosphorus load. However, 90% of phosphorus load is no longer in Chedoke Creek	Least expensive option, but does not address anything other than phosphorus load	Potential downstream water quality improvements, benefits to Chedoke Creek during low flow as long as chemical stays in place
Direct Removal	Removes the source of contamination	Restores the original creek bed and removes the contaminated organic layer while reducing the oxygen demand	Moderately expensive but nearby sewer mains create a significant economic advantage for disposal	The City intends to restrict access to Chedoke Creek so there will be no direct social benefits

4. The Chedoke Creek Workplan shall, at a minimum:

i. Consider technical reports, Ministry comments and affected stakeholders' comments, to determine an acceptable plan to implement the recommendation in the Wood report to restore the Chedoke Creek, while mitigating impacts of implementing the plan on the natural environment, including water;

In preparing the Work Plan, Wood has relied on the following reports:

- "Quantification of Volume and Contaminant Loadings", Hatch, September 28, 2018
- "Chedoke Creek Natural Environment and Sediment Quality Assessment and Remediation Report", Wood, January 24, 2019
- "Chedoke Creek – Implementation and Costing Report", Wood, January 24, 2019

- "Peer Review Report - Chedoke Creek Natural Environment and Sediment Quality Assessment and Remediation Report" , May 15, 2019 , SLR Consulting (Canada) Ltd
- "Ecological Risk Assessment (ERA), Chedoke Creek, Hamilton, Ontario" ,SLR Consulting (Canada) Ltd. , February 12, 2020
- "Cootes Paradise: Environmental Cootes Evaluation Hamilton, Ontario" by SLR Consulting (Canada) Ltd. , April 22, 2020
- "Response to Ministry of Environment, Conservation and Parks May 28, 2020 letter entitled Chedoke Creek Spill Response – District Comments" SLR Consulting (Canada) Ltd. , June 12, 2020
- Memo entitled "Chedoke Creek Project, Wood Commentary on SLR Peer Review Comments, City of Hamilton" dated May 23,2019 by Wood Environment & Infrastructure Solutions.
- Letter from the City entitled "Response to Director's Order 1-MRRCX" Items 1 & 2 submitted on February 14th, 2020
- Report entitled "Main-King CSO Tank Overflow Volume Estimates" by HATCH Limited dated April 14th, 2020.
- Letter from the City entitled "Response to Order No.1-MRRCX, Items 3 and 4" submitted on April 30, 2020 with the following attachments:
    - Letter from the City of Hamilton entitled "Director Order Number; Item No. 4, Surface Water Monitoring Program" dated April 30, 2020;
    - Report entitled "Cootes Paradise: Environmental Cootes Evaluation Hamilton, Ontario" by SLR Consulting (Canada) Ltd. dated April 22, 2020.
- "Chedoke Creek Water Quality Improvement Study", GM BluePlan and Wood, (Draft), February, 2021

In terms of MECP comments, the following key points have been extracted from the Provincial Officer's Report (ref. 1-OW6SS) which accompanied the Director's Order, as relevant to guide the development of this Work Plan:

- *Further work is required to assess and address the potential presence of any species at risk in Chedoke Creek that may be subject to dredging. This could include the development of mitigatable measures to protect any species at risk during dredging or avoidance of specific areas for dredging. Consideration on the impact of dredging on species at risk is also given for: if the potential impact from dredging is deemed to be a long-term negative impact; if current conditions are degraded due to historical or spill impacts and already potentially negatively impacting the species; and if there would be a long-term impact improvement despite a short-term negative impact from dredging, in order to determine what and where it is appropriate to dredge.*
- *Any on-going sources of contamination are not anticipated to re-contaminate any remediated area to the same level historically seen or to the level seen from the 24 billion litres of sewage seen in this spill and is generally minor in comparison to the loadings seen from the spill.*
- *Some of the key items from the Ministry's technical staff review of the Chedoke Creek ERA and impact assessment are as follows:*
    - *The data interpretation and aggregate data analysis used in assessing pre spill conditions, spill period conditions and post spill conditions did not look at specific year differences (2018 vs 2014-2017) but used mean data analysis over the spill period potentially masking* the

extent of the impact of the spill seen, particularly in 2018, for some parameters and didn't determine if the pre-spill period used was representative of conditions at the time of the spill.

- *Information supported the sediment being impacted by the sewage spill by some of the nutrients;*
- *Impacted sediment was found to be a moderate to high risk with bacteria, PAH's and copper;*
- *The contaminant loading of nutrients, cBOD and other sewage related parameters showed ongoing impact on DO levels;*
- *Elevated TAN levels in Chedoke Creek above pre-spill conditions were on-going*

- *Based on advice received from ministry technical experts, it is not as feasible, for a number of reasons, to undertake a direct restoration of the added loadings to Cootes Paradise and the western Hamilton Harbour area both from the extent and type of the dispersion of TP, and the cost, effectiveness and potential to cause more harm than good in these areas using a direct removal method like dredging. In order to address the impacts of the increased loadings caused by the spill, based on advice received from Ministry experts, other remedial options must be considered and utilized to offset and/or improve the conditions in these systems in an effort to mitigate the added loading and associated impact as a result of the spill, and thus restore the natural environment.*
- *Considering the above noted on-going impacts and continuing potential impairment, I am of the opinion, after consultation with Ministry staff and technical experts, that a "no action" recommendation by the City does not discharge its obligation to restore the natural environment nor does it address or prevent potential adverse effects, or may impair or continued impairment of the natural environment, including waters.*
- *Thus, further action is necessary to restore the natural environment in relation to Chedoke Creek and that further action is needed to offset the impacts of the spill to Cootes Paradise. Accordingly, I require the City to undertake remedial measures outlined in the accompanied Provincial Officer's Order to restore the natural environment in Chedoke Creek as a result of the spill and take steps to determine what is required in relation to Cootes Paradise and implement those steps once an appropriate course of action is determined*

In terms of affected stakeholders, Wood has considered comments provided by RBG (ref. Runciman/ Theijsmeijer-RBG to Widmeyer/Yeudall-MECP, Feb 13, 2020) as follows:

- Desire to convene a meeting to discuss concerns regarding the potential extent of the sewage sediment in the marsh, and the future remediation efforts required to address this issue RBG suggested about 2,500 tonnes of sewage material was deposited into the Chedoke Inlet of Cootes Paradise during the spill
- RBG expressed that it anticipates that the sewage material will be substantially located on the RBG Cootes Paradise Marsh property, as well as from the marsh to Burlington Bay. RBG suggested that there may be greater ecological damage and contamination to the bed of the marsh than initially anticipated

Pursuant to the above, RBG has also been a stakeholder on the recent City of Hamilton study "Chedoke Creek Water Quality Improvement Study", GM BluePlan and Wood, (Draft), February, 2021. Furthermore, Wood staff has contacted RBG over the course of preparation of this plan (January 2021), for insights into local conditions, including knowledge of species at risk, as well as to secure relevant information on RBG restoration plans for Cootes Paradise.

Wood has also discussed with MECP any other stakeholders who should be consulted directly, and based on this dialogue (ref. Meeting on February 12, 2021 see Appendix B), MECP staff has suggested that the area RAP be contacted for its insights. As of the time of preparation of this Plan, contact has not been made due to time constraints, however the City and Wood commit to discussing the targeted dredge program with RAP representatives over the course of the preparation of the associated plans.

4. The Chedoke Creek Workplan shall, at a minimum:

ii. Contain a detailed timeline setting out critical milestones and checkpoints with the Ministry for carrying out the Chedoke Creek Workplan;

An overall schedule has been prepared on the basis of current understanding of field work requirements, Species at Risk protocols and Regulator input associated with approvals for permits. Ref Section 5.0.

iii. Contain a Species at Risk assessment plan and associated timelines for Chedoke Creek downstream of the spill and including potential impacted areas downstream of Chedoke Creek that may be impacted by targeted dredging;

iv. Undertake consultation with the Species at Risk Branch within the Ministry in respect of any identified items pursuant to 4 iii) and incorporate this feedback and outcome into the workplan for any species at risk;

As outlined in Section 4.5.6, the Wood Team has consulted with the MECP SAR Team to determine the associated species at risk as well as associated protocols and approval requirements and timelines.

v. Provide a description of any anticipated approvals needed to implement the Chedoke Creek Workplan, initial consultation and proposed timelines to obtain such approvals, if required, for the Workplan to be implemented;

vi. The consultation in iv) and v) shall include the Regional Technical Support Section of the Ministry;

Section 4.5 and Appendix B detail the consultation undertaken by the Wood Team regarding permits and approval requirements associated with the targeted dredge operation. Further the Regional Technical Support Section of the Ministry has been consulted for input (ref. Section 4.5.6).

vii. Contain a description of the identified areas and the extent (depth, location) of the targeted dredging with a description of how the items outlined in Item 5 below were addressed and a description of any methods for refining identified areas in Item 5 including the impacted areas identified in the Wood reports and SLR reports and timing as needed, in the Chedoke Creek Workplan;

As discussed herein, and outlined in various recent consultation with MECP staff, the information on the amount, location and composition of contaminated material is not known at present. It has been proposed to fill this information gap with field data collection including bathymetry and sediment sampling of the Lower Chedoke Creek, Princess Point Embayment and outlet zone of Cootes Paradise. The intent of these field activities (ref. Section 4.2) is to provide insights in to the "extent (depth and location)" for the targeted dredging. As detailed in Section 4.3, the approach to targeted dredging will be led by a decision-making process which will adapt to field conditions once these are better defined.

viii. Contain a description of the approximate volume of material to be removed;

The Hatch Report (ref. "Quantification of Volume and Contaminant Loadings", Hatch, September 28, 2018), indicated that 2,375 +/- tonnes of total suspended solids (TSS) were discharged during the spill event. Wood's "Chedoke Creek Natural Environment and Sediment Quality Assessment and Remediation Report" included an evaluation of a range of possible in-situ sediment volumes based on the TSS discharged during the spill event. The soft sediment volume of 5,600 m^3 present within Chedoke Creek in 2018 approximates the estimated volume of wastewater TSS that was discharged during the spill event if it were consolidated to 40% solids. This solids content is considerably higher than typical gravity thickening processes for wastewater sludges which produce a maximum sludge concentration of around 10% solids. Wastewater solids generally undergo thickening processes for only a few days before they are moved to a secondary dewatering process for finishing. Given the extended time wastewater solids may have been resident in Chedoke Creek following the spill, it is reasonable to assume that significant self-compaction beyond normal thickening processes may have occurred. It is also reasonable to assume that a portion of the wastewater solids may have been transported beyond Chedoke Creek and more may have decomposed naturally.

The removal of sediment mass is an important consideration for the proposed remediation efforts within Chedoke Creek and downstream. The current extent of organic sediment volume is likely to have changed since 2018 and will be reassessed as part of this work plan to determine the current volume and nutrient content of organic sediments within the creek and downstream in Cootes Paradise. Based on Wood's findings, additional sediment volume may be identified within Cootes Paradise that could present suitable remediation benefits if removed.

ix. Identify and contain a description of proposed mitigation measures for any short-term impact(s) that may arise from implementing the Chedoke Creek Workplan for Chedoke Creek, its shoreline and connected waterways/natural environment, on any species at risk and other potentially impacted uses. Mitigation measures may include, but are not limited to: exclusion measures for local aquatic uses; limit recreational uses in the area; total suspended solids control as required for carrying out the targeted dredging; and proposed monitoring during any remediation to monitor effectiveness of mitigation measures during dredging identified in iv); and

The overall conditions of Chedoke Creek during Wood's 2018 ecological investigations indicated no significant submerged or emergent vegetation and poor water and sediment quality which reduced the potential for significant presence of pollution tolerant species. The 2018 field effort was intended to provide a preliminary assessment of potential ecological or recreational impacts. Additional effort will be required to assess the presence of Species at Risk or other potential ecological impacts to the Chedoke Creek system and downstream in Cootes Paradise. Utilizing construction best management practices, such as fish exclusion techniques (e.g., deploying silt curtain from shore to extent of dredge area thereby excluding fish from work limits) and fish salvage and relocation protocols to remove fish from with the isolated work areas will be used. Prior to any dredging work being conducted within Chedoke Creek, fish will be removed and excluded from the work area. Additional wildlife exclusion measures and mussel relocation plans will be developed as needed to ensure local biota are avoided, excluded or removed from the dredging activities, as best possible.

Recreational use of Chedoke Creek is already restricted by the City of Hamilton. Additional restrictions may be necessary particularly during the dredge operation depending on the potential for a revised project footprint to include portions of Cootes Paradise.

While the specific type of dredging technology is still under consideration, hydraulic dredging generally provides the most effective and economic turbidity control measures in a flowing system such as Chedoke Creek. Furthermore, it is anticipated that fine organic sediments will be pumped into the City's wastewater system which will significantly reduce the potential for turbid water returning to Chedoke Creek. Furthermore, once the plan is prepared, a construction monitoring program will be detailed and implemented. Additional details are provided in Section 4.3.

x. Contain a proposed monitoring plan to monitor the recovery of the natural environment and effectiveness of the Chedoke Creek Workplan once dredging is complete

The Wood Team has developed an outline of a proposed monitoring plan which focuses on key indicators related to the natural environment, which would be expected to be tied to the planned improvements associated with the dredging program and the removal of contaminated material. The monitoring program will ultimately also need to reflect any specific conditions associated with the permitting of the works. For example, the anticipated *Fisheries Act* authorization typically includes post-construction performance monitoring to ensure the site and any enhancement features are functioning as intended and meeting the target success criteria as identified in the authorization. Similarly, the SAR Overall Benefit Permit as per the *Endangered Species Act* will specify post-enhancement performance monitoring with target success criteria. These post-construction monitoring events can occur within the short-term (e.g., years 1, 2 and 3 post-construction), as well as longer term studies (e.g., years 5 and 10^{+} post-construction) depending on the species, offset/benefit feature and expected timeframe for use and measures of performance.

5. With respect to the area from the Main/King CSO outfall to the mouth of Chedoke Creek, the Chedoke Creek Workplan shall take into consideration the scope of targeted dredging work necessary to restore the natural environment to pre-spill conditions, as to be agreed upon by the Ministry, and to mitigate any impairments or potential impairments from the spill, in relation to the following, but not limited to:

i. Sediment areas identified as impacted, in consultation with the Ministry, by the sewage spill;

ii. Sediment areas identified as containing elevated organic material consistent with sewage sludge;

iii. Sediment areas identified as elevated nutrients (particularly TP, TAN, and TKN);

iv. Sediment areas identified as had, may have, or continuing to have reduced dissolved oxygen levels in the water column from historical levels;

v. Sediment areas identified as having elevated parameters as identified by the ERA carried out by SLR ("Ecological Risk Assessment (ERA), Chedoke Creek, Hamilton, Ontario" dated February 12, 2020) to have moderate or high risk for impacts, or otherwise identified by the reports or in comments by the Ministry; and

vi. Addressing any ecological flow path requirements and connectivity within the creek in any remedial action plan that may impact low flow path and connectivity.

Wood's "Chedoke Creek Natural Environment and Sediment Quality Assessment and Remediation Report" included a preliminary evaluation of items 5.i. through 5.iv. These items and Items 5.v. and 5.vi. are reviewed in detail in Section 2 of this plan. These data will be supplemented with additional field efforts collected by Wood as part of this plan.

6. By October 31, 2021 or such other date approved by the Director in writing, complete the approved Chedoke Creek Workplan

Per the overall project schedule (ref. Section 5.0), as currently understood based on consultation with regulators, the process of field data collection, permitting, approvals, design, tendering and construction, will exceed the time period beyond October 31, 2021. Notwithstanding, it is the intent of the City of Hamilton to continue to work cooperatively and efficiently with MECP and other regulators to seek opportunities to reduce the procedural timeframes and thereby conduct the targeted dredge work, as soon as possible.

7. Within one (1) month of the completion of the of the work undertaken pursuant to the approved Chedoke Creek Workplan, submit to the Director, a report prepared by the Qualified Person confirming that the natural environment has been restored to pre-spill conditions and that further impairment to the natural environment will not occur as a result of the spill to the Chedoke Creek as detailed in the attached Provincial Officer's report, and at a minimum contain the following:

i. The details of the work undertaken to complete the Chedoke Creek Workplan;

ii. Any monitoring results completed before, during and after the work undertaken in accordance with the Chedoke Creek Workplan;

iii. Analysis of the results in Item 7(ii) above for the purposes of the intended monitoring; and

iv. Determination if any requirement for on-going monitoring is required to verify the effectiveness or maintenance of the remedial actions undertaken is necessary.

This condition of the Order is planned following the completion of the works (targeted dredging) which is currently speculated to occur Q3/Q4, 2022. Further, since some of the improvements are unlikely to be instantaneously realized, it is anticipated that the monitoring data collected immediately following the targeted dredge operation, may not fully achieve the potential benefits which will likely accrue overtime. This perspective will ultimately be outlined in the "report" cited in Condition 7 above.

2.0 Summary of 2014 – 2018 Spill

2.1 Hatch Report Summary

The Ministry of the Environment, Conservation and Parks (MECP) issued Provincial Officer's Order #1-J25YB (Order) on August 28, 2018. Part 1(a) of the Order required the City of Hamilton to determine the volume and contaminant loading from the Chedoke Creek spill event beginning January 28, 2014 and ending July 18, 2018. Hatch, under the direction of Wood, estimated the spill event volume for wet and dry weather discharge, as a result of a partially open (4.94%) bypass maintenance gate at the Main/King combined sewer overflow influent well and a second gate failure that occurred in January 2018 outside the CSO tank influent well. The failure of this second gate increased the amount of flow diverted towards and under the first gate, increasing the volume of the discharge to the Chedoke Creek. Hatch's report titled "Quantification of Volume and Contaminant Loadings" was submitted to the City of Hamilton on September 28, 2018.

The spill volumes estimated by Hatch are included in **Table 2.1**. The majority of the spill volume occurred during wet weather flow (WWF) with dry weather flow (DWF) occurring only after the second gate failure. Spill volume is presented in terms of gigaliters (GL).

Table 2.1. Estimated Spill Volume for Period from January 28, 2014 to July 18, 2018

Sample Description	TSS (mg/L)	TP (mg/L)	Ammonia (mg/L)	TKN (mg/L)	cBOD (mg/L)
DWF Data					
Average DWF Conc. From WWTP Influent	266	4.52	21.6	34.7	173
Main/King DWF Single Sample	154	3.86	22.2	45.4	135
WWF Data					
Average WWF Conc. Main/King CSO Influent	76	1.61	4.58	10.0	41.3
Average WWF Conc. Royal CSO Influent	229	0.64	0.41	2.5	15.7
Average WWF Conc. McMaster CSO Influent	73	0.99	2.00	4.9	29.2
Average WWF Conc. Bayfront CSO Influent	66	0.67	1.22	4.0	29.9
Average WWF Conc. Eastwood CSO Influent	113	2.06	5.64	11.9	78.1

Hatch then determined the event mean concentrations (EMCs) for ammonia, total Kjeldahl nitrogen (TKN), total phosphorus (TP), total suspended solids (TSS) and carbonaceous biochemical oxygen demand (cBOD) using wastewater data from the Woodward wastewater treatment plant (WWTP) to estimate DWF conditions and grab samples from the Main/King CSO to estimate WWF conditions as shown in Table 2.2. Samples from other CSOs were compared to provide an estimate of variability.

Table 2.2. Estimated Average DWF/WWF Pollutant Concentrations

Gate Flow Component	WWF Spill Volume 2014 - 2018 (GL)	DWF Spill Volume 2018 (GL)	Total Spill Volume 2014 - 2018 (GL)
From Equation (1) For $H_2 > 0.740$ m	11.7	0.1	11.8
From Equation (2) For $0.148 \text{ m} < H_2 < 0.740$ m	8.8	2.6	11.4
From Equation (3) For $H_2 < 0.148$ m	0.6	0.2	0.8
Total Spill Volume	21.1	2.9	24.0

Hatch then multiplied the DWF EMCs estimated from the WWTP and the WWF EMCs from Main/King CSO grab samples (shown in green in Table 2.2) by their corresponding DWF and WWF to develop the estimated total contaminant loadings shown in **Table 2.3**.

Table 2.3. Estimated Contaminant Loadings for Period from January 28, 2014 to July 18, 2018

Flow Component	Spill Volume (GL)	Estimated Total Contaminant Loading (Tonnes)				
		TSS	TP	Ammonia	TKN	cBOD
DWF (2018)	2.9	771	13	63	101	502
WWF (2014-2018)	21.1	1,604	34	96	211	871
TOTAL (2014-2018)	24.0	2,375	47	159	312	1,373

The contaminant loadings developed by Hatch have been used as the basis for developing targeted restoration strategies discussed throughout the remainder of this plan.

2.2 Natural Environment and Sediment Quality Assessment Remediation Report Summary

Wood assisted the City of Hamilton with the preparation of a Conceptual Remediation Plan as required by the MECP and the original Order (#1-J25YB) as detailed in "Chedoke Creek – Implementation and Costing Report", Wood, January 24, 2019 and "Chedoke Creek Natural Environment and Sediment Quality Assessment and Remediation Report", Wood, January 24, 2019. The findings of the reports as they relate to sediment quality and characterization field studies, biota sampling surveys (benthic invertebrates and aquatic habitat) and analysis of existing data (fish community and water quality) are summarized along with a comparison of estimated contaminant loadings and in-situ sediment conditions within Chedoke Creek.

Water Quality Summary

Several water quality stations were evaluated as part of the 2019 report. Water quality at the CP-11 station provides the most complete and continuous period of record including data before during, and after the spill event. Because the CP-11 station is approximately 1 km downstream of the Main/King CSO, it is subject to additional factors such as inputs from the landfill leachate pumping system and backflow from the Cootes Paradise. SLR identified several additional sampling locations within Chedoke Creek as part of the April 20, "Cootes Paradise Environmental Impact Evaluation" which were not available for review prior to submittal of the Chedoke Creek Natural Environment and Sediment Quality Assessment and Remediation Report. Some of these sampling locations, including CP-11 Outlet and STN1, are closer to the Main/King CSO than the CP-11 station. However, as SLR indicated in its report, these locations were either temporary or sampled irregularly and lacked data sufficiency requirements for time-step statistical analyses. In particular, the CP-11 Outlet location was sampled only eight times and only in 2018 compared to 142 discrete total phosphorus samples obtained at the CP-11 location between 2009 and 2018. Regardless of the short period of record, the CP-11 Outlet and other stations that may be closer to the Main/King CSO help to characterize the water quality conditions immediately downstream of the spill and will continue to be evaluated as the Remediation Work Plan progresses.

Station CP-11 is located just upstream of the confluence of Chedoke Creek and Cootes Paradise as shown in Figure 2.1. Water quality data at CP-11 were compared for the pre-spill period between January 5, 2009 and January 27, 2014; the initial gate failure period between January 28, 2014 through December 31, 2017; the second gate failure between January 1, 2018 and July 18, 2018; and correction of the gates on July 18, 2018 through September 2018. Figures 2.2 through 2.4 show time series data for TP, *E. coli*, and ammonia at CP-11. Additional stations including CP-1, CP-2, CP-20, CC-9, CC-3, and CC-2 and water quality parameters including pH, chlorophyll-*a* and total suspended solids were evaluated as part of the "Chedoke Creek Natural Environment and Sediment Quality Assessment" (Wood, January 2019) and Remediation Report; however, have not been included in this report. Additional analyses of water quality at these and other stations within Chedoke Creek are provided in SRL's "Cootes Paradise Environmental Impact Evaluation", April 2020. SRL's findings were, in general, similar to Wood's findings discussed in the following.

Pre-spill water quality at the CP-11 station was consistent with runoff from urbanized watersheds. TP concentration averaged 0.19 mg/L with average ammonia concentration of 0.54 mg/L. Average *E. coli* counts were not particularly elevated prior to the spill event. Dissolved oxygen concentration was near saturation and did not suggest significant presence of BOD.

Water quality began to degrade after the initial gate failure on January 28, 2014. *E. coli* counts during the January 28, 2014 through December 31, 2017 were about an order of magnitude higher than prior to the beginning of the spill event (Figure 2.3). Median TP concentration was 2.2 times higher than the pre-spill period. Median ammonia concentrations were similar to pre-spill conditions although the maximum concentrations were higher after the start of the spill event. Dissolved oxygen concentration following the first gate failure was similar to the pre-spill condition.

Water quality decreased dramatically after the failure of the second gate on January 1, 2018. TP concentration increased steadily from less than 1 mg/L at the beginning of the second gate failure to over 2.5 mg/L through mid-summer of 2018. Median *E. coli* counts increased by three orders of magnitude following the second gate failure. Median ammonia concentration was approximately an order of magnitude higher (5.89 mg/L) than both the pre-spill period and period between the first and second gate failures.

Water quality at the CP-11 station appeared to improve rapidly following correction of the first and second gates on July 18, 2018. TP concentrations at CP-11 decreased to background levels, and similar to pre CSO levels. Median ammonia concentration following gate corrections was 0.28 mg/L or about half of the median concentration during the spill event.

Analyses of the available Chedoke Creek water quality data using medians or means provides a coarse assessment that is considered consistent with current data limitations. Additional tests for statistically significant differences between medians using the nonparametric Mann-Whitney U test were conducted for dissolved oxygen, total phosphorus, ammonia and *E. coli*, as shown in Figures 2.5 through 2.8. Pre-spill data from 2009 through 2012 was compared to post spill data from 2014 through 2018. The results indicate significant differences in the median TP concentrations and *E. coli* counts before and after the spill event and no significant differences between median dissolved oxygen and ammonia concentrations. Continued data collection will provide the opportunity to perform additional statistical analyses such as seasonal Mann-Kendall trend analysis, which is recommended for future evaluation and should indicate if water quality conditions are improving and/or have recovered within and downstream of Chedoke Creek.

Further collection of laboratory water quality data at all active water quality monitoring stations within and immediately downstream of Chedoke Creek is recommended and should include *E. coli*, total Kjeldahl nitrogen, nitrate+nitrite nitrogen, total nitrogen (the sum of total Kjeldahl nitrogen and nitrate+nitrite nitrogen), total ammonia nitrogen, total phosphorus, orthophosphate, chlorophyll-*a*, and total suspended solids. Field water quality parameters, primarily dissolved oxygen and pH, should be collected at the highest frequencies possible and a field-deployed datasonde is recommended for collection of continuous data that would address the current data limitations and would thereby capture diurnal trends.

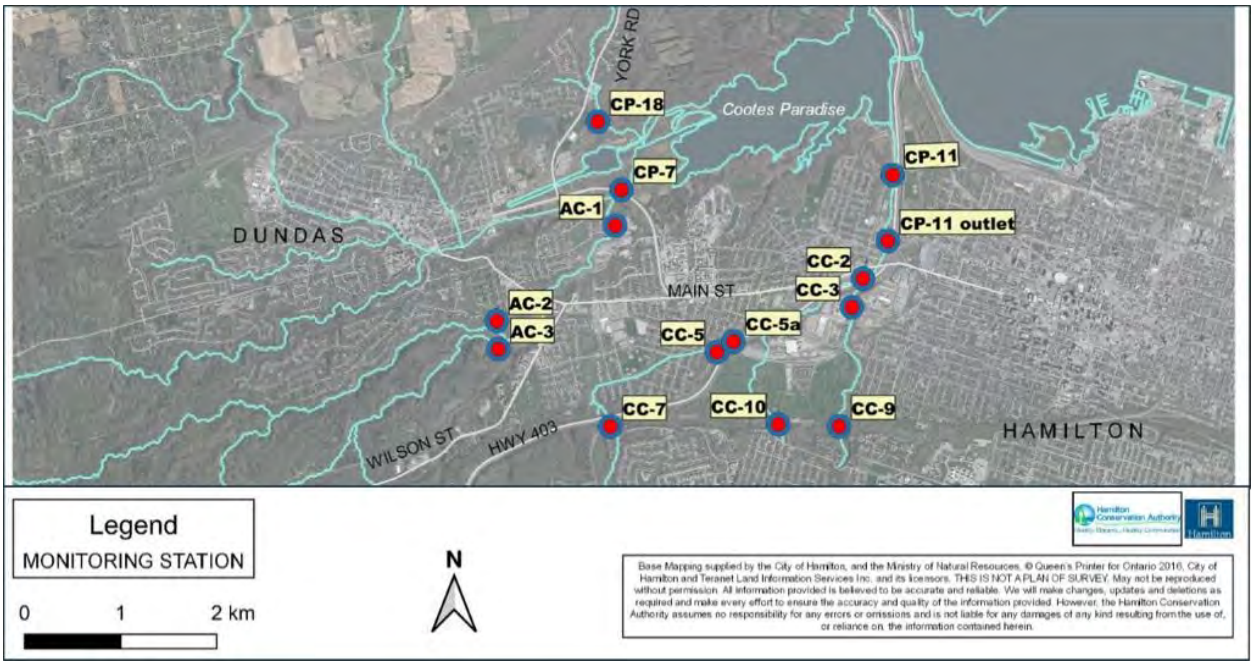


Figure 2.1. Map of Chedoke Creek and Cootes Paradise Monitoring Stations

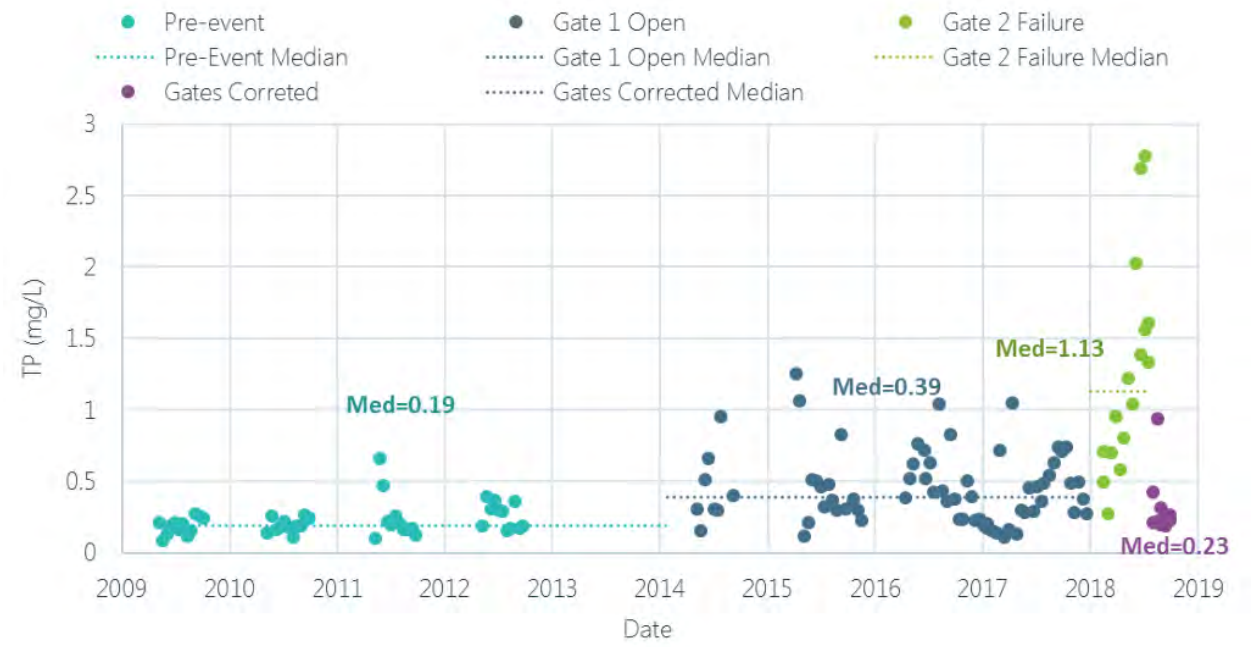


Figure 2.2. Total Phosphorus Concentrations at CP-11, and Median Values for the Four Time Periods

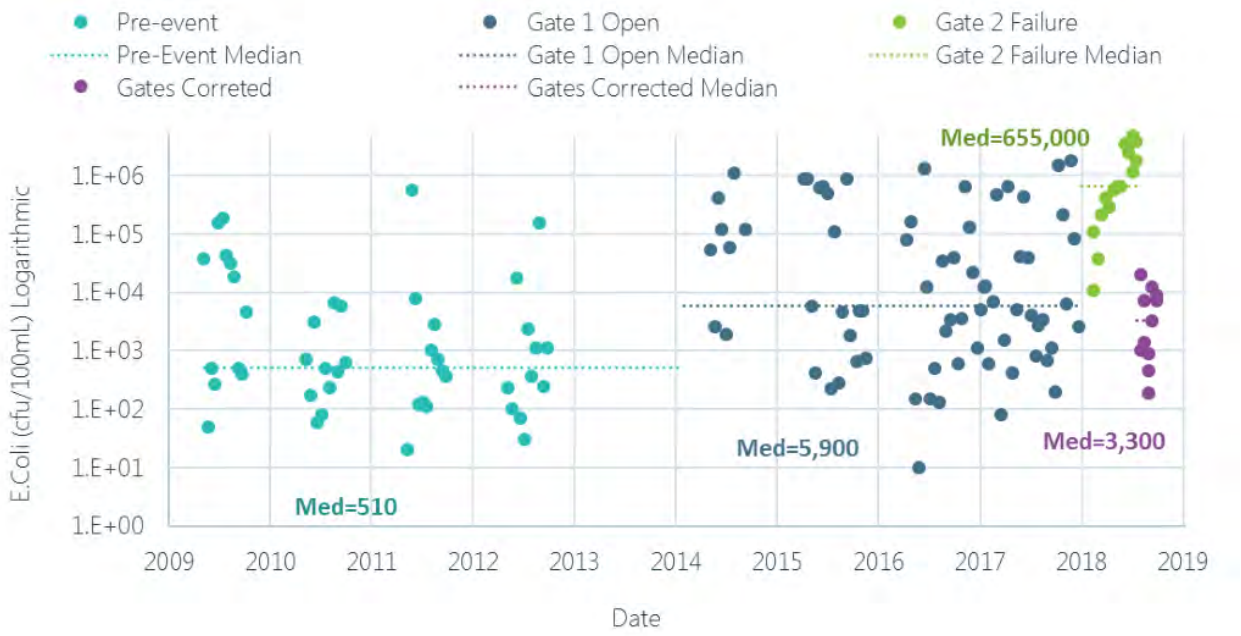


Figure 2.3. *E. coli* **Levels at CP-11, and Median Values for the Four Time Periods**

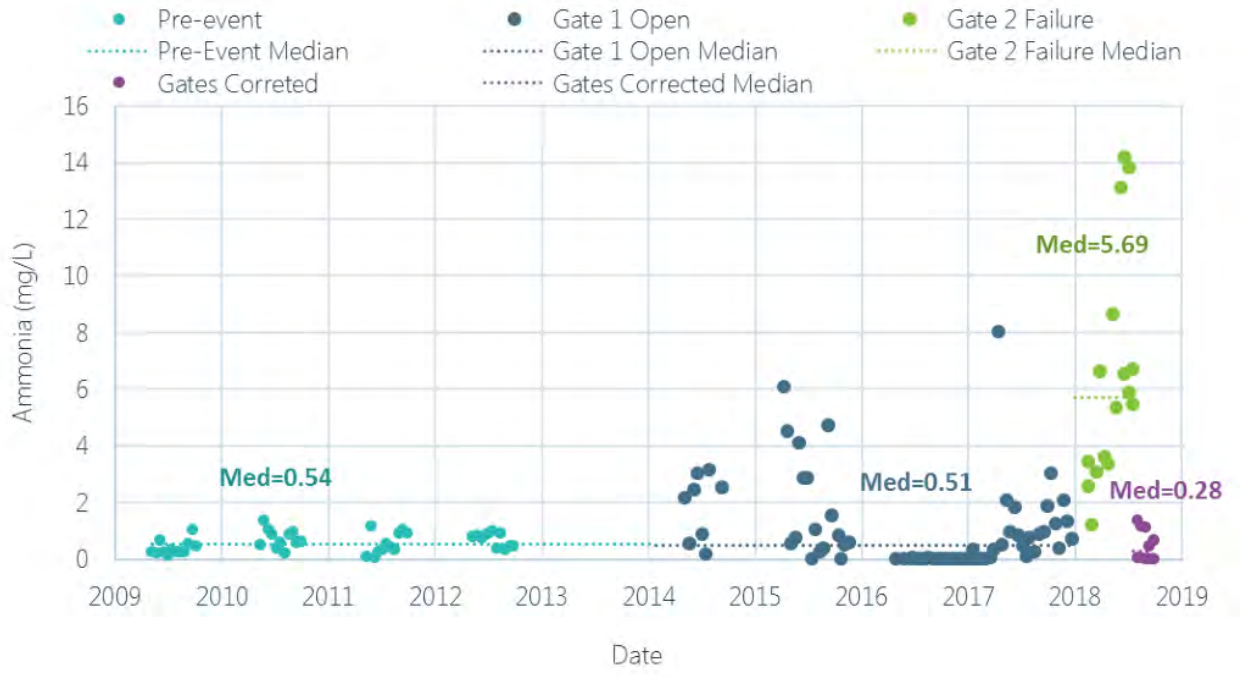


Figure 2.4. Ammonia Concentrations at CP-11, and Median Values for the Four Time Periods

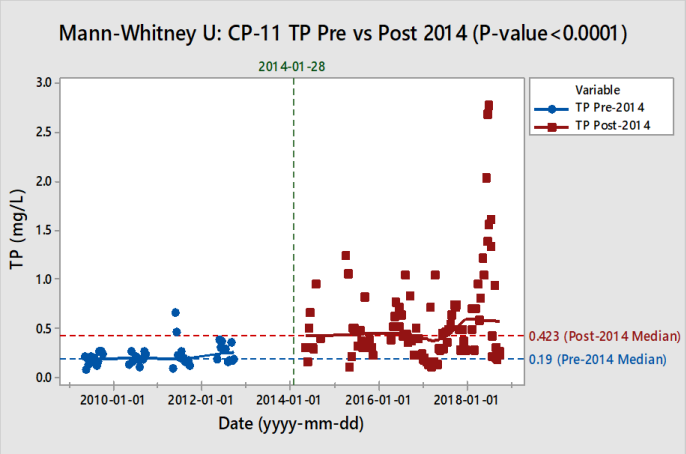


Figure 2.5. Mann-Whitney Total Phosphorus Results for CP11 pre vs post 2014

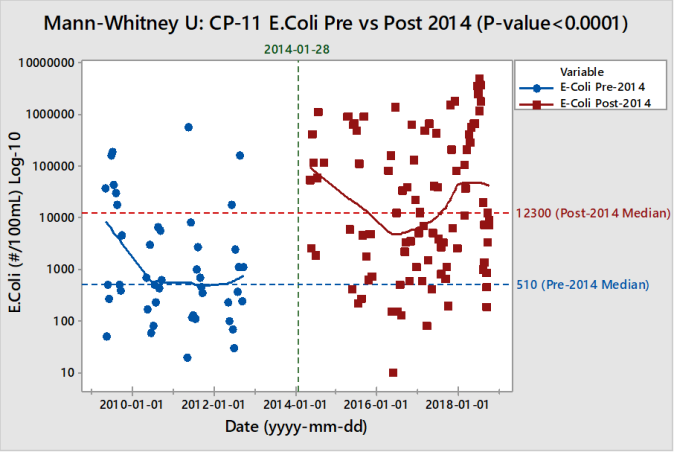


Figure 2.6. Mann-Whitney *E. coli* Results for CP11 pre vs post 2014

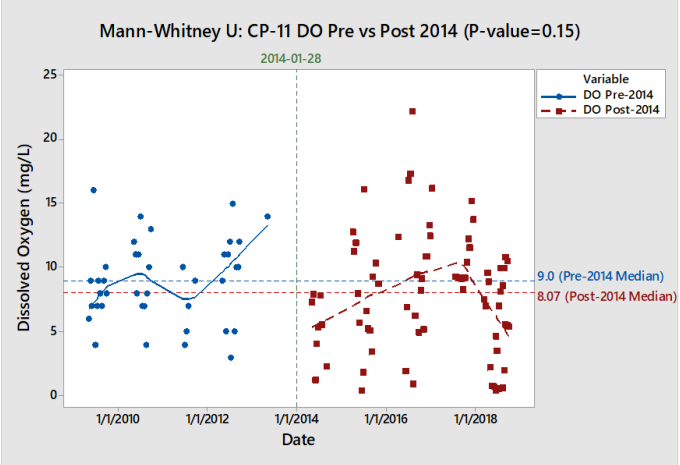


Figure 2.7. Mann-Whitney Dissolved Oxygen Results for CP11 pre vs post 2014

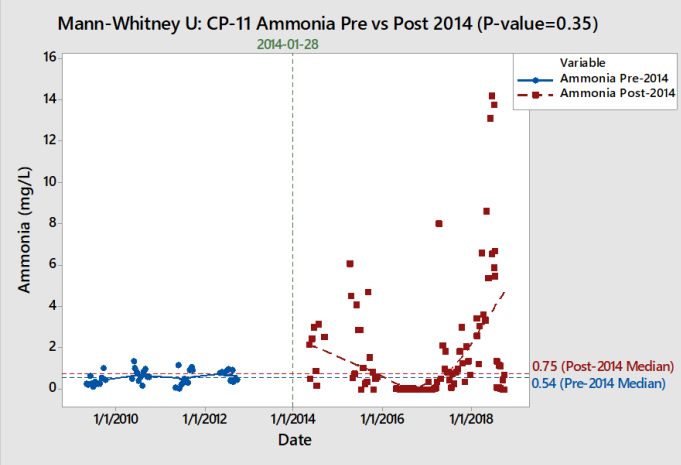


Figure 2.8. Mann-Whitney Ammonia Results for CP11 pre vs post 2014

Ecological and Physical Stream Conditions Summary

Wood evaluated the ecological and physical conditions of Chedoke Creek in 2018 using an upstream-to-downstream transect with various sediment samples collected at cross sections as shown in Figure 2.9.

Figure 2.9. Ecological and Physical Stream Conditions Survey Locations

The environmental findings of the Chedoke Creek Natural Environment and Sediment Quality Assessment and Remediation Report are summarized below.

Stream Conditions

The 2018 stream survey indicated no submerged aquatic vegetation, limited riparian vegetation, and an armored streambank. Some instream habitat (e.g., woody debris) was observed. An algae bloom was observed at Transect C-3/G-5. Stream sediments were generally muddy, and the soft sediment thickness layer increased from 0.1 m to about 0.7 m from upstream to downstream. Substrate within the upper half of the creek was sandy and rocky. Soft sediment fractions increased from 13 to 41% from upstream to downstream. Water velocity was observed to be highest within the shallow upstream half of the creek and gradually slowed as the water depth became deeper within the downstream half of the creek.

Benthic Invertebrates

Aquatic invertebrates were sampled in 2018 at the locations identified in Figure 2.9. Invertebrate abundances and diversity generally decreased from upstream to downstream, reflecting the reduction in habitat quality as defined by sediment condition. The overall benthic community was dominated by pollutant-tolerant organisms typically found in poor habitats. The most abundant organisms were the pollutant-tolerant taxa including chironomids and *Tubificidae* worms. The benthic invertebrate community of Chedoke Creek indicates a pollution-tolerant community which indicates poor environmental conditions typical of urban streams.

Fish Community

Fish data collected by the Royal Botanical Garden (RBG) from 2001 through August 2018 were evaluated along with fish sampling data collected by Wood in 2018 as shown in Figure 2.5. Data were normalized to catch per unit area. Fish abundance was variable over the period of record, but was, on average, highest at the station C1, located about 250 meters upstream of the outflow to Cootes Paradise. Fish abundance was also high at station M5, west of the Chedoke Creek discharge to Cootes Paradise. The greatest number of species, on average, was also found at C1. Fish abundance of 6.1 fish/ 50 m was higher at C1 in 2013 than the 0.1 fish/50 m observed in 2014. A reduction in fish abundance was also observed at station M5 during this same period. Fish abundance increased in 2015 but declined for the next three years relative to the pre-spill abundances. The number of fish species also decreased at C1 after 2014 and similar conditions were found until 2018 when the number of species increased. The number of stress-tolerant fish also appeared to increase from 2014 until 2018 when they declined. Fish sampling results appear to indicate the fish community of Chedoke Creek responded negatively during the spill event and positively following the end of the spill event.

Sediment Conditions Summary

Wood conducted preliminary sediment core and/or sediment grab sampling within Chedoke Creek at ten (10) locations between September 18th and 19th of 2018 as shown in Figure 2.5. Soft sediment thickness across the sample location transects showed greater accumulation of sediments along the west shoreline throughout the creek. Measured sediment thickness ranged from 0.10 to 0.70 m (mean thickness 0.37 m) along the west shoreline compared to 0.04 to 0.59 m (mean thickness 0.26) along the east shoreline and 0.03 to 0.66 m (mean thickness 0.32 m), near the centre of the creek. In general, the upstream sample locations including C-1, C-2, G-1 and G2 contained less soft sediment (thickness range 0.06 to 0.37 m) compared to the most downstream sample locations C-5/G-6 and C-6/G-7 (thickness range 0.44 to 0.70 m). Soft sediment thickness and bathymetry figures are provided in Figures 2.10 through 2.15.

Sediment core aliquots and grab samples were analyzed for the following parameters:

- qPCR – genetic analysis of sediment that identifies the relative abundance (%) of municipal sewage-based bacteria in the sample for comparison to natural sources of bacteria;
- Ammonia (NH3+NH4);
- Total Kjeldahl Nitrogen (TKN);
- Total Phosphorus;
- Total Metals (including: zinc, lead, copper); and
- O.Reg 153/04 Polycyclic Aromatic Hydrocarbons (PAH).

Sediment grab samples were analyzed for the following additional parameters:

- Sediment grain size analysis; and
- Pore water analysis for biochemical oxygen demand (BOD), faecal coliforms and dissolved oxygen (DO).

Bacteria

The bacteroidetes and faecal coliform sample results showed that the highest concentrations were found at the C3/G-5 sample transect, downstream of the Kay Drage Park bridge (Figure 2.9). The qPCR results showed that the highest human and total bacteroidetes were present in the surface strata (0 to 15 cm) at the C-3C replicate sample located near the west shoreline. Concentrations in the mid-strata aliquot (15 to 30 cm) of C-3C were also higher than most other mid-strata samples. The bacteroidetes and faecal coliform results from the downstream sample transects show lower concentrations, with most of the lowest values at the C-6/G-7 sample location within Cootes Paradise (further from the Main/King CSO source).

Biological Oxygen Demand

The highest porewater biological oxygen demand (BOD) results were found at sample transect C-5/G-6 immediately upstream of the Princess Point bridge, as shown on Figure 2.9, with the next highest BOD value observed at the G-3 sample transect located upstream of the Kay Drage Park bridge. The area of Chedoke Creek at transects G-3 and C-5/G-6 also contained the highest amount of organic material, which coincides with field observations indicating slower water velocities and increased settling of suspended solids at these locations.

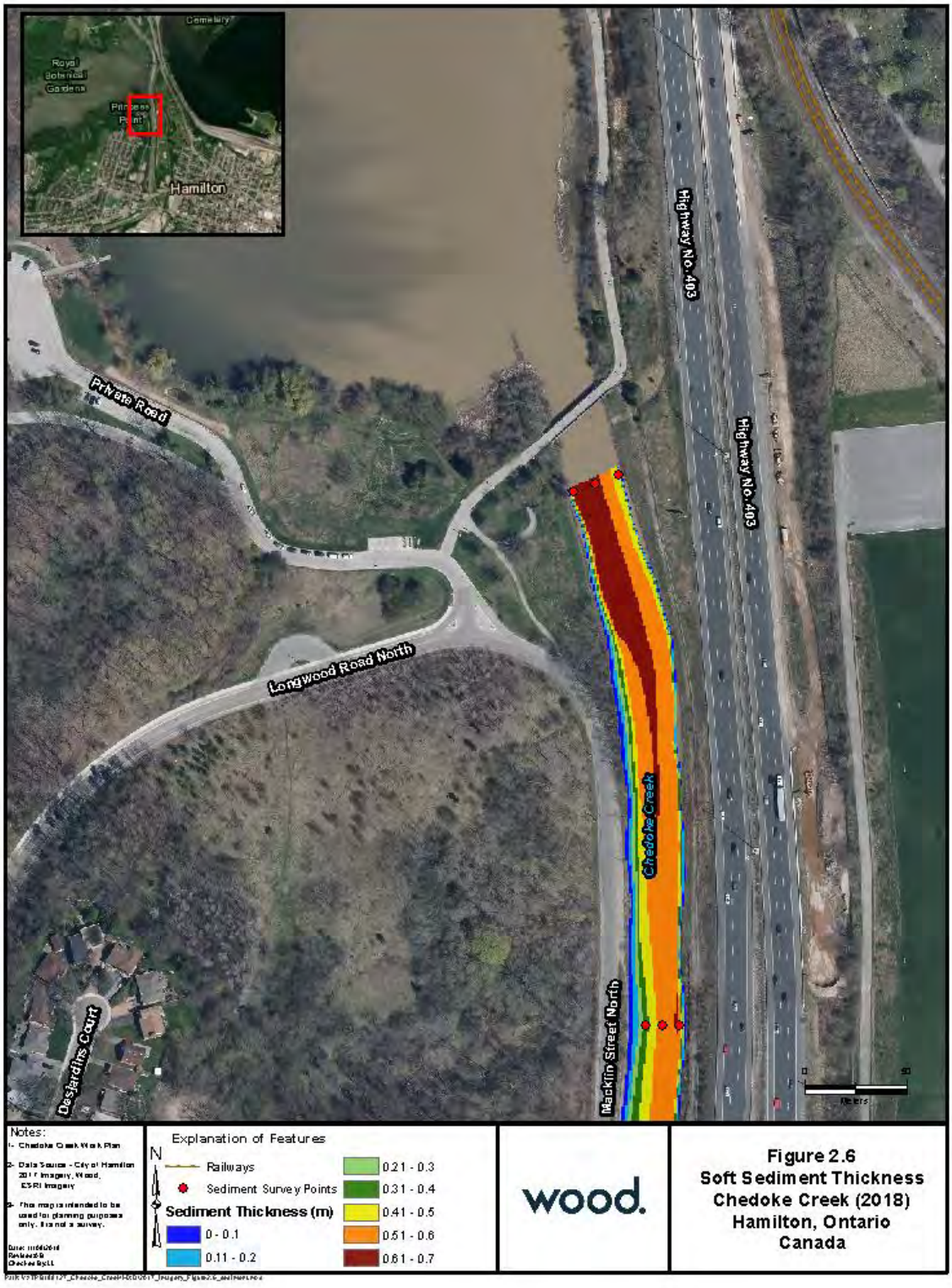


Figure 2.10. Soft Sediment Thickness, Chedoke Creek (2018), Hamilton, Ontario, Canada

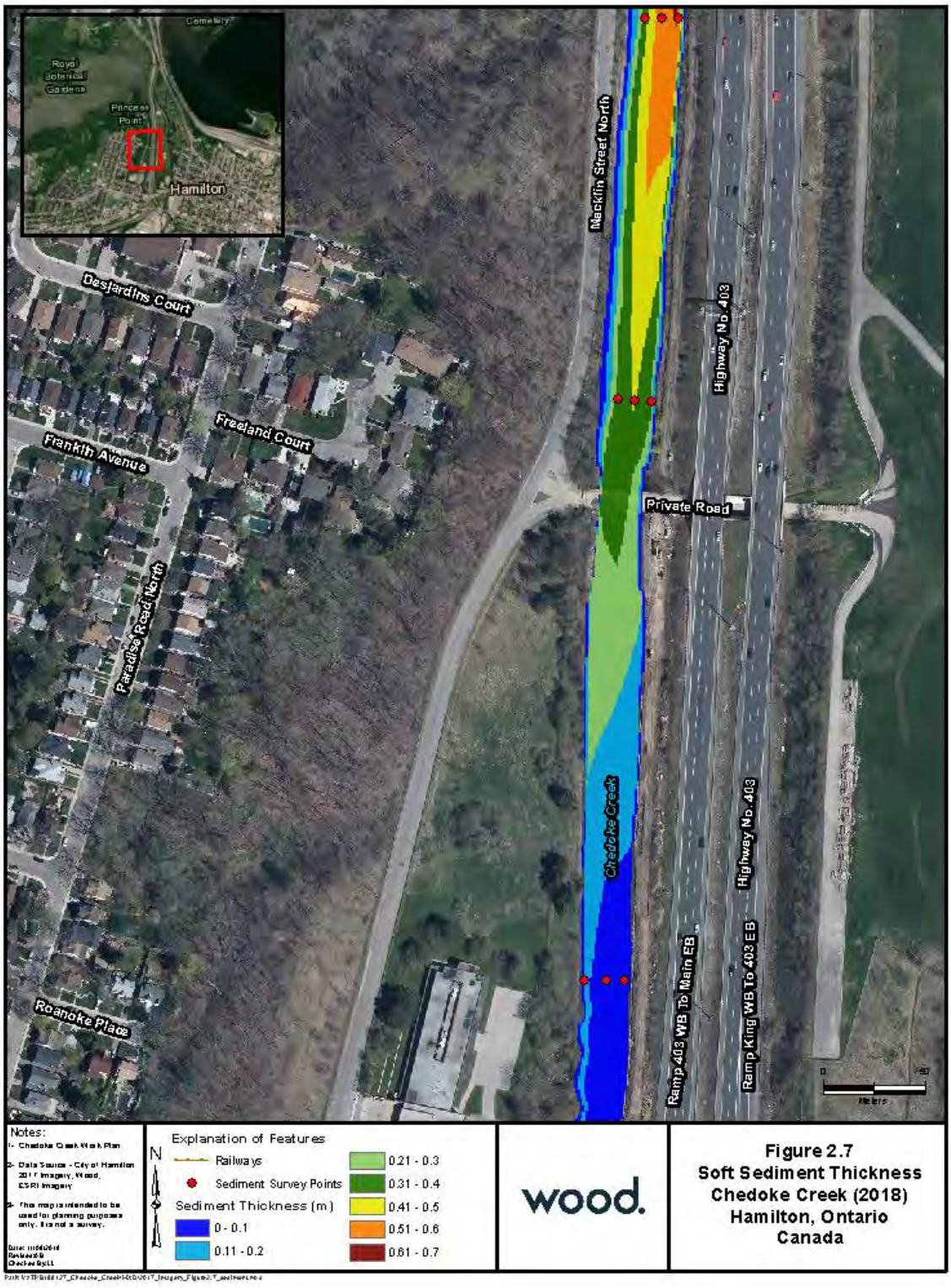


Figure 2.11. Soft Sediment Thickness, Chedoke Creek (2018), Hamilton, Ontario, Canada

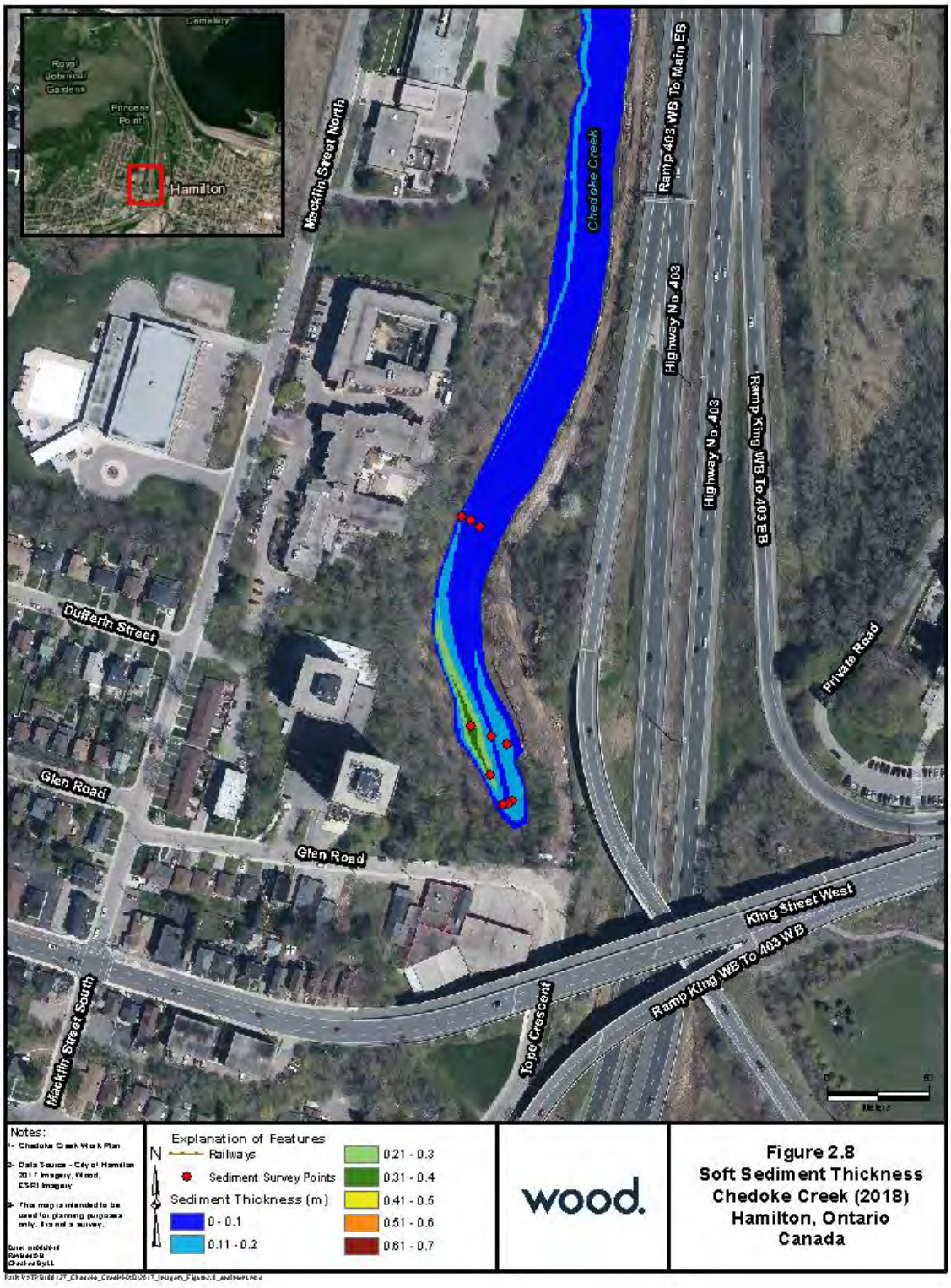


Figure 2.12. Soft Sediment Thickness, Chedoke Creek (2018), Hamilton, Ontario, Canada

Figure 2.13. Bathymetric Map, Chedoke Creek (2018), Hamilton, Ontario, Canada

Figure 2.14. Bathymetric Map, Chedoke Creek (2018), Hamilton, Ontario, Canada

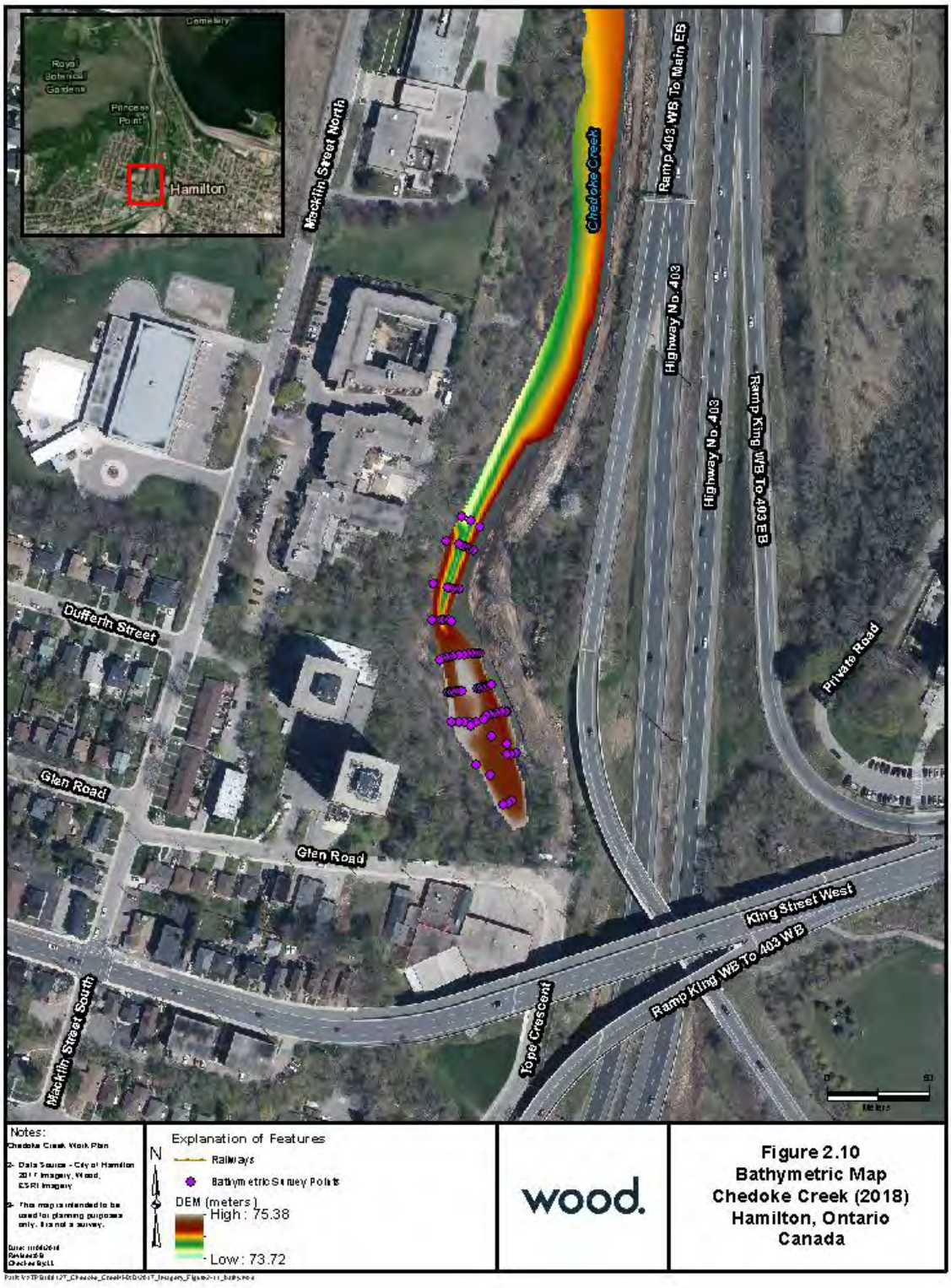


Figure 2.15. Bathymetric Map, Chedoke Creek (2018), Hamilton, Ontario, Canada

Nutrients

Sediment quality nutrients of interest included ammonia+ammonium, total phosphorus and total Kjeldahl nitrogen (TKN), all of which were found in the highest concentration within the surface strata (0 to 15 cm) at the C-3/G-5 sample transect, specifically the C-3C sample location (Figure 2-4). The next highest surface strata nutrient concentrations were found at the C-4C sample location, and both locations were positioned near the west shoreline, in areas of soft organic sediment. These sample locations were situated between the Kay Drage Park and Princess Point bridges, showing higher nutrient concentrations were present within this reach and were mostly higher than the surface strata within the Cootes Paradise sample location (C-6/G-7). Nearly all TKN concentrations in surface strata were above the PSQG LEL (550 µg/g), suggesting these sediments contain a level of contamination that can be tolerated by the majority of sediment-dwelling organisms, but not necessarily stress-intolerance taxa as discussed above. Total phosphorus concentrations in all sediment strata samples were greater than the PSQG LEL (600 µg/g) between transects C-4 and C-6/G-7, with the highest concentrations observed at transect C-5/G-6. The phosphorus SEL (2,000 µg/g) was not exceeded by any sample concentration.

Previous sediment quality studies conducted by the RBG in 2006 and 2013 documented nutrient parameters at two locations (CC-1 and CC-2) positioned further northwest from the 2018 C-6/G-7 sample location (Figure 2.9). Pre-spill RBG data suggest that TKN enrichment had already occurred downstream in Cootes Paradise. Similarly, total phosphorus enrichment was found to have occurred downstream in Cootes Paradise prior to the event. The means and timeframe of TKN and TP enrichment remain unclear.

The mid and lower strata aliquot samples collected from Chedoke Creek showed nutrient concentrations were mostly higher than the surface strata concentrations at sample transects C-5/G-6 and C-6/G-7. These nutrient concentrations within deeper sediment strata suggested legacy nutrient enrichment had occurred where organic sediments were accumulating in the slower-flowing, lower reaches of the creek and within Cootes Paradise.

Nutrient concentrations were high in most samples collected from less than 30 cm in depth, portions of the creek that were sandy (C-1 through C-3) and deep (> 30 cm) samples had the lowest total Kjeldahl nitrogen and total phosphorus concentrations. Deeper sediment samples (> 30 cm) collected downstream of C-3 were generally nutrient-enriched which is consistent with the depth of soft sediments in these areas. Presumably, a sandy sediment stratum with lower nutrient concentrations exists downstream of C-3, but further sampling at deeper intervals is needed to identify the vertical elevation of this layer.

Heavy Metals and Polycyclic Aromatic Hydrocarbons

The findings pertaining to metal concentrations from Chedoke Creek samples collected by Wood in 2018 are summarized compared to the PSQG and O. Reg. 153/04 values. The PSQGs are guidelines which promote the protection of aquatic life using LEL values (equal to the O. Reg. 153/04 concentrations), as well as the PSQG SEL criteria that indicate levels of sediment contamination at which pronounced disturbance of the sediment-dwelling biota community can be expected.

Most of the highest heavy metal concentrations of interest (Cu, Pb and Zn) within surface strata (0 to 15 cm) were found between the C-3/G-5 and C-5/G-6 sample transects which were similar to the results found for other parameters. Concentrations of copper, lead and zinc were generally greater than their respective PSQG LELs, but mostly below the SEL values. Graphs of these metals and their respective regulation values are provided in Figure 2.16. Other metals with O. Reg. 153/04 and PSQG sediment quality values include arsenic, cadmium, cobalt, chromium, nickel and silver.

The surface strata metal concentrations between the C-3/G-5 and C-5/G-6 sample transects were generally greater than the upstream or furthest downstream sample results. Overall, the deeper sediments contained higher concentrations of these metals at transect C-4 and further downstream. The C-5C sample location positioned near the west shoreline, upstream of the Princess Point bridge contained the highest mid and lower-strata metal concentrations. Unlike nutrients, metals pose a direct toxicity to living organisms and removal of soft sediment material containing these metals would likely be beneficial to the ecological conditions within Chedoke Creek and downstream.

Figure 2.16. Copper, Lead and Zinc Concentrations in Chedoke Creek Sediments

Arsenic, cadmium, chromium and silver concentrations were generally below the PSQG LEL values in the upstream locations. Arsenic, chromium and nickel concentrations are shown in Figure 2.17 for comparison to their respective O. Reg. 153/04 values. The arsenic and chromium concentrations for sample locations C-1 through C-3 were mostly below the regulation value, with concentrations greater than the regulation at sample locations C-4 through C-6. Nickel concentrations in the upper strata samples (0 to 15 cm) were all greater than the regulation value, with most of the mid and lower strata samples also greater than the regulation value. In general, most sediment quality parameter concentrations were highest in the downstream sample locations between sample transects C-4 and C-6.

Figure 2.17. Arsenic, Chromium and Nickel Concentrations in Chedoke Creek Sediments

Cobalt was the only metal concentration consistently below the PSQG LEL and O. Reg. 153/04 value, with the highest concentration (22 µg/g) being less than half the LEL value (50 µg/g). The cadmium and silver concentrations were mostly below their respective regulation values for sample locations C-1 through C-3 and replicate sample C-4A (near east shoreline). Cadmium and silver were above the PSQG LEL and O. Reg. 153/04 value for most of the strata sampled between transect C-4 and C-6.

Similar to the nutrient-enrichment discussion above, the observed metal concentrations were lower in the sandier portions of the creek, above the C-3 sample location. The metal concentrations evaluated in sample locations downstream of C-3 were likely representative of the organic material within Chedoke Creek. Additional sampling at deeper intervals is necessary to determine whether metal concentrations decrease below the organic layer.

Most PAH concentrations from all samples were greater than their respective O. Reg. 153/04. Results from the composite grab samples are show in Table 2.4 and are generally representative of core samples regardless of collection interval. Anthracene had the fewest regulation exceedances, and most of the mid and lower strata sample concentrations were consistently greater than the regulation values. The PAH results have been used to determine disposal options for removed (dredged) sediment. Additional sampling at deeper intervals is necessary to refine this analysis and determine whether these exceedances exist below the organic layer. As noted, the PAH concentrations of soft sediments within the creek do not solely represent impacts attributable to the spill event and include other confounding factors such as other sources of contaminants (e.g., other CSOs and urban runoff), however isolating these sources with the current data was not feasible using the limited preliminary sediment data and sediments with higher PAH concentrations will be evaluated as high priority for removal.

Table 2.4. Polycyclic Aromatic Hydrocarbons from Grab Samples Collected in Chedoke Creek

Sample Transect		PSQG SEL	G-1 Comp	G-2 Comp	G-3 Comp	G-4 Comp	G-5 Comp
Nutrients and Bacteria	**O.Reg 153/04 PSQG LEL †**						
PAHs							
Acenaphthene			0.83	0	0	0	0
Acenaphthylene			0	0	0	0	0
Anthracene	0.22		**0.99**	0.12	0	0	0.16
Benzo(a)anthracene	0.32		**2.96**	**0.38**	0.18	**0.34**	**0.68**
Benzo(a)pyrene	0.37		**2.4**	0.36	0.18	0.33	**0.68**
Benzo(b)fluoranthene			3.59	0.53	0.32	0.53	1.28
Benzo(ghi)perylene	0.17		**1.45**	**0.22**	0.13	**0.2**	**0.38**
Benzo(k)fluoranthene	0.24		**1.37**	0	0	0	**0.29**
Chrysene	0.34		**3.24**	**0.45**	0.26	**0.42**	**0.84**
Dibenzo(a,h)anthracene	0.06		**0.37**	0	0	0	0
Fluoranthene	0.75		**9.08**	**1.11**	0.59	**0.96**	**1.91**
Fluorene	0.19		**0.84**	0	0	0	0
Indeno(1,2,3-cd)pyrene	0.2		**1.34**	0.19	0.11	0.18	**0.32**
1-Methylnaphthalene			0.2	0	0	0	0
2-Methylnaphthalene			0.3	0	0	0	0
Methylnaphthalene, 2			0.49	0	0	0	0
Naphthalene			0.98	0	0	0	0
Phenanthrene	0.56		**9.53**	**0.73**	0.25	0.45	**0.94**
Pyrene	0.49		**6.75**	**0.85**	0.47	**0.76**	**1.48**

Sediment Conditions in Cootes Paradise

Available sediment data also includes information from sediment quality studies conducted within Cootes Paradise by the RBG in 2006 and 2013. The RBG data include metal concentrations at the two locations noted in the nutrient discussion earlier. Cadmium, copper, iron, lead and zinc concentrations were greater than the PSQG LEL concentrations for all samples (CC-1 and CC-2); however, no concentrations exceeded the respective PSQG SEL values. Arsenic concentrations in 2006 at CC-1 and CC-2 were equal to the PQSG LEL (6 µg/g) and were below the LEL in 2013, 5.6 and 5.2 µg/g, respectively. All upper strata arsenic concentrations in the 2018 study were below the PSQG LEL. The RBG 2006 studies also documented PAH concentrations at the CC-1 and CC-2 sample locations (no PAH sampling conducted in 2013). The RBG 2006 PAH results show sediment sampled at CC-1 contained PAH concentrations less than the respective O. Reg. 153/04 values. PAH concentrations at RBG location CC-2, positioned further offshore than CC-1 within Cootes Paradise, were equal to, or greater than, many of the O. Reg. 153/04 values. All 2006 PAH concentrations were less than the 2018 PAH concentrations observed at the Chedoke Creek sample locations, including location C-6 positioned immediately downstream of the creek outlet into Cootes Paradise.

The 2018 results suggest legacy metal enrichment has occurred prior to the Main/King CSO spill event and removal may be beneficial. However, it is important to note other potential sources of metal enrichment are ongoing and likely occurred prior to the discharge event. These include, but are not considered limited to, other operating CSOs (e.g. Royal CSO Tank) located upstream, the storm water drainage from the adjacent highway infrastructure and runoff from upstream urban environs (i.e., extensive roadway network) discharging to the creek, as well as other upstream sources (e.g., industrial and landfill sources). As noted earlier, establishing a clear distinction between legacy and event-based contamination is not considered feasible with the available data.

Comparison of In-Situ Sediment Conditions and Spill Quantities

Wood estimated a layer of soft organic material approximately 16 m wide with a mean thickness of approximately 0.27 m (+/-) along roughly 1,275 m (+/-) of the creek bed between the Main King CSO and Cootes Paradise. The volume of organic material within Chedoke Creek was estimated in 2018 to be approximately 5,600 m^3 (+/-).

Soft sediment collected from Chedoke Creek indicates moisture content of approximately 40% which suggests that this material is relatively dense and consistent with settling and consolidation of suspended particulate material in the wastewater stream. This material would likely include a portion of the TSS discharged during the spill event which would have subsequently compacted over the duration of the spill event and thereafter.

As discussed in Section 1, Wood estimated that the 2,375 tonnes of TSS discharged during the spill event, per Hatch 2018, would occupy a volume of 5,260 m^3 at 40% solids. This is similar to the approximate in-situ soft sediment volume of 5,600 m^3 discussed above. However, it is unlikely that all of the solids mass discharged during the spill event was retained within the creek. The in-situ mass is more likely to be a combination of the remaining heavier organic particles discharged during the spill event and other material that may have been present prior to the spill. Pursuant to the 2019 report, Wood conducted a reassessment of the TKN present within Chedoke Creek which suggests 3 to 4 tonnes are present which is less mass than previously reported within the Chedoke Creek sediments. Total phosphorus mass within the Chedoke Creek soft sediments was estimated to be 3.3 tonnes while total loading from the event was estimated to be 47 tonnes. The balance of the TP and reassessed TKN mass may have been transported downstream as dissolved phosphorus. This is consistent with the relatively high concentrations of TP observed in the water column in Chedoke Creek and downstream in Cootes Paradise between 2014 and 2018.

As discussed in Section 1, while removal of solids mass is important, it is equally important to identify the potential for TP and TKN removal. The majority of TP and TKN mass load appears to have be solubilized or transported downstream. Additional effort is included with this work plan to determine the extent of sediment deposition from Chedoke Creek within Cootes Paradise, as well as the mass of contaminants that could be removed accordingly.

Current Conditions

Wood's initial assessment of the chemical and physical sediment characteristics within Chedoke Creek was conducted more than two years ago (fall 2018). Given the time that has lapsed since the end of the spill event and the potential for downstream sediment transport, it is highly conceivable that significant changes may have occurred within Chedoke Creek that could impact the scope of the original restoration approach outlined by Wood in January 2019.

Following the work by Wood, SRL Consulting Canada performed additional sediment sample analyses in 2019 as part of the Environmental Risk Assessment. Nutrients within the same 0-15 cm sediment interval analyzed by Wood indicated decreasing concentrations of both TKN and TP which is consistent with the characteristics of wastewater decomposition.

Given the dynamic nature of Chedoke Creek sediments, additional physical and chemical characterization of sediment within the potential project footprint is considered required to accomplish the following objectives:

1) Provide sufficient physical and chemical information required for project design
2) Determine the vertical and horizontal distribution of contaminants (including TKN and TP) within the potential dredge footprint
3) Determine the anthropogenic sediment horizon where contaminant concentrations should equal that of background conditions
4) Determine an appropriate target dredge elevation which reduces the risk of exposure to contaminants that may be uncovered during the dredge process
5) Determine the available disposal options for the dredged material

Wood has developed a sampling plan detailed herein which will involves collection of detailed bathymetric and sediment data. This information will be used to guide an adaptive project design and management approach that will satisfy the MECP's current Order.

2.3 Supplemental Field Work and ERA Summary

Following Wood's submittal of the Conceptual Remediation Plan, the City of Hamilton retained SLR Consulting Canada (SLR) to collect additional sediment data and provide an assessment of the potential environmental risks associated with a proposed dredge project. SRL performed sediment sampling within Chedoke Creek and Cootes Paradise at similar locations and intervals used by Wood and identified in Figure 2.9.

SLR conducted an Aquatic Ecological Risk Assessment (ERA) at the Chedoke Creek Site in 2019 in response to the spill. The study area encompassed the lower section of the Chedoke Creek paralleling Highway 403. Sediment samples from within the study area were analyzed for metals, PAHs, and nutrients. The dataset used in the ERA included 22 sediment samples from two depths (shallow=0-0.10 m or 0-0.15 m and deep >0.15 m) collected in 2018 and 2019. The ERA also assessed risk from surface water which is not included in this discussion.

Contaminants of potential concern (COPCs) were identified by comparing the maximum sediment contaminant concentrations to published ecological effect benchmarks, or toxicity reference values (TRV), listed below in order of preference:

- Sediment screening benchmarks: Provincial Sediment Quality Guidelines (PSQGs) Lowest Effect Level (LEL), the Canadian Sediment Quality Guidelines (CCME) freshwater Interim Sediment Quality Guidelines (ISQGs), or the background sediment concentrations for metals in the Great Lakes region. The MacDonald threshold effect concentration (TEC) and probable effect concentration (PEC) benchmarks were also referenced in the SLR ERA.
- In addition to the sediment screening benchmarks listed above, the PSQG Severe Effect Level (SEL) were incorporated into this discussion to assist in identifying the most contaminated areas. While the LEL "indicates a level of contamination that can be tolerated by the majority of sediment-dwelling organisms; sediments meeting the LEL are considered clean to marginally polluted," the SEL "indicates a level of contamination that is expected to be detrimental to the majority of sediment-dwelling organisms. Sediments exceeding the SEL are considered heavily contaminated."1

To identify COPCs, the maximum concentration of an analyte from within the study area was divided by the TRV to calculate a hazard quotient (HQ). Along with other lines of evidence, analytes with an HQ>1 were identified as COPCs. Additional lines of evidence supporting the COPC identifications based on the sediment samples included: biological observations, toxicity tests, and an assessment of the benthic invertebrate community. Because the ERA identified PAHs as contributing the most risk, SLR also examined the relative degree of PAH contamination of sediment samples and calculated a mean HQ quotient (HQ-Q).

In addition, the SLR ERA considered both listed and non-listed wildlife species.

ERA Results

The Chedoke Creek sediment contaminants of potential concern (COPCs) based on maximum concentrations from the study area are identified in Table 2.5 - COPCs for Chedoke Creek.

1 https://www.ontario.ca/document/guidelines-identifying-assessing-and-managing-contaminated-sediments-ontario/identification-and-assessment

Table 2.5. Sediment COPCs for Chedoke Creek

COPC Group	COPCs	
	Shallow (0-0.15 m) Sediment [a]	Deep (>0.15 m) Sediment
Metals https://www.ontario.ca/document/guidelines-identifying-assessing-and-managing-contaminated-sediments-ontario/identification-and-assessment	Arsenic, cadmium, chromium, copper, lead, **manganese**, **mercury** and zinc	Arsenic, cadmium, chromium, copper, lead and zinc
PAHs	**Acenaphthylene**, acenaphthene, anthracene, benz(a)anthracene, benzo(g,h,i)perylene, benzo(k)fluoranthene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, 2- methylnaphthalene, naphthalene, phenanthrene, pyrene and total PAHs	Acenaphthene, anthracene, benz(a)anthracene, benzo(g,h,i)perylene benzo(k)fluoranthene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene indeno(1,2,3-cd)pyrene, 2-methylnaphthalene, naphthalene, phenanthrene, pyrene and total PAHs
Nutrients	Total Kjeldahl nitrogen (TKN) and total phosphorus (TP)	TKN and TP

Source: SLR, 2020

[a] Bold text indicates analyte identified as COPC in only shallow sediment. Manganese and mercury were not analyzed in deep sediment and can only be assessed in shallow sediment. Acenaphthylene was undetected in deep sediment, although the detection limit exceeded the sediment screening benchmark.

Vertical Distribution of COPCs in Sediment

The SLR Chedoke ERA relied primarily on the shallow samples to assess risk, according to MECP Guidance (MOE 2008). However, deeper sediment samples data were also considered. The COPCs identified in shallow (0.15 cm) and deep (>0.15 cm) sediments based on maximum concentrations were similar (ref. Table 2.5 - COPCs for Chedoke Creek). Although there were more contaminants identified as COPCs in the shallow sediment, this was primarily a result of study design and analytical limitations. To better understand the differences between the contaminant concentrations by depth, SLR calculated 95% UCL concentrations for both the shallow and deep sediment datasets:

- PAHs: UCL 95% concentration were generally higher in the shallow sediment (14 of 17 individual PAHS). Total PAHs was also higher in the shallow sediment. SLR concluded that shallow sediments present a higher PAH risk to aquatic receptors.

- Metals: Of the metal COPCs analyzed from both depth datasets, 95% UCLs of arsenic, cadmium, chromium, and lead were higher in the deep dataset compared to the shallow dataset. 95% UCLs for the remaining COPCs, copper and zinc, were lower in the deep dataset compared to the shallow dataset.
- Nutrients: TKN and TP 95% UCLs were higher in the deep dataset compared to the shallow dataset. Deep concentrations were generally similar to historical ranges.

Spatial Distribution of COPCs in Sediment

According to the SLR Chedoke ERA, the spatial distribution of sediment contaminants within the creek varied by contaminant type, as summarized below:

- Metals:
  - Shallow sediment (0-0.10 m or 0-0.15 m): metals concentrations in shallow sediment generally increased from upstream to downstream. Shallow sample metal concentrations of cadmium, copper, lead, manganese, nickel, and zinc exceeded LELs throughout the study area. Arsenic, total chromium, and mercury concentrations also exceeded LELs, though less frequently. Overall, the highest metals concentrations were typically observed at locations C5-East and C3-West. Only copper exceeded the SEL, at locations C3 West, C4 West and C5 east.
  - Deep sediment (0.15-0.30 m, >0.3 m): metals concentrations in deep sediment also generally increased from upstream to downstream. Deep sample metal concentrations exceeded LELs throughout the study area. Cadmium and copper exceeded the SELs in the samples from the C-4 and C-5 area; nickel and zinc exceeded the SELs in the C-5 area.
  - Samples from >0.3 m were limited, and no overall trends were observed that differentiated the samples from 0.15-0.30 m versus >0.3 m. SEL exceedances were observed in samples from both .15-0.30 m and >0.3 m
  - The majority of SEL metal exceedances in both shallow and deep sediment occurred in the C-4 and C5 areas, though SEL metal exceedances were more frequent in deep sediments.
- PAHs:
  - Shallow sediment (0-0.10 m or 0-0.15 m): Shallow sample PAH concentrations exceeded the PAH LELs throughout the study area. The SELs were exceeded for two analytes (fluorene and pyrene), both upstream at C-1 West. Total PAHs in shallow samples were generally highest at the location downstream of the King/Main CSO (which is in the area of location C1), decreased at locations G3 and G4, and increased downstream of Macklin Street Bridge. Between Macklin Street Bridge and Princess Point, total PAH concentrations were similar.
  - Deep sediment (0.15-0.30 m, >0.3 m): deep sediment samples were also variable among stations. Deep PAH concentrations exceeded the PAH LELs throughout the study area. The PAH SELs were not exceeded. The highest total PAH concentrations in deep samples of 47.46 ug/g and 21.11 ug/g were from C3 and C2, respectively. The total PAH concentration at C5 was similar to C2.
  - Samples from >0.3 m were limited, and no overall trends were observed that differentiated the samples from 0.15-0.30 m versus >0.3 m. However, at location C-5 Centre, the samples from >0.3 m had fewer LEL exceedances than samples from 0.15-30m and 0-0.15 m.
  - PAH concentrations in shallow and deep sediment exceeded LELs throughout the study area. Only shallow sediment had SEL exceedances (fluoranthene and pyrene at C1).

- Nutrients:
    - Shallow sediment (0-0.10 m or 0-0.15 m): In shallow sediment, TKN and TP exceeded LELs throughout the study area; no SELs were exceeded.
    - Deep sediment (0.15-0.30 m, >0.3 m): In shallow sediment, TKN and TP exceeded LELs throughout the study area; no SELs were exceeded.
    - Note that samples from >0.3 m were limited, and no overall trends were observed that differentiated the samples from 0.15-0.30 m versus >0.3 m. However, only one sample from these deep (0.15-0.30 m, >0.3 m) locations had no TKN or RP exceedances; this was at C-3 East from >0.3 m.

Uncertainty

SLR reported that uncertainty in the results reported in the ERA can result from the following:

- Lack of screening levels for some analytes mean that risk cannot be assessed.
- Availability of background concentrations can limit assessments.
- Using the maximum detected concentration overestimates concentrations to which a population of receptors would be exposed over time and across the site.
- In interpreting screening level HQs, it is customary to assume that all COPCs are 100 percent bioavailable. Bioavailability is the extent to which a substance can be absorbed or otherwise ingested by a living organism, potentially causing an adverse response. The bioavailability of chemical parameters is related to the extent to which it can desorb, dissolve, or otherwise disassociate from the environmental medium in which it occurs. Factors such as organic carbon and pH may affect the bioavailability of chemical parameters in soil.
- Risk calculations assume that the most sensitive receptors and receptor life stages are present at the Site. Risk may be overestimated where it is calculated using screening benchmarks that are based on toxicity to receptors or receptor life stages that are not present.

ERA Summary and Recommendations

SLR's Chedoke Creek ERA concluded that (ref. SLR 2019):

- "The hazard quotients calculated as part of the risk characterization indicated that potential risks to aquatic life and amphibians exposed to surface sediment were negligible for nutrients and negligible to low for metals. This however does not preclude potential risks from exposure to nutrients for which TRVs are not available. Based on the hazard quotients for COPCs with available TRVs, potential risks were identified for aquatic life and amphibians exposed to PAHs in surface sediment. The potential risks were qualified as low, moderate or high depending on location. PAHs were identified as the risk drivers among the COPCs for which TRVs were available."
- "The results of the ERA indicate that the PAHs, metals and bacteria in the study area sediment, as well as the sediment oxygen demand resulting from the degradation of natural organic detritus and/or organic waste, likely restricts the benthic invertebrate community makeup to stress tolerant organisms."

While SLR characterized the ecological risk associated with surficial sediment from within the Chedoke Creek study area, there was limited information on deeper sediments. A limited number of samples were collected from >0.3 m and the maximum sample depth was unclear. Contamination was evident in the samples from >0.3 m (LEL and SEL exceedances) and additional sediment sampling will be performed as part of this work plan to capture the vertical extent of contamination at Chedoke Creek.

3.0 Goals and Objectives of Targeted Dredge

3.1 Restoration to Pre-Spill Conditions

The goal of the Chedoke Creek targeted dredge project is to return the creek to its estimated condition prior to the beginning of the spill event and to provide reasonable complementary offsetting remediation projects to account for additional environmental impacts that may not be addressed by dredging alone. Based on Wood's 2018 observations, the spill impacts to Chedoke Creek appear to be primarily related to the accumulation of organic sediments that resulted in increased nutrient export, bacteriological contamination, low dissolved oxygen concentrations, and physical smothering within the creek, as well as habitat loss for those species dependent on sandy substrates. In addition to sediment removal, removal of nutrients including TP and TKN are of primary importance because they tend to flux from organic sediments and can have continuing impacts to water quality which lead to algal blooms, low dissolved oxygen, reduced light penetration and other water quality problems.

Chedoke Creek serves as a major drainage conveyance for a densely populated portion of the City of Hamilton. The creek received urban stormwater runoff and CSO discharges for decades prior to the beginning of the 2014 spill event. Wood's 2019 report included a review of aerial photography indicating that Chedoke Creek had no identifiable emergent or submerged aquatic vegetation between the Main King CSO discharge structure and Cootes Paradise prior to the spill event. Similar conditions indicating lack of aquatic vegetation were evident in 2017. Wood's review of all available chemical, physical and biological data before, during and after the Chedoke Creek spill suggests that there were obvious water quality impacts during the spill event, but sediment impacts are difficult to quantify other than the estimated TSS generated during the spill event. Pre-spill sediment conditions within Chedoke Creek were likely impacted by the accumulation of organic sediments discharged during the spill event which settled within the deeper downstream sections and potentially within Cootes Paradise. Water quality impacts generated during the spill event appear to have dissipated since the Main/King CSO structures were corrected but sediments likely continue to have at least some impacts to water quality through release of nutrients and consumption of dissolved oxygen, as the wastewater solids continue to decompose.

Summary of Wood's 2019 Conceptual Remediation Plan and New Targeted Dredging Plan

Wood's 2019 targeted dredging plan outlined within the "Chedoke Creek Natural Environment and Sediment Quality Assessment and Remediation Report" evaluated several options and recommended hydraulic dredging as the preferred means of removing approximately 5,600 m^3 of organic sediments within Chedoke Creek. The majority of the organic sediments per 2018 data, were located within the second half of the creek run between the two pedestrian bridges. In addition, over-dredging of 15-20 cm was recommended to remove the portion of sandy sediments that may have interacted with the organic contaminants above. It was noted that additional bathymetric and sediment chemistry data would be needed to determine the final dredge target elevation that would result in the maximum ecological restoration benefits, while reducing potential contaminant exposure risks from underlying sediment layers.

Wood will develop a new targeted dredging plan which involves collection of new sediment data to determine the most effective removal strategies for material with Chedoke Creek as well as additional material within Cootes Paradise. Targeted sediment removal will focus on organic sediments, as well as areas that may have higher concentrations of TKN and TP. In addition to the potential for pollutant mass removal, targeted dredging may have beneficial impacts to the ecological conditions within Cootes Paradise, particularly if loose organic sediments are identified and can be removed to firmer substrate and higher dissolved oxygen conditions, that may be more conducive to supporting better ecological diversity.

As discussed in Section 1, Wood evaluated several options as part of its initial assessment, for remediation of Chedoke Creek. Hydraulic dredging was recommended for the following reasons:

a. Mechanical dredging may not be practicable due to the limited width of the creek, density of riparian vegetation, and lack of continuous access.

b. Hydraulic dredging provides nearly complete containment of the dredge slurry along the pumping route, which reduces exposure of the sediments to the atmosphere that could cause odour or other problems.

c. Dredge slurry from a hydraulic dredge can be easily routed to a nearby wastewater system for dewatering and ultimate treatment and disposal, thus avoiding potential issues related to dredged material storage, dewatering, and handling operations, which are generally space intensive and costly.

d. Hydraulic dredging reduces the potential for downstream turbidity problems because the majority of sediments disturbed by the cutter head are captured by the suction force used to transport the sediment slurry to the dredge material management area.

3.2 Offsetting Works

The City of Hamilton is proposing to incorporate additional offsetting remediation within the Chedoke Creek targeted dredge footprint to augment and complement the benefits of the targeted dredging project. The objectives in this regard, as discussed with MECP staff, relates to the "no regrets" principle associated with certain works which are known to improve the uptake of various contaminants, known or understood to be resident in the study area. Several water quality management technologies are commonly used as complements to dredging to improve water quality conditions by increasing dissolved oxygen and reducing nutrient concentrations. Some of the technologies which will be assessed over the course of the plan execution include, but will not be limited to:

1) Floating vegetated mats
2) Small scale Aeration systems
3) Shoreline plantings
4) Beneficial sediment reuse and sediment stabilization

Floating vegetated mats are relatively simple structures designed to promote growth of aquatic vegetation and nutrient absorption. Plantings are placed within net pots held together by a floating platform which can vary in size based on the available space or removal requirements. The platform is anchored to the shoreline or substrate and plants are harvested periodically resulting in direct removal of the nutrients they have assimilated from the water column.

Unconfined aeration systems are often used in lake and water quality management to increase the oxygen transfer rate, improve mixing of stagnant water and limit the potential for stratification. Aeration systems consist of a compressor, an air distribution system, and a diffuser assembly. The type of compressor depends on the water depth and required air volume. Shallow water aeration systems generally require only a diaphragm compressor which is capable of producing a relatively large air volume at low pressure. The low energy requirements of diaphragm compressors often allow them to be solar powered which increases the potential deployment locations and simplifies setup. Diffuser assemblies are typically placed on the bottom and include an anti-scour plate to limit sediment disturbance.

Shoreline plantings are effective at providing habitat, enhancing nutrient uptake and stabilizing sediments. Plantings are commonly recommended in areas where natural littoral vegetation has been impacted for a variety of reasons and water quality or sediment conditions prevent natural recruitment from occurring. Identification of the appropriate species and a suitable nursery or donor site is important to the success of a planting project. Planting success can be improved by a variety of planting techniques that are specific to the species, substrate and depth.

Dredged solids may have a beneficial reuse application depending on the type of material identified for removal and its chemical composition. In some cases, sandy material may be utilized to stabilize areas where lake sediments may not have suitable structure to promote growth of emergent vegetation. There may be several locations within Cootes Paradise that could benefit from application of sandy material to promote development of marsh that is currently not supported, likely as a result of poor substrate conditions. If enough sandy material is present of sufficient quality, it may be possible to use the material to formalize an earthen berm to direct discharge from Chedoke Creek away from Princess Point at the location of the current Christmas tree berm at the mouth to Cootes Paradise.

4.0 Scope of Work

4.1 High-Level Overview

Wood has prepared a potential dredge template shown in **Figure 4.1** which is inclusive of the estimated 5,600 m^3 of organic material documented in 2018 and additional area within Cootes Paradise downstream of the mouth of Chedoke Creek. The amount of material removed, depends on the findings from planned bathymetric and sediment surveys as well as the sediment composition and chemistry.

Bathymetry of Cootes Paradise in the Princess Point embayment will be evaluated to determine the extent of what is anticipated to be a sediment delta which has been deposited over time through Chedoke Creek. While it is not likely that all of the sediment delta would have been the result of the Main/King CSO spill, the organic material within the expected sediment delta is likely contributing to ongoing dissolved oxygen depletion, as well as nutrient flux and recycling which degrades water quality further downstream within Cootes Paradise. Removing a portion of the organic sediments within the delta should provide additional offsetting benefits within Cootes Paradise and downstream. Notably however the balance of the improvements to off-set the impacts of the discharge event to Cootes Paradise and the Western Harbour will be established as part of the Cootes Paradise Workplan.

Wood will collect bathymetric, sediment thickness, and sediment core data that will be used in the adaptive management decision tree shown in **Figure 4.2** to determine the extent of dredging and potential nutrient load removal resulting from the project.

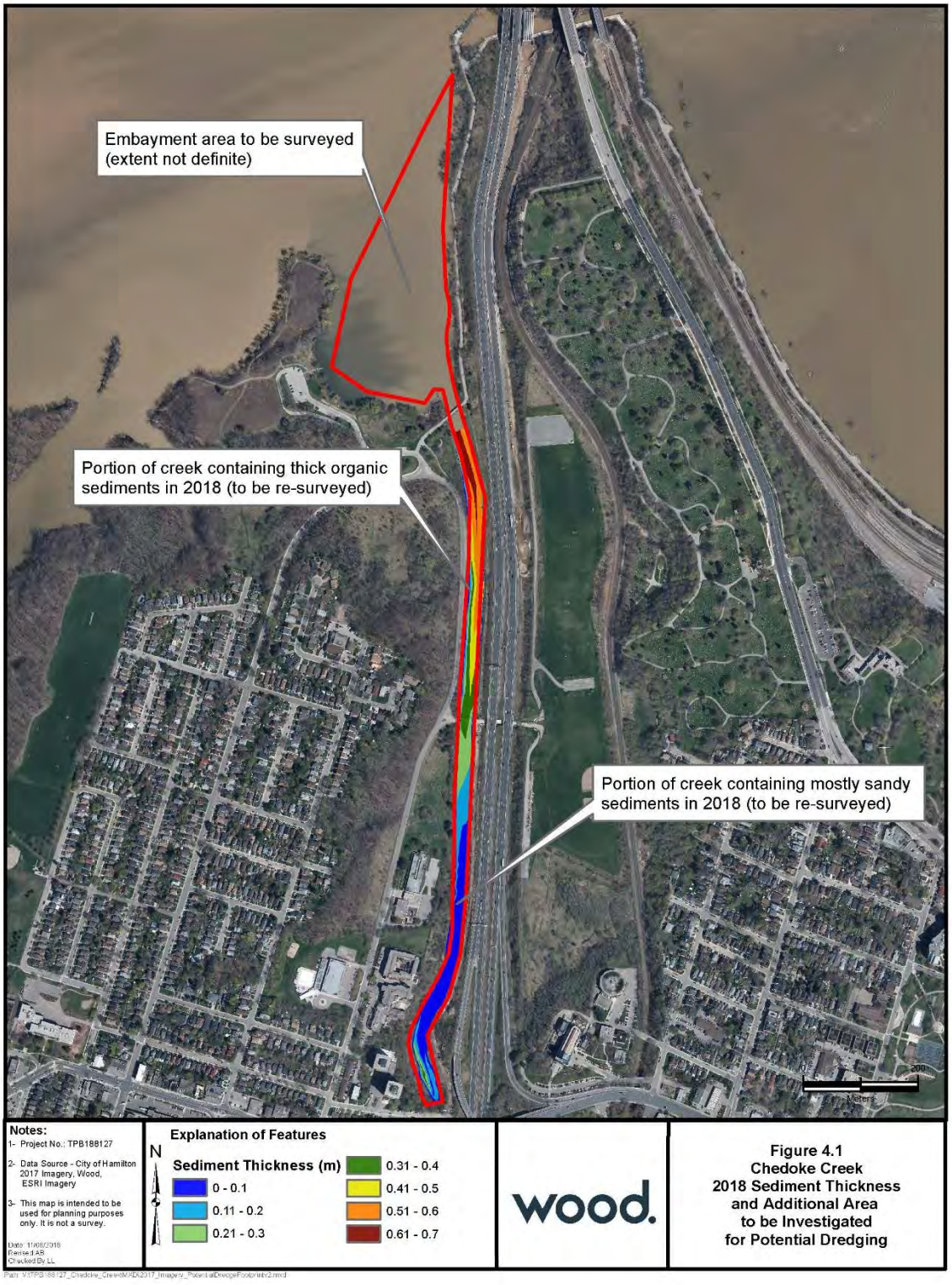


Figure 4.1. Chedoke Creek 2018 Sediment Thickness and Additional Area to be Investigated for Potential Dredging

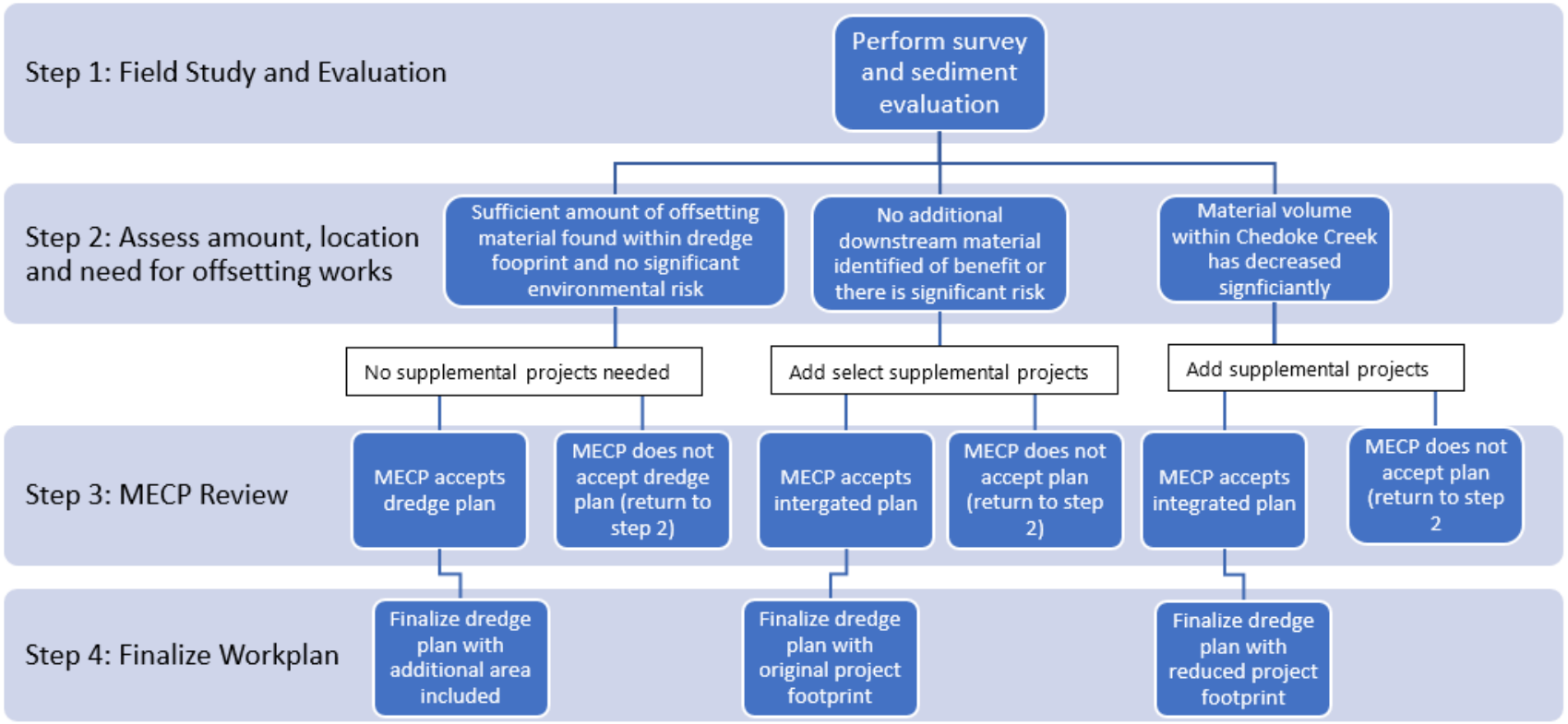


Figure 4.2. Dredge Design Decision Tree

4.2 Field Work

The proposed 2021 field studies include several components required to support the dredge design, as well as anticipated permitting requirements. These studies will confirm existing conditions within Chedoke Creek and areas within the Princess Point embayment of Cootes Paradise and downstream. The proposed components and anticipated schedule include:

i. Bathymetry and LiDAR surveys;
ii. Sediment characterization (thickness and quality); and
iii. Species at Risk (SAR)

4.2.1 Bathymetry and LiDAR Surveys

Bathymetric surveys of the existing channel and areas of the Princess Point embayment and downstream are proposed to confirm total water depth to top of sediment and support detailed design for dredging activities. The bathymetric survey area will include the non-wadable reach of Chedoke Creek from the upstream extent where the habitat transitions from a faster flowing erosional environment to slower velocity, depositions areas where soft sediment dredging will occur. A Lowrance Elite 5 GPS enabled depth sounder with side scan sonar will be utilized from a boat to measure total water depth. The survey will be performed by travelling multiple transects (e.g., centre line, several off-center) parallel with shore and crisscrossing these transects to provide suitable aerial coverage within the channel. A topographic survey of the nearshore water elevation at various locations within the creek and embayment will be completed concurrently with the bathymetric surveys, thereby allowing the bathymetric data to be shown as metres above sea level (masl) for design, and appropriately registered to a common datum. Manual total depth measurements will also be taken to provide additional quality control (QC) infield. It is also important to measure total water depth at the historic sediment sampling locations (ref. Figures 2.6 through 2.11) which can be shown as masl to better understand and quantify changes in sediment deposition or mobilization since the previous studies. It is also proposed to survey an area of the Princess Point embayment and downstream, as shown on Figure 4.3 that has not been previously sampled for sediment quality by the City (e.g., Wood or SLR). These survey data will include total water depth measurements from the onboard instrumentation, as well as infield manual depth measurements for QC and sediment quality sample collection as described herein.

Furthermore, it is proposed to conduct a LiDAR survey in order to gather detailed topographic information on the shorelines along the study area. The approximate limits of the proposed LiDAR survey are shown in Figure 4.4. The LiDAR survey typically uses a camera fixed to a wing of a plane and generates data in the form of a point cloud, which is then translated into a three-dimensional drawing. Some advantages of using LiDAR is that it is more efficient for capturing the data and coverage, when compared to a land-based (walking) topographic survey, and the LiDAR can gather more points with more relative vertical accuracy.

The current City topographic survey information is a digital elevation model (DEM) from 2015, which is only accurate to 0.5 m, and hence a more accurate survey of the study area is considered required for the dredge plan. The LiDAR survey is proposed to capture approximately 20 m of the shoreline along both sides of the entire study area. This includes Chedoke Creek from the concrete box culvert at Main Street to the pedestrian bridge at Princess Point, the embayment by Princess Point, and the eastern shoreline of Cootes Paradise from the creek to the canal. The topography will also be tied into the bathymetric survey which will be carried out during the sediment sampling program. This will provide the basis for an accurate estimation of the sediment volumes for the targeted dredge plan.

In addition to being used with the bathymetric survey information, the topography of the shore and riparian zone, which is captured in the LiDAR survey points, may be used by the City in the potential design of proposed restoration and/or plantings as part of the potential compensation and offsetting work related to the Fisheries Act Authorization and SAR Overall Benefit Permit.

Figure 4.3. Proposed Limits of LiDAR Survey Remediation Work Plan, Chedoke Creek

4.2.2 Sediment Characterization

The proposed sediment characterization work is needed to improve the understanding related to the resolution of soft sediment contamination data regarding vertical chemical composition within the sediment profile (e.g., cores), as well as geographically within the creek and Princess Point embayment and beyond within the boundary shown on Figure 4.1. Specific sample locations within the erosional upper reaches of Chedoke, within the depositional area of the creek and within the Princess Point embayment and beyond will be identified in the field sampling plan. Sediment cores will be collected using a manually-driven core sampler for discrete interval sediment sampling down to the parent material (and/or refusal) where possible. A total of four (4) sediment aliquots will be extruded from the cores at each of these locations in incremental strata (0 to 15 centimeters [cm], 15 to 30, 30 to 60 and >60 cm), where sufficient total soft sediment depth is present. This includes the bioactive sediment strata (upper 10 cm) representing the most recently deposited soft sediment, as well as deeper strata that contain historic deposition and as shown during the previous studies, legacy contamination from confounding sources of pollutants (Wood 2019a, SLR 2020). Photographs of complete cores and subsampled aliquots will be taken and catalogued for further visual interpretation as necessary.

A total of three (3) core samples will be collected at each sample location. These core samples will be extruded infield and aliquots will be combined and homogenized to produce one (1) composite aliquot sample from each increment strata specified above (e.g., four samples per location, as possible). Blind split sample field duplicates will be collected representing 10% of the total samples submitted (e.g., one duplicate for every ten samples) as per industry quality assurance and control (QA/QC) protocol. These duplicate sample results will be assessed for relative percent difference in concentrations between the original (native) sample and the blind split duplicate to evaluate data quality objectives, including acceptance of the reported results.

The homogenized sediment core aliquots will be placed into individual pre-labelled containers (laboratory provided glass jars) including sample ID, date and time of sampling for analysis to provide depth related assessment of parameters of interest. A laboratory provided chain of custody will be submitted with each sample shipment thereby ensuring all samples have been tracked and logged per laboratory QA/QC practices.

The proposed parameters of interest for each sediment core aliquot include:

- Moisture content (as per ASTM D2216)
- Percent fines (as per D1140)
- Organic matter (as per D2974)
- Ammonia (NH3+NH4);
- Total Kjeldahl Nitrogen (TKN);
- Total Phosphorus;
- Total Metals (including: zinc, lead, copper);
- O.Reg 153/04 Polycyclic Aromatic Hydrocarbons (PAH); and
- Carbonaceous biological oxygen demand (cBOD) analysis will be conducted on the near-surface aliquot (0 to 15 cm).

4.2.3 Species at Risk

The proposed project may interact with several Species at Risk (SAR) within Chedoke Creek, as well as the Princess Point embayment of Cootes Paradise. The *Endangered Species Act* (ESA) has options regarding permitting required for work within SAR habitat including an A-permit (risk to human health and safety) or C-permit (conventional overall benefit permit). However, both options would require supporting assessment of desktop and field survey data. A third permitting option would be under O.Reg 242/08, "Threats to health and safety, not imminent" under the ESA, which will also be considered. A preliminary desktop review and consultation with ecological knowledge holders (e.g., RBG) suggest the presence of the following species and their respective conservation status:

- Blanding's Turtle (*Emydoidea blandingii*) – Provincially **THREATENED**, Federally **ENDANGERED**
- Bat species – Provincially and Federally **ENDANGERED** including;
  - Little Brown Myotis (*Myotis lucifugus*);
  - Northern Myotis (*Myotis septentrionalis*);
  - Eastern Small-footed Myotis (*Myotis leibii*) [only Provincially **ENDANGERED**) and
  - Tri-Colored Bat (*Perimyotis subflavus*)
- Lilliput mussel (*Toxolasma parvum*)– Provincially **THREATENED**, Federally **ENDANGERED**
- American eel (*Anguilla rostrata*) – Provincially **ENDANGERED**, Federally **THREATENED**

A thorough review of available secondary source data, including confirmed species occurrence mapping, and habitat suitability assessment will support a-priori likelihood assessment of species presence or reliance on habitat within the project area. Species-specific surveys are proposed as per the existing protocols (as available) described below.

4.2.3.1 Blanding's Turtle

Blanding's Turtles occur throughout Southern and Central Ontario and are known to occur within Cootes Paradise in very low abundance (e.g., <5 individuals; RBG 2014). In fact, an article published by a local newspaper (Hamilton Spectator) in May 2018 indicated RBG scientists believe there was only one sexually mature female remaining in Cootes Paradise at that time. As such, potential impacts to these turtles and their habitat during the dredging activities will be assessed and turtle surveys within the project area may be required. It is understood Blanding's turtles are a cryptic species and may not be detected within the project area using the conventional survey protocol. Therefore, further discussion with MECP will evaluate the need for physical turtle surveys and an alternative option may include habitat mapping to delineate habitat categories (MNRF 2019) and potential presence/use during seasonal periods within the project timeline.

The proposed field surveys (should they be needed) will follow the Peterborough District Ministry of Natural Resources and Forestry (MNRF) survey protocol for Blanding's Turtle (MNRF 2015). The protocol's survey technique is based on the cumulative knowledge of several Ontario Blanding's Turtle experts, survey guidelines developed by the United States Geological Survey (USGS) and Northeast Blanding's Turtle Working Group (2012), as well as guidelines for turtle basking surveys developed by Casper and Hecnar (2011). As such, data collected as per this protocol can be compared to other standard surveys and will provide defensible data to support the selected permitting approach.

These surveys are proposed to begin after ice-off (open water conditions) typically in April (no later than June 15th) when turtles are basking. The protocol specifies basking surveys are carried out between 8 am and 5 pm, during sunny periods when air temperature is warmer than water temperature and is greater than 5°C. The detectability of Blanding's Turtles varies with the type and quality of the habitat, the

abundance of the population and the experience of the surveyor. A significant number of surveys have been required to detect the presence of some populations in Ontario, especially those that occur at low density, consequently, up to 10 surveys have been needed to avoid false absence when carrying out basking surveys for turtles (MNRF 2015). Since Blanding's Turtles have previously been observed within Cootes Paradise, the utility of basking surveys will be discussed further with MECP and alternative evaluation of habitat use may be completed. Additional detail about environmental considerations and rationale for the survey conditions are provided in the protocol (MNRF 2015).

4.2.3.2 SAR Bats

The potential for SAR bats within the project area is dependent on the availability and presence of hibernacula and maternity roost sites. The project area is mostly treed, meaning the riparian and upland vegetation zone of Chedoke Creek and the Princess Point embayment. Interaction with these species may occur due to site clearing and access for the dredging activities; however, the Guelph District MNRF survey protocol for SAR bats within treed habitat will be used to determine likelihood of these species presence and habitat use (MNRF 2017). Potential hibernacula features will be documented during the field surveys; however, the protocol is designed to detect potential maternity roost features and bat species presence/absence.

The protocol utilizes a phased assessment approach, first utilizing desktop and aerial survey data to assess habitat suitability. These bat species require trees with at least 10 cm diameter-at-breast-height (dbh) for suitable maternity roost habitat and ecological land classification mapping of the study area can support this assessment. Additionally, secondary source data review will be conducted to confirm if bat surveys have been conducted within the project area and if additional information to support field surveys and permitting are available.

Phase II of the survey protocol includes identification of suitable maternity roost trees, which are specified to occur during the leaf-off period (for Little Brown Myotis and Northern Myotis) and during the leaf-on period for Tricolored bat. The protocol specifies the preferred tree species (e.g., maple and oak) and snag/cavity trees for these species. Additionally, the Eastern Small-footed myotis will be considered during the surveys and screening, as this species is Provincially Endangered.

If the Phase I assessment determined suitable maternity roost habitat is available, acoustic surveys are recommended to confirm the presence/absence of the three SAR bat species. Acoustic detectors are deployed in the best locations possible to maximize the probability of detecting all three species and the data collected during Phase II should be used to inform detector placement.

4.2.3.3 Lilliput Mussel

Freshwater mussels occur throughout creeks, rivers, ponds and lakes within Ontario; however, most of the Ontario SAR mussel species occur within southwestern Ontario. The Hamilton area has several of these mussel SAR including the Lilliput. Shells of the Lilliput have historically been collected within the Cootes Paradise area (Sunfish Pond; COSEWIC 2013), and more recently, live Lilliput mussels were detected at seven sample locations within Cootes Paradise (Morris et al 2015) including two locations within the Princess Point embayment. Two other mussel SAR were detected during the 2015 surveys; Eastern Pondmussel (*Ligumia nasuta*) and Mapleleaf (*Quadrula quadrula*); however, these occurrences were located near Bull's Point, approximately 1.2 kilometres northwest of the Chedoke Creek outlet on the north (opposite) shore of Cootes Paradise. To our knowledge, Chedoke Creek has not been sampled for mussels; however, the dredging activities within the creek and embayment have the potential for direct interaction with mussel species. Consequently, surveys as per the MNRF survey protocol (2018) for SAR unionid mussels in wetlands are proposed to assess potential presence at the targeted dredge locations to support mussel relocation

plans and permitting as required. A Protection and Recovery Permit under Section 17(2)(b) of the ESA may be required to survey for, salvage and relocate SAR mussel species within the project area. Online registration of the proposed activities will be discussed with MECP to confirm permitting requirements.

Survey timing should be completed between June 1st and September 30th, when water temperatures are greater than 16°C to allow for re-anchoring or burrowing of the retrieved mussels prior to arrival of colder temperatures. Due to the non-wadable conditions within Chedoke Creek and offshore areas of the Princess Point embayment, it is suggested scooping techniques are utilized for a timed search method as per the protocol. The search locations will include the targeted dredge locations (when determined) and may include downstream areas, as well as surrounding habitat that may be subject to project activities.

A mussel relocation protocol will be developed, including identification of all mussels to species, measuring the mussels (all individuals or a representative subsample pending abundance) and marking for post-dredge relocation performance monitoring as/if needed. Once the permitting and regulatory obligations are better understood, a formal plan will be drafted with MECP, including input from other stakeholders (e.g., MNRF, RBG, DFO).

4.2.3.4 American Eel

The MECP noted American Eel have been periodically detected in low abundance at the fishway to Princess Point located at the mouth of the Desjardins Canal where Cootes Paradise flows into Hamilton Harbour (MECP 2021). The fishway is designed to keep Common Carp out of Cootes Paradise but allow native fish to move between the waterbodies. The RBG fish community sampling utilizing electrofishing within Cootes Paradise (including Chedoke Creek) have not historically detected American Eel (RBG data 2001-2018).

Provincial American Eel survey protocols are not available; therefore, a desktop habitat suitability assessment of Chedoke Creek and the Princess Point embayment will be conducted. Eel occurrence data show low abundance within Cootes Paradise, as such, field sampling/surveys are not anticipated and the desktop data review should support the assessment of potential project interactions with this species.

A mitigation plan for American Eel will be considered, and likely be incorporated within the general fish exclusion measures for isolating the targeted dredging work areas. This may include using turbidity curtains deployed from shore, thereby excluding fish from within the work area. Additional fish removal efforts may be used (e.g., electrofishing, seine netting) to ensure the work areas do not contain fish. Any fish caught within the work area will be identified and released beyond the work area under a licence to collect fish for scientific purposes issued by the MNRF.

4.3 Dredge Design and Impact Mitigation Measures

Work Objective

Building from the collection of data related to the amount, location and composition of sediment, Wood will develop dredge design plans using information obtained from the updated bathymetric and sediment physical and chemical characterization discussed in Sections 4.2 and 4.3 above. The plan will consider Wood's original conceptual elements discussed the 2019 report and as shown in Figure 4.4. Wood will review the potential risks associated with public contact and need for special handling and disposal of the sediment to be removed. Depending on the final dredge template and material consistency, Wood will evaluate safe, convenient, and economic means of handling the dredge slurry from Chedoke Creek. Careful consideration will be given during the design phase to develop an approach that will optimize low flow continuity and fish passage within the creek while maintaining appropriate water conditions within the work area. The means of passage (flow and fish) will be contingent on the adopted dredge approach and associated logistics.

Figure 4.4. Conceptual Project Sketch, Chedoke Creek, Hamilton, Ontario, Canada

As with most dredge projects, dredged material transportation, dewatering, and final placement of the dredged material are generally the most challenging and costly elements. Areas with potential pipeline access to Chedoke Creek project area and direct access to a sanitary sewer line or sewer force main, which lay adjacent to Chedoke Creek, will be reviewed as possible material handling locations. The following task outline includes the services considered required to develop engineering design plans, acquire permits, and develop final tender and construction documents (plans and specifications) for the dredging and the dewatering sites.

Data Collection

Wood will review available data and use the bathymetric and topographic data collected through this plan for the Chedoke Creek and surrounding upland. The bathymetric survey will be carried out as discussed in Section 4.2 by sonar and ground-truthing via physically sounding and probing the sediment thickness on an approximate 5 m x 50 m grid along the Creek using a 5 cm diameter PVC sounding pole with foot (as feasible). The sounding pole will be vertically lowered at the selected location until it comes in contact with the top of the sediment interface. The elevation at the bottom of the pole will be recorded. The sounding pole will then be pushed down until it makes apparent contact with the creek bottom at which point another elevation will be recorded. The difference in the elevations will be the approximate sediment thickness at that particular location. This system will be coupled with a real-time GPS navigation and positioning system, as well as the electronically recorded depth file for survey accuracy of the sediment locations, elevations, and depths.

The topographic survey will obtain spot elevations within proposed dredged material management area (DMMA) as depicted in Figure 4.5 to corroborate new LiDAR being collected within the area. The survey will also identify accessible stormwater infrastructure that discharges into the Chedoke Creek. Accessible stormwater structure invert elevations and approximate structure sizes will be measured and mapped.

Upon completion of the survey, Wood will process the data and produce final deliverable products to consist of topographic maps depicting the creek bottom elevations and contours, the sediment interface elevations and contours and resultant approximate quantity of existing sediment. Horizontal datum will be NAD83/2011 and vertical datum will be NAVD88. All topographic mapping will be in accordance with City of Hamilton engineering standards (2009).

Wood proposes to include collection of 24 sediment cores (e.g., 8 sample transects) within the depositional habitat of Chedoke Creek for physical and chemical tests to determine sediment characteristics and disposal options. Additionally, four sample transects within the upper reaches of Chedoke Creek between the culvert outlet and depositional habitat will be sampled, as well as a proposed density of one core sample location per 1,000 m^2 within the Princess Point embayment and downstream. Objectives of the testing will be to determine the volume of sediments for potential removal, texture of these materials that affect dredged material management/dewatering; nutrient content which indicates the benefits of sediment removal on receiving waters; and contaminants that may affect disposal and beneficial re-use options. Intact soil cores will be taken to the depth of the underlying clay layer. Chemical and physical analysis will be conducted as specified in Section 4.2.2.

In order to select the appropriate polymer for dewatering, if required, Wood will collect 20 liters of sediment and 20 liters of creek water for bench scale testing, with the bench scale testing to be completed by two separate polymer manufacturers.

The bench scale testing will select the most appropriate polymer using a jar test, followed by simulation of dewatering rates and final percent solids for a mechanical and passive dewatering application.

Design

Wood will complete 30% design plans for sediment removal, processing and hauling. Sediment processing and handling methods will be outlined, as will anticipated disposal facility locations and details. Wood will complete site visits with City of Hamilton staff to review the potential pump locations, containment areas, piping, sediment processing equipment and staging areas. Provisions for low flow continuity and fish passage will also be considered during this phase of the design. An option for the sediment disposal site includes the Kay Drage park and a previous landfill area. Another option currently under consideration would involve the closure of a portion of Macklin Street and use of the ROW. Wood will inspect multiple proposed locations; identify any problems and evaluate special design concerns for all potential alternative locations. Wood will also discuss potential use of the City's Woodward Wastewater Treatment facility to accept a portion of the dredged material and develop initial pumping routes and daily pumping volume estimates.

Wood will address comments and obtain approval of 30% design plans from the City of Hamilton. The 30% design plans will be used as necessary to facilitate any potential pre-application permit discussions, which are on-going.

Upon the City's approval of 30% design plans, Wood will prepare 60% design plans and provide an opinion of probable project construction costs, as well as a summary outline of anticipated plans and sheets required for the final design. The 60% plans will include location of utilities if any are located within the project area, such as overhead electric lines, underground sewer and water, and communication lines. The 60% design will also include an evaluation of the dredging (hydraulic / mechanical) and dewatering (passive / mechanical) techniques. The evaluation will require analysis of the bathymetry, sediment cores, and analytical data for the sediment to be removed. The 60% design will summarize the results from the polymer test to determine the appropriate mix ratio and application into the dewatering process, if necessary. Modification of the current Chedoke Creek flow path to permit dredging will also require a hydraulic/hydrologic model which will be determined once the preferred alternative is selected by the City, to assess flood and erosion risks within the flowing portion of the waterway.

Wood will collect any necessary geotechnical information that may be required for the DMMA and any staging areas which may require geotechnical evaluations. Wood will review the various best management practices (BMPs) for any necessary erosion and sediment control.

Upon submittal of 60% design plans to the City, Wood will incorporate any comments and advance the plans to 90% for used in preparing the required permit submittals. The 90% plans will provide a summary of the final material quantities and a preferred disposal option with allowances for additional options provided they meet the engineering and regulatory requirements and are in the City's best interest. The 90% plans will also include, to the best of Wood's ability, identification of avoidance areas as determined during ecological and cultural surveys. Any required mitigation measures for turbidity control, fish salvage, public access or recreation or relocation of benthic organisms will also be identified.

Permitting

Permitting requirements for the proposed targeted dredging activities include various provincial and federal agencies, as well as consultation and engagement with stakeholders, and Indigenous Nations and Peoples. The following agencies have been contacted and permitting requirements under existing legislation are currently understood or pending regulatory response:

- Hamilton Conservation Authority – *Conservation Authorities Act*
- Royal Botanical Gardens – Research Permit
- Ministry of Transportation – *Public Transportation Act* and *Highways Improvement Act*

- Ministry of Natural Resources and Forestry – *Lakes and Rivers Improvement Act*
- Transport Canada – *Canadian Navigable Waters Act*
- Fisheries and Oceans Canada – *Fisheries Act*
- Ministry of the Environment, Conservation and Parks – *Endangered Species Act*
- Ministry of Heritage, Sport, Tourism, and Culture Industries – Archaeology Assessment
- Impact Assessment Agency of Canada – *Impact Assessment Act*

Some of the above listed permitting and approvals may require consultation with Indigenous groups and the public. Further details regarding each regulatory agency and associated permitting are provided in Section 4.5.

Final Bid Package and Construction Bid Documents

Upon approval by the City and receipt of comments from regulatory agencies on 90% design plans, Wood will incorporate comments and produce the complete 100% (final) design plans, technical specifications and engineer's probable cost estimates for construction. Wood will submit the final design plans to the City for final approval.

The tendering process is described in additional detail in Section 4.6, however Wood will prepare a complete outline of required bid documents and obtain approval of the outline from the City following submittal of 100% plans. Wood will prepare complete construction and dredging technical specifications, general bid requirements, figures, and location maps needed to successfully bid the project. Wood will complete a final bid response form in the City's format needed for bidding the project. Wood will support City staff by addressing bidders' questions during the procurement process and will provide a letter of recommendation for the selected contractor.

4.4 Other Remediation Works

The need for implementation of additional remediation works beyond targeted dredging will depend on Wood's findings during the field investigations of Chedoke Creek and Cootes Paradise. If adequate sediment and associated nutrient mass load is found within Cootes Paradise and is economically feasible to remove to offset the loading generated during the spill event, additional remediation works may not be necessary, or at most be limited. However, given the uncertainty of the level of contaminants, the cost of expanding the dredge project into Cootes Paradise and the extent and composition of organic sediments resident within Cootes Paradise, it may be effective to implement the additional remediation projects discussed in Section 3, and others.

Once Wood has assessed the sediment conditions within Chedoke Creek and Cootes Paradise, the information will be provided to the City and the MECP along with recommendations on proceeding with a dredge-only project; a primarily dredge-based project supplemented by other remediation projects; or a limited dredging project with significant implementation of additional remediation efforts. The number and location of potential remediation sites will be determined once the existing sediment conditions and the feasibility of various dredging options have been established.

4.5 Permitting

As noted in Task 3 of Section 4.3, the following regulatory agencies and associated permitting and approval requirements are anticipated or have been acknowledged through pre-consultation and engagement for the targeted dredging project. Anticipated review and approval timelines are provided based on Wood's current understanding of the processes and are subject to change pending agency review and response (ref. Appendix B for current summary status of regulator consultation).

4.5.1 Hamilton Conservation Authority

As per the Conservation Authorities Act regulation 161/06 under Ontario Regulation 97/04, a Hamilton Conservation Authority (HCA) Work Permit is required for the proposed dredging project. The permit application will be submitted in July 2021 once the detailed design is available and other supporting information have been collected and compiled. These may include project staging, an erosion and sediment control plan, flood risk assessment, discharge and material management plan, landscape/restoration plan, fisheries assessment, vegetation inventory, landowner permission (e.g., RBG – Cootes Paradise), as well as a description of the ecological components including potential SAR. Recent correspondence with the HCA indicates a maximum review period of 64-days; however, the early engagement and pre-consultation activities are expected to shorten this period.

4.5.2 Royal Botanical Gardens

The Royal Botanical Gardens (RBG) perform monitoring studies and regulate research projects by others within Cootes Paradise, which includes the outlet of Chedoke Creek and the Princess Point embayment. As such, the proposed targeted dredging project will require an RBG research permit that includes details regarding the purpose and nature of the proposed project and allows the RBG to provide additional guidance regarding sensitive areas, best management practices and SAR. Since the RBG has been included in early consultation and will continue to be included in the planning of this project, issuance of the research permit is anticipated within one month of the formal permit request submission.

4.5.3 Ministry of Transportation

An Encroachment Permit and Building and Land Use Permit are expected to be required as per the *Public Transportation Act* and Highways Improvement *Act*. The Ministry of Transportation (MTO) Corridor Management Officer has been contacted to confirm expected review and approval timelines; however, these approvals are commonly processed for construction activities near-to and within the Provincial infrastructure right of ways and the proposed project does not require access from the highway. Currently, the City assumes a 3 to 9 month review period, and are anticipating clarification from the MTO shortly.

4.5.4 Ministry of Natural Resources and Forestry

The Guelph District MNRF have confirmed approval under the *Lakes and Rivers Improvement Act* (LRIA) will not be required for this project since the HCA Work Permit will address the dredging review and approval requirements. As such, no further permitting schedule is required for the LRIA.

The in-water work timing window guidelines (MNRF 2013) identify when in-water work is restricted based on the fish species present and the MNRF region. Chedoke Creek is within the Southern Ontario Region and the local fish community includes Largemouth Bass and Northern Pike, which have in-water work timing restrictions from March 15 to July 15. Chedoke Creek fish sampling shows low species richness and abundance relative to other areas of Cootes Paradise, and the species found in greatest abundance have been Pumpkinseed and Goldfish (RBG 2017). As such, an exemption to the in-water timing restriction may

be approved by MNRF pending further discussion, which would provide more flexibility for the execution of the targeted dredge operation.

A licence to collect fish for scientific purposes may be required to support fish removal and relocation activities related to the dredging project to clear work areas of fish prior to dredging activities. This license is commonly obtained for biological survey work and is expected to be issued within weeks following application submission.

4.5.5 Transport Canada

The Navigation Protection Program (NPP) within Transport Canada (TC) reviews permit applications under the *Canadian Navigable Waters Act* (CNWA). Historically Chedoke Creek was deemed navigable by TC and Chedoke Creek is not found on the Schedule to the Act. Additionally, the proposed works may include suction dredging (does not meet requirements of Minor Works under the act), meaning an application for the approval of the project under the CNWA will be required. Early engagement with TC have provided some information via email correspondence; however, further dialogue with a TC Inspection Officer are anticipated to provide additional guidance on the potential permitting options (including Emergency authorization). Timelines for the potential review and approval process are not well known; however, a 3 to 4 month period is anticipated with submission of the application in July 2021. There are mandatory components of the conventional approval process that include a 30-day notice for public comment and a 45-day response and resolution period, followed by a 15-day decision period. These timelines will be discussed with TC to update the anticipated permitting schedule.

4.5.6 Fisheries and Oceans Canada

The Fisheries Protection Program (FPP) evaluates projects via the Request for Project Review (RFR) form submission that assesses whether projects are likely to cause death of fish or harmful alteration, disruption or destruction (HADD) of fish habitat, which would be in contravention of the *Fisheries Act* (FA) and require authorization to proceed. Early consultation with DFO indicates an RFR will be required to initiate further dialogue with a DFO biologist and the City plans to submit this by 19 February 2021. The conventional FA Authorization process is shown below:

- Submit RFR – 45-day review period (maximum, can be as short as 2-weeks)
- Early consultation with DFO for FA Authorization – begin once RFR response received
- Ongoing consultation with DFO to support Draft FA Authorization application
    - Indigenous engagement likely required – to be conducted concurrently with other engagement activities.
- Draft FA Authorization application submitted July 2021 (60-day review period)
- Minister FA Authorization application decision (90-day review/approval period)

The conventional review and approval timeline above indicates approval may be available by February 2022; however, the City plans to engage DFO as soon as possible following the RFR response to expedite pre-submission review and updates as much as feasible. During this early consultation, the City will also explore an Emergency Authorization option and associated timelines for review and approval, which are site-specific and require dialogue with DFO to confirm.

4.5.7 Ministry of the Environment, Conservation and Parks

Consultation and applications submitted to the MECP will include two permitting components; 1) Species at Risk, and 2) Permit to Take Water in support of the proposed dredge project. The following sections provide a summary of these components.

Species at Risk Permitting

As noted earlier, there are a number of potential SAR within the project area, some of which may have direct interactions with the proposed dredging project. As such, early consultation with MECP (currently ongoing) and field survey data will inform the permitting process under the ESA. The ESA presents two primary options for permitting; 1) Section 17(2)(c) Overall Benefit Permit (OBP) process and 2) Section 17(2)(a) Permit regarding risk to human health and safety. Alternatively, proceeding under the Health and Safety Regulation (O.Reg 242/08) would be separate from the Section 17(2)(a) option and would be through the online Health and Safety Projects Registry, that would not require a formal permitting process. The City will evaluate these options concurrently and continue to engage MECP SAR staff to support decision making and to confirm timelines.

It is assume permitting through the ESA will satisfy requirements of the Federal *Species at Risk Act* (SARA) and a separate SARA approval will not be required. This will be confirmed during consultation with DFO in the *Fisheries Act* authorization project review process.

Section 17(2)(c) Overall Benefit Permit

The C-permit option involves two sub-options; the conventional OBP timeframe includes ongoing MECP consultation with submission of the Information Gathering Form (IGF) and species-specific surveys as per standard protocols, followed by submission of the Alternatives Avoidance Form (AAF) and finally submission of the C-Permit Application Form (CPAF), permit drafting and permit submission. This option can include 10 to 13-months to received final approval, meaning final approval will be received May/August 2022.

Alternative, MECP have offered an expedited C-Permit process thereby the AAF and CPAF are submitted concurrently, thereby reducing the overall schedule by some weeks (est. 2 to 3). This option assumes presence of the SAR and requires pre-consultation with MECP to ensure the submitted AAF and CPAF align with the desktop data review findings, assumptions and may be subject to change once field studies are conducted; therefore, requiring permit amendments.

Section 17(2)(a) Human Health and Safety

The A-Permit option requires the City to demonstrate the propose dredging activities are in response to a risk to human health and safety. The MECP have identified this option; however, an A-Permit is typically used for immediate work tasks to mitigate imminent threats to human health and safety (e.g., bridge failure due to vehicle accident damage that comprised structural integrity). The proposed dredge project is not an imminent risk but can be assessed as a response to a risk to human health. A comprehensive report with a description of the site conditions, SAR present or likely to be present, as well as potential impacts associated with the proposed works would be provided to MECP. No public consultation or OBP are required for an A-permit; however, acceptance via the local MECP office that the proposed project meets the A-permit criteria is required and the ultimate approval relies on the Ministers' judgment to assign relevant conditions of the permit. The A-permit option will likely reduce ESA permitting timelines by approximately two months; however, the assessment of applicability to Section 17(2)(a) and possibility a Section 17(2)(c) permit is ultimately required poses more uncertainty than the C-permit option.

O.Reg 242/08

Requirements under O.Reg 242/08, section 23.18 applies to threats to health and safety that are not imminent. This refers to activities that are necessary to avoid or reduce harm to human health or safety where the threat is not imminent, but is likely to have serious consequences in the short or long term if the work is not completed. Specifically, work undertaken to prevent the contamination or pollution of the earth or to clean an area that has been contaminated. This option requires the City to register the proposed project via the online Registry with supporting documentation and line of evidence proving the proposed activities are needed to mitigate a threat to health and safety as per the ESA.

The City will evaluate the above options and continue dialogue with MECP to progress the SAR permitting component.

Permit to Take Water

The proposed targeted dredge activities may use suction dredging technology and as such will require water taking (and likely ultimate water removal from the creek). A Permit to Take Water (PTTW) may be required, as the water withdrawal rate would be greater than 50,000 litres per day. It is understood the proposed targeted dredge areas are mostly positioned within the lower Chedoke Creek and even with the Cootes Paradise static water elevation, dewatering activities would not likely pose an ecological impact (flow reduction). However, the need for a PTTW and associated timelines will need to be confirmed through ongoing discussions with MECP.

4.5.8 Ministry of Heritage, Sport, Tourism, and Culture Industries

The 2006 Erosion and Slope Stability Improvements project at Chedoke Creek required an archaeological assessment of the creek which produced a clearance letter and ultimate conclusion of low potential presence of intact archaeological sites within the creek and upland area (Varley 2006). As such, no additional archaeological assessments are anticipated for the dredging work within Chedoke Creek. Potential dredging within the Princess Point embayment may require archaeological assessment of the nearshore areas; however, this will be determined once the design and targeted dredge areas are better defined. The Ministry of Heritage, Sport, Tourism, and Culture Industries will be contacted to confirm further assessment requirements; however, this scope of work and review timelines are not anticipated to be a critical path item for the permitting schedule.

4.5.9 Impact Assessment Agency of Canada

The MECP has indicated a Provincial Environmental Assessment will not be required. The Impact Assessment Agency of Canada (IAAC) was contacted to confirm if the proposed project will require a Federal assessment under the *Impact Assessment Act* (IAA). The *Physical Activities Regulations* under the definition of Hazardous Waste and *SOR/2005-149 Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations* have been reviewed. Specifically, Schedule 6 that lists Hazardous Constituents Controlled Under Leachate Test and Regulated Limits. While not a direct comparative reference, we can advise that the limited sediment sampling done to date for the contaminants of potential concern (COPCs) are compared against the Provincial Sediment Quality Guidelines (PSQGs) Lowest Effect Level (LEL), the Canadian Sediment Quality Guidelines (CCME) freshwater Interim Sediment Quality Guidelines (ISQGs), or the background sediment concentrations for metals in the Great Lakes region. In this context the proposed targeted dredging, processing, treatment and disposal of residual sludge is planned on the basis that the dredgate is non-hazardous. As such, the project scope does not include the construction of a new facility, nor expansion of an existing facility for the treatment, incineration, disposal or recycling of hazardous waste. A formal response from the IAAC is anticipated to confirm no federal assessment under the IAA will be needed..

4.6 Tendering and Construction

Prequalification Process

The City intends to proceed with a prequalification process for the targeted dredge. The prequalification process is separate from the tender process and is undertaken in advance. Only prequalified bidders will be invited to the tender stage.

The objective of prequalifying is such that the City can screen the potential bidders to a short list of the most qualified bidders. The prequalification process will require that the bidders furnish proof of their competency, responsibility and prior experience with dredging projects of a similar size and scope. The City will provide a scoring/weighting to the prequalification criteria, and list minimum requirements, and the methodology for ranking the submissions, to ensure that the process is transparent and defensible.

Prequalification criteria typically include: corporate experience, staffing information and experience, project manager experience, site supervisor experience, quality controls, demonstration of project understanding, and other technical and financial criteria. Technical criteria would be proposed to include specific examples of similar dredging projects which used the same equipment as will be proposed for this construction. Financial requirements include proof of the ability of the bidder to finance the project and to provide proper insurance and bonding.

Tendering

Tendering for the construction will follow the completion of the prequalification process and will be only open to the prequalified bidders. There typically will not need to be any further technical requirements, however the City may add new criteria if considered required.

Staging

Staging areas will likely be required for assembly and placement of dredge barges. Generally, a crane is required to lift a barge off of a flat-bed truck and into the adjacent waterbody. Ample space appears to exist in the Princess Point park area. Staging areas are generally roughly specified in the plans but the contractor determines the specific needs based on the required equipment.

In addition to mobilization of the dredge barge, hydraulic pumping requires an area for pipe fusing which is generally conducted adjacent to the waterbody. It is likely that a pipe fusing station can be identified within the Princess Point park area as well.

The DMMA typically provides the necessary staging area for dewatering equipment and stockpiling of material. The rate of production of dewatered material will dictate the number of trucks required to move the material to the final receiving location.

Any required booster pumps will either need to be mounted on floating barges (typical) or can alternatively be placed on land if ample space is available.

Construction

Construction is estimated to be of approximately four (4) to six (6) months in duration; this estimate is conditional on time of year, as well as the scope and need for additional offsetting projects within the targeted dredge footprint.

4.7 Monitoring Plan

4.7.1 Construction Monitoring

Monitoring construction activities will include best management practices and conventional auditing principles used for landscape and constructions sites, as well as in-water work considerations as defined by the pathways of effects decision matrix used by DFO for mitigating interactions between project activities and the environment. Some typical examples of these practices include but are not limited to the following (subject to change pending final design and permitting approval conditions):

Fish and SAR Protection

- In-water construction timing windows will be adhered to.
- In-water work areas will be isolated prior to in-water work occurring.
- Temporary isolation measures will be removed slowly to minimize sediment and/or other material being disturbed and distributed within the watercourse.
- Fish will be relocated by qualified personnel from the isolated work areas, under a fish collection permit from the MNRF (if isolation measures cannot initially exclude fish upon deployment such as shore-based installation).
- All pumping for the purposes of dewatering where fish are likely to be present will have fish screens on the intake and outlet pipes.
- Fish screens will be located a minimum of 300mm above the bottom of the watercourse, where possible, and will be inspected and clean and/or repaired/replaced as required.
- The flow of the watercourse outside of the work area shall be maintained without interruption at all times.
- Turbidity monitoring will be conducted outside of the silt curtain to ensure areas surrounding the targeted dredge locations are not impaired as per Ontario turbidity monitoring thresholds (e.g., 25 NTU greater than background).

Riparian Vegetation

- Clearing and grubbing will only be completed in areas where immediate work will take place.
- No excavation/grading shall take place outside the disturbance limits as shown on the approved drawings.
- All access to the work shall be from the access paths shown on the contract drawings.
- Tree protection will be installed prior to construction (as/if required).

Sediment and Erosion Control (ESC)

- In-water work areas will be isolated with temporary impermeable barriers or other means as determined through detailed design.
- The contractor shall design the flow barriers to a minimum 2-year storm event water level or as specified in the contract documents.
- Contractor shall inspect flow barriers daily to ensure functioning as intended. All leaks, holes and repairs shall be completed as soon as reasonable.

- The entire construction site to be monitored daily for ESC issues daily for the duration of the contract. All deficiencies and/or breaches of ESC measures must be rectified immediately.
- Under no circumstances shall runoff from unvegetated soil or excavated pits be discharged off site or directly into active or temporarily inactive watercourses.
- All dewatering discharge is to be done away from the watercourse using sediment traps, filter bags, settling ponds, check dams, etc. to prevent silt sediment from entering watercourses, ditches, adjoining properties, etc. unless noted otherwise on drawings, discharge location shall be placed a minimum 30m from any watercourse.
- ESC measures must be maintained throughout the duration of construction and fully removed once all disturbed areas have stabilized in order to prevent any entry of sediment or deleterious substances from entering the environment and nearby watercourse. These measures need to be inspected daily, prior to and following any rain/snow event by the contractor to ensure their functionality. All damaged ESC measures must be repaired and/or replaced as soon as reasonable.
- All stockpiles and storage areas are to be located outside of the regional flood plains and are to be surrounded by sediment control fencing or equivalent.
- Vehicle and equipment refueling and maintenance must be completed a minimum of 30 m away from the watercourse and the contractor must control and prevent the entry of petroleum products, debris, rubble, concrete, asphalt and/or deleterious substances into the watercourse.
- All equipment entering the watercourse/work area must be cleaned prior to entering and after works.
- All materials and equipment used for the purpose of site preparation and project completion shall be operated and stored in a manner that prevents any deleterious substance (i.e. petroleum products, debris) from entering the creek.
- Contractor shall continually monitor the weather forecasts and evacuate all personnel and remove all materials and equipment from the work area prior to any severe flooding. The contractor must prepare for storm events, floating debris and ice, etc.
- All access to the work shall be from the access locations shown on the contract drawings. No equipment or vehicle shall be permitted to cross through the watercourse, unless otherwise approved.

4.7.2 Post-Construction Monitoring

Post-construction monitoring will ultimately reflect any specific conditions associated with the permitting of the works. For example, the anticipated *Fisheries Act* authorization typically includes post-construction performance monitoring to ensure the site and any enhancement features are functioning as intended and meeting the target success criteria as identified in the authorization. Success criteria usually include the following for dredging and potential placement/construction of habitat enhancement features:

- Physical construction of the measures/features;
- Physical function of the measures/features;
- Stability of structures/features; and
- Habitat use and species presence.

Similarly, the SAR OBP under the *Endangered Species Act* will also specify post-enhancement performance monitoring with target success criteria. These post-construction monitoring events can occur within the short-term (e.g., years 1, 2 and 3 post-construction), as well as longer term studies (e.g., year 5 and 10 year post-construction) depending on the species, offset/benefit feature and expected timeframe for use and measures of performance.

Furthermore, it is anticipated that the monitoring (post-construction) will focus on determination of the benefits of the targeted dredge operation and any complementary offsetting works to adequately document the return of the system to pre-spill conditions. The parameters of interest and associated protocols for collection and assessment will be discussed with MECP and others in developing the monitoring scope.

5.0 Schedule

5.1 Project Schedule

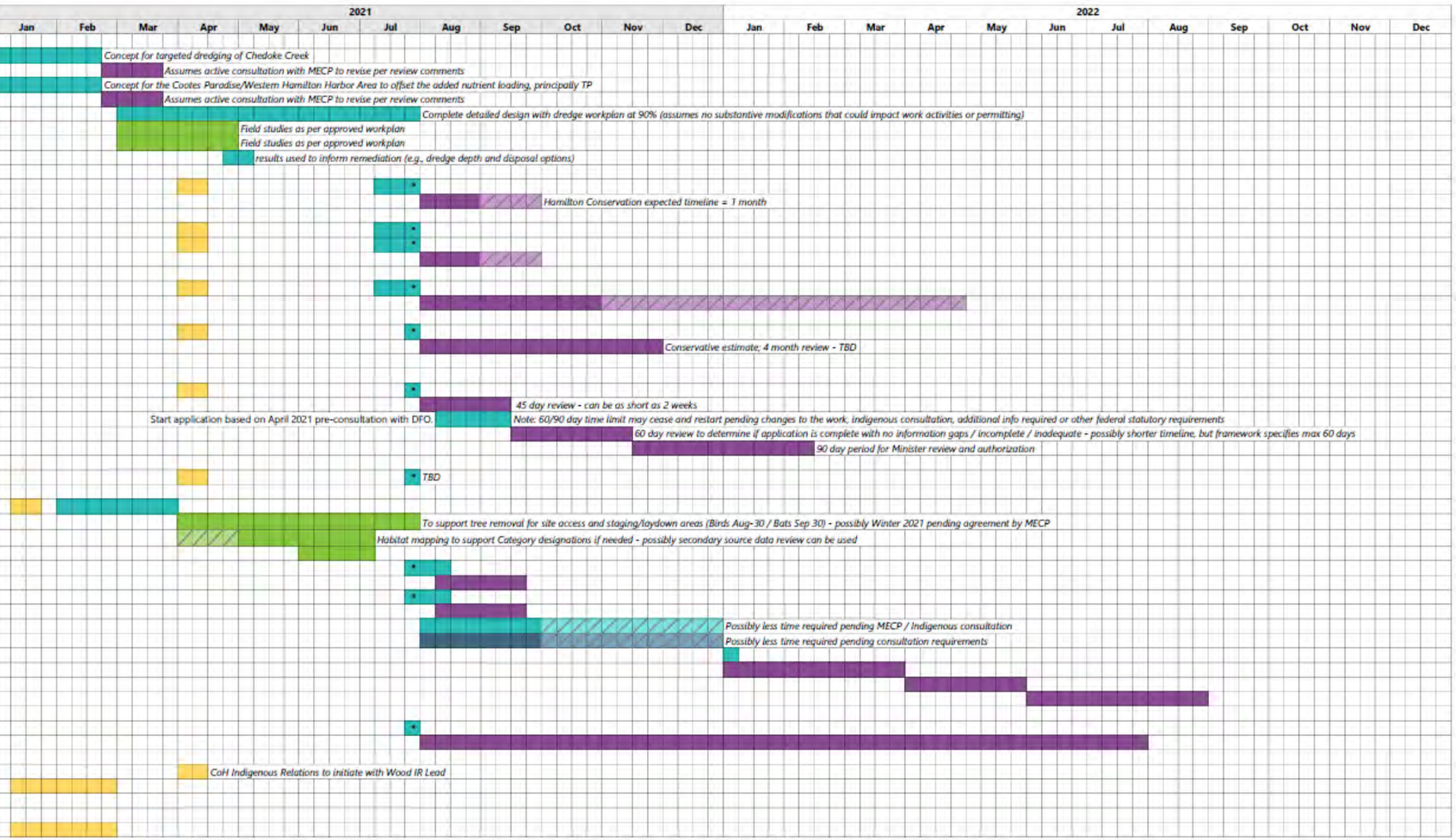
The proposed project schedule assumes conventional permitting processes but includes early engagement with MECP and other regulatory agencies and stakeholders. The following list provides a high-level overview of the project schedule components with anticipated timing as currently understood:

- Field data collection
  - Sediment characterization, LiDAR and Bathymetry (March-April 2021)
  - SAR field surveys (April-August 2021)
- Design (March-July 2021)
- Consultation, including permitting related engagement (February-December 2021)
- Permitting including early engagement (February 2021 to August 2022)
- Tendering, pre-approval process (May to August, 2022)
- Construction (September to December 2022)
- Post-construction Monitoring (To be determined as per regulatory approvals)

Table 5.1 shows a detailed project schedule with annotated critical path and mandatory review periods as specified by regulation. The City will continue to engage all agencies and stakeholders to expedite the permitting review and approvals process as able. Consequently, the proposed schedule herein is subject to change and expected to undergo updates throughout the early and mid-term life of project.

Table 5.1. Project Schedule

Item	Regulatory Agency | Legislation	Est. No. Weeks
1.0	**MECP | *Environmental Protection Act* & *Ontario Water Resources Act***	
1.1	Develop Remediation Workplan (due to MECP 22-FEB-2021)	7
1.2	Review and Response MECP/COH	4
1.3	Remediation/Mitigation Report (due to MECP 22-FEB-2021)	7
1.4	Review and Response MECP/COH	4
1.5	Targeted Dredging Work Plan Refinement & Design	20
1.6	Data Collection (e.g., Topo / Bathymetry)	4 to 8
1.7	Data Collection (e.g., Sediment Field Studies)	4 to 8
1.8	Laboratory Analysis & Reporting	2
2.0	**Hamilton Conservation | *Conservation Authorities Act***	
2.1	Work Permit application package and submission	2 to 3
2.2	Review period	6 to 8
3.0	**Ministry of Transportation | *Public Trans. and Highway Improv. Act***	
3.1	Encroachment Permit application package and submission	2 to 3
3.2	Building and Land Use Permit application package and submission	2 to 3
3.3	Review period - assumed to be concurrent for both listed above	6 to 8
4.0	**MNRF | *Lake and Rivers Improvement Act***	
4.1	Application package and submission	2 to 3
4.2	Review period	12 to 27
5.0	**Transport Canada | *Canadian Navigable Waters Act***	
5.1	Minor Works application - if required	1
5.2	Minor Works Approval or acknowledgement letter	TBD
6.0	**Fisheries and Oceans Canada | *Fisheries Act***	
6.1	**Conventional Authorization Schedule**	1
6.2	Request for Project Review Preparation and Submission	1
6.3	DFO Fisheries Protection Program Review and Response	4 to 6
6.4	Fisheries Act Authorization (FAA) Application & Consultation with DFO	3 to 5
6.5	DFO FAA Review and Response (60-day period)	8
6.6	Minister FAA Application Decision (90-day period)	12
6B	**Emergency Authorization Schedule**	
6B.1	Contact DFO to confirm if project can be under emergency schedule	TBD
7.0	**MECP | *Endangered Species Act***	
7.1	Existing Data Review incl. Provincial Data and SAR Study Design	4 to 8
7.2	Bat SAR Field Surveys (Physical and Acoustic)	4 to 6[#]
7.3	Blanding's Turtle Field Surveys	4 to 6[#]
7.4	Lilliput / Mussel Surveys	4 to 5
7.5	Information Gathering Form (IGF)	1 to 3
7.6	MECP Review of IGF	6
7.7	Avoidance Alternatives Form (AAF)	1 to 3
7.8	MECP Review AAF	6
7.9	MECP Consultation - Draft Compensation Strategy	8 to 20
7.10	Indigenous Engagement & Comment	8 to 20
7.11	Overall Benefit Permit Application - CPAF Submission	1
7.12	Overall Benefit Permit formal MECP Review/Comment	12
7.13	EBR Posting (60-day period)	8
7.14	Minister Approval (90-day period)	12
8.0	**MECP | *Ontario Water Resources Act***	
8.1	Permit to Take Water Application	1
8.2	MECP Review and Approval (timeline to be confirmed)	52
9.0	**Archeology and Indigenous Consultation**	
9.1	Indigenous Relations/Consultation - to be confirmed	TBD
9.2	Archeological survey requirements - to be confirmed	TBD
10.0	**Environmental Assessment**	
10.1	Provincial; not anticipated	N/A
10.2	Federal CIAA; exemption to be confirmed	TBD



Legend / Notes:

- * Requires submission of detailed design to support application
- * Field studies to be completed within allowable survey timelines
- Early consultation to confirm anticipated schedule and planning
- Wood / City of Hamilton Desktop Support and Reporting
- Wood Field Surveys
- Regulator Consultation and Review Period
- Consultation Assumed to be Conducted by Others

Species at Risk Survey Timelines

- Blanding's turtle; after ice-off typically beginning in April between 08:00-17:00 during sunny periods when air temp is warmer than water and >5 degC; min effort 6 surveys within a 3-week period (May/June/July) (MNRF 2015)
- Mussel SAR; between 1 June and 30 September when water temp >16 degC, suggest using SAR wetland survey protocol for downstream reaches and quadrat sampling for upstream wadable areas with high flow velocities as needed. (MNRF 2018)
- Bat SAR; Little Brown Myotis/Northern Myotis (leaf-off) | Tri-coloured Bat (leaf-on), physical surveys and bat (acoustic) detectors; Acoustic conducted during evenings 01-30 June, air temp >10 degC, low wind, no precip, 10 visits to confirm absence (Guelph MNRF 2017)

5.2 MECP Critical Milestones and Checkpoints

Through the provision of the Order, MECP has outlined a series of dates and timelines which require action by the City of Hamilton to address the two (2) core components as related to the Targeted Dredge ("Chedoke Creek Report") and the remediation plan for Cootes Paradise and the West Hamilton Harbour ("Cootes Paradise Report"). This section outlines critical milestones and dates as currently understood, specific to the "Chedoke Creek Report" and the associated development and execution of the targeted dredge work plan.

Table 5.2. Critical Milestones from Order

Submit Chedoke Creek Report	February 22, 2021
Complete Work Plan/Targeted Dredge	October 31, 2021
Submit report by QP detailing Targeted Dredge Operation	Within 1 month after completion
Notice to affected landowners	Within 7 days of submission of work plan
Notice to affected landowners	Within 7 days of Approval of work plan by Director
Notice to affected landowners	7 days before the implementation of any part of the work plan
Written Notice to Director	Within 7 days of commencement of work
Notification to Director	Within 2 days of any change to work plan
Written description of change to Director	Within 2 weeks of any change to work plan
Monthly Progress Update	Prior to the 1st of each month
Meet with MECP	Within 7 days of submission of the Monthly reporting

6.0 Consultation

6.1 MECP

Since release of the Director's Order December 4, 2020 (ref. Appx A), the City Team and Wood have had three (3) formal meetings as part of a broader group regarding the targeted dredge work plan on the following dates:

- January 15, 2021
- January 29, 2021
- February 12, 2021

Details and meeting minutes are provided in Appendix B. The primary objective of these sessions related to the following:

- Confirming/clarifying the requirements in the Order
- Providing an overview of the City's Chedoke Creek Watershed Water Quality Study
- Reviewing the scope of work associated with the Targeted Dredge operation
- Consultation regarding agency permitting requirements
- Discussing scheduling

In addition to the core team meetings, Wood has also had direct dialogue with the Species at Risk Team as outlined in Section 4.5. Those meetings have specifically focused on the species at risk, data collection protocols and timing for permitting.

In addition, MECP provided comments on the first draft of this Work Plan from the SARB and local office (March 4 and March 18, 2021 respectively); this updated report responds to those comments.

Further consultation is planned with MECP formally as per the conditions of the Order, to keep Ministry staff up-to-date on progress associated with the various conditions, including:

- Prior to the first of each month, the City will provide to the Director written, monthly progress updates on the progress made to comply with the order.
- In conjunction with the written monthly progress updates, the City shall meet with the Director within 7 days of the submission of the monthly report to discuss the progress reports

6.2 Stakeholders

As noted in the Introduction, the City has consulted with RBG, as part of the effort associated with the preparation of this Work Plan (ref. personal communication, Scheckenberger- Theijsmeijer, January 29, 2021 and Klodnicki-Theijsmeijer, February 13, 2021). Consultation with the RBG and others (e.g., Hamilton Remedial Action Plan team) to support the targeted dredge project will continue over the course of plan development. The objective of the consultation was to gain further insights into:

- Issues of concern
- Available data/information to support dredge project
- Insights related to Species at Risk
- Background to currently planned projects in RBG's Master Plan

Some of the key outcomes from this dialogue included:

- History of Cootes Paradise and area infrastructure (Hwy 403, Landfill)
- Enhancement work conducted by RBG prior to the spill including carp barrier, plantings and other wetland restoration plans and projects in the area
- Thoughts on sediment dispersion/location/characterization
- Species at risk – Lilliput mussel, Maple Leaf mussel, Blanding turtles
- Outline of other species – spiny soft shell turtles, Swifts, Barn swallows, beavers
- Christmas Tree Berm – plans to make permanent
- Master plan components – restoration of delta at Princess Point, restoration of Lower Chedoke Creek, aerator system in upper Chedoke Creek
- Request for outline of permits to be considered in the targeted dredge operation

6.3 Public

While formal public engagement is not required as part of the implementation of the plan for the targeted dredge in response to the Order, as it would be through Class or Full Environmental Assessment projects, the City is advocating for a process to keep the general public informed including the local users of potentially affected spaces, during and after the dredge operation. The approach to public engagement will include: media releases, technical briefs and through the updates on the City's project website. The process of informing the Public is a Council priority and key objective.

6.4 Indigenous Nations

Given that the City's response to the Order through the Chedoke Creek Work Plan (Targeted Dredge) is not a formal Class Environmental Assessment, it does not formally attract the requirement for Indigenous Nations and Peoples engagement. That said, it is the City's intent to keep its Indigenous partners informed and seek opportunities for fulsome and meaningful engagement.

City staff has committed to developing the most effective approach for engagement for the near-term Targeted Dredge project, as well as the future projects arising from the Cootes Paradise Work Plan execution. The various groups having interest will be identified and then, through direct contact, opportunities will be discussed.

Appendix A:
Director's Order

Ministry of the Environment, Conservation and Parks

Ministère de l'Environnement, de la Protection de la nature et des Parcs

Director's Order

Section 157.3 Environmental Protection Act, R.S.O. 1990
Section 16.4 Ontario Water Resources Act, R.S.O. 1990
Section 26.3 Pesticides Act, R.S.O. 1990
Section 107 Safe Drinking Water Act, S.O. 2002, c.32 (SDWA)
Section 32 Nutrient Management Act, 2002, S.O. 2002

Order Number
1-PE3L3

To:

HAMILTON, CITY OF
700 WOODWARD Ave N
HAMILTON ON L8H 6P4
Canada

HAMILTON, CITY OF
71 MAIN STREET WEST, 1st Floor
HAMILTON, ONTARIO L8P 4Y5
Canada

Site: Chedoke Creek, downstream of the Main/King Combined Sewer Overflow discharge pipe, the eastern end of Cootes Paradise and western end of Hamilton Harbour, and as further described in the Provincial Officer Report # 1-OW6SS under section entitled "Description of the Site and the Orderees".

Response to Request

Attention: City Clerk

I have reviewed Provincial Officer Order 1-OW6SS ("Order") dated 20/11/2020 (dd/mm/yyyy) in response to your request for the review dated November 27, 2020, submitted by your lawyer, Ms. Rosalind Cooper on behalf of the City of Hamilton. I have considered your submissions and met with the issuing Provincial Officer, Shelley Yeudall and technical support staff in the Ministry of the Environment Conservation and Parks (Ministry) to discuss the Order and the above noted request. I have also considered the submissions made at a meeting held on December 3, 2020 between City officials Andrew Grice, Cari Vanderperk and Mark Bainbridge and Ministry officials including myself, Shelley Yeudall, Lindsey Burzese, Zafar Bhatti and Sarah Day.

Pursuant to my authority under s. 157.3 of the Environmental Protection Act, R.S.O. 1990, c. E.19 (EPA) and s. 16.4 of the Ontario Water Resources Act, R.S.O. 1990, c. O.40 (OWRA) I hereby confirm and alter portions of the Order as set out below.

Item No. 1of the Order was altered to extend the compliance date as specified below.

Item No. 2, No. 3, No. 8 and No. 10 of the Order were altered to extend the compliance dates as specified below, and to refer to the Director as opposed to Provincial Officer for the submission of required documents.

Item No. 6, No. 7, No. 12, No. 13, No. 15, No. 17, No. 18, No. 19 and No. 20 of the Order were altered to refer to the Director as opposed to the Provincial Officer.

Item No. 16 of the Order was revoked.

Item No. 4, No. 5, No. 9, No. 11 and No. 14 of the Order are confirmed.

For ease of reference this order uses the definitions used in the Provincial Officer's Report.

Also, for ease of reference, the Director's Order now reads as follows:

1. By January 15, 2021, retain the services of a Qualified Person that has the experience and qualifications to carry out the work specified in this order.

2. By January 15, 2021, submit to the Director written confirmation that the Qualified Person has been retained to carry out the work specified in this order, that a copy of the order has been given to the Qualified Person; and that the Qualified Person has the experience and qualifications to carry out the work.

Chedoke Creek Downstream of the Main/King CSO Discharge Pipe

3. By February 22, 2021, submit to the Director, for approval, a remediation workplan for Chedoke Creek that is developed by the Qualified person to undertake the targeted dredging of Chedoke Creek based on the recommendation identified in section 5.2.5 of the Wood report entitled "MECP Order # 1-J25YB Item 1b Chedoke Creek Natural Environment and Sediment Quality Assessment and Remediation Report" dated January 24, 2019 ("Chedoke Creek Workplan"). The Chedoke Creek Workplan shall be prepared in accordance with the requirements set out in Items 4 and 5 below.

4. The Chedoke Creek Workplan shall, at a minimum:

i. Consider technical reports, Ministry comments and affected stakeholders' comments, to determine an acceptable plan to implement the recommendation in the Wood report to restore the Chedoke Creek, while mitigating impacts of implementing the plan on the natural environment, including water;

ii. Contain a detailed timeline setting out critical milestones and checkpoints with the Ministry for carrying out the Chedoke Creek Workplan;

iii. Contain a Species at Risk assessment plan and associated timelines for Chedoke Creek downstream of the spill and including potential impacted areas downstream of Chedoke Creek that may be impacted by targeted dredging;

iv. Undertake consultation with the Species at Risk Branch within the Ministry in respect of any identified items pursuant to 4 iii) and incorporate this feedback and outcome into the workplan for any species at risk;

v. Provide a description of any anticipated approvals needed to implement the Chedoke Creek Workplan, initial consultation and proposed timelines to obtain such approvals, if required, for the Workplan to be implemented;

vi. The consultation in iv) and v) shall include the Regional Technical Support Section of the Ministry;

vii. Contain a description of the identified areas and the extent (depth, location) of the targeted dredging with a description of how the items outlined in Item 5 below were addressed and a description of any methods for refining identified areas in Item 5 including the impacted areas identified in the Wood reports and SLR reports and timing as needed, in the Chedoke Creek Workplan;

viii. Contain a description of the approximate volume of material to be removed;

ix. Identify and contain a description of proposed mitigation measures for any short-term impact(s) that may arise from implementing the Chedoke Creek Workplan for Chedoke Creek, its shoreline and connected waterways/natural environment, on any species at risk and other potentially impacted uses. Mitigation measures may include, but are not limited to: exclusion measures for local aquatic uses; limit recreational uses in the area; total suspended solids control as required for carrying out the targeted dredging; and proposed monitoring during any remediation to monitor effectiveness of mitigation measures during dredging identified in iv); and

x. Contain a proposed monitoring plan to monitor the recovery of the natural environment and effectiveness of the Chedoke Creek Workplan once dredging is complete.

5. With respect to the area from the Main/King CSO outfall to the mouth of Chedoke Creek, the Chedoke Creek Workplan shall take into consideration the scope of targeted dredging work necessary to restore the natural environment to pre-spill conditions, as to be agreed upon by the Ministry, and to mitigate any impairments or potential impairments from the spill, in relation to the following, but not limited to:

i. Sediment areas identified as impacted, in consultation with the Ministry, by the sewage spill;

ii. Sediment areas identified as containing elevated organic material consistent with sewage sludge;

iii. Sediment areas identified as elevated nutrients (particularly TP, TAN, and TKN);

iv. Sediment areas identified as had, may have, or continuing to have reduced dissolved oxygen levels in the water column from historical levels;

v. Sediment areas identified as having elevated parameters as identified by the ERA carried out by SLR ("Ecological Risk Assessment (ERA), Chedoke Creek, Hamilton, Ontario" dated February 12, 2020) to have moderate or high risk for impacts, or otherwise identified by the reports or in comments by the Ministry; and

vi. Addressing any ecological flow path requirements and connectivity within the creek in any remedial action plan that may impact low flow path and connectivity.

6. By October 31, 2021 or such other date approved by the Director in writing, complete the approved Chedoke Creek Workplan.

7. Within one (1) month of the completion of the of the work undertaken pursuant to the approved Chedoke Creek Workplan, submit to the Director, a report prepared by the Qualified Person confirming that the natural environment has been restored to pre-spill conditions and that further impairment to the natural environment will not occur as a result of the spill to the Chedoke Creek as detailed in the attached Provincial Officer's report, and at a minimum contain the following:

i. The details of the work undertaken to complete the Chedoke Creek Workplan;

ii. Any monitoring results completed before, during and after the work undertaken in accordance with the Chedoke Creek Workplan;

iii. Analysis of the results in Item 7(ii) above for the purposes of the intended monitoring; and

iv. Determination if any requirement for on-going monitoring is required to verify the effectiveness or maintenance of the remedial actions undertaken is necessary.

Cootes Paradise/Western Hamilton Harbour Area

8. By March 22, 2021, submit to the Director for approval, a proposed remediation/mitigation report that is prepared by a Qualified Person(s) for the Cootes Paradise/Western Hamilton Harbor Area to offset the added nutrient loading, principally TP, identified in the Wood reports, the SLR reports and particularly the Hatch reports, and address any other potential on- going impacts (dissolved oxygen, algal blooms) as a result from the sewage spill to this area ("Cootes Paradise Report").

9. The report in Item 8 shall, at a minimum:

i. Identify and review all potential remediation or mitigation measures, whether direct, indirect, or a combination of measures with consideration for short and long-term measures to address the remediation goal to offset added nutrient loading particularly for TP and any potential on-going impacts (dissolved oxygen, algal blooms) from the sewage spill to the Cootes Paradise/Western Hamilton Harbor Area as identified in the Wood reports, the SLR reports and the Hatch reports;

ii. Undertake consultation with and provide a summary of comments received from the Royal Botanical Gardens, Hamilton Conservation Authority, the Ministry, and any other relevant affected stakeholders for potential remediation and mitigation options as per item i. above;

iii. Contain a cost/benefit analysis of all options to assess efficiency and effectiveness of any remediation or mitigation options;

iv. Identify the recommended options for remediation and mitigation;

v. Identify the proposed offset goal to achieve remediation and/or mitigation with respect to the approximate equivalent loadings from the sewage spill;

vi. Propose a methodology for quantification with respect to the offset of the loadings for any remediation and/or mitigation measures to meet the intended goal for overall remediation and/or mitigation to address the added TP loading from the spill; and

vii. Identify and propose timelines to implement the recommended remediation or mitigation measures to offset loadings from TP, impacts to dissolved oxygen from nutrients or other measures that may improve existing or potential impairments with identification of options that can be implemented as soon as possible to start to reduce the on-going or potential impacts.

10. Within six (6) weeks of approval of Item 8 above or such other date approved by the Director in writing, submit to the Director for approval, a proposed workplan for the approved remediation/mitigation measures for Cootes Paradise/Western Hamilton Harbour Area ("Cootes Paradise Workplan"). The workplan shall consider and address, as necessary, Work Ordered in Item 8 and 9 above and any ministry comments upon approval of Item 8, and shall include, but not be limited to, the following:

i. A detailed workplan and timeline for carrying out the approved remediation/mitigation options within the Cootes Paradise/Western Hamilton Harbour Area;

ii. Calculations referred to in Item 9 iv) and v) or as otherwise approved; and

iii. Proposed follow-up monitoring required to ensure the recovery and effectiveness of the remediation plan.

11. Within two (2) weeks of the approval obtained pursuant to item 10 above, commence implementation of the approved Cootes Paradise Workplan within the timelines set out in the approval.

12. Submit a report prepared by the Qualified Person within one (1) month of the completion of the work undertaken pursuant to the approved Cootes Paradise Workplan to the Director confirming that the natural environment has been restored and outlining the completed items and the work undertaken to restore the natural environment, including, but not limited to, the following:

i. Any monitoring results completed before, during and after the work undertaken in accordance with Cootes Paradise Workplan;

ii. Analysis of the results in Item 12 (i) above for the purpose of the intended monitoring; and

iii. Determination if any requirement for on-going monitoring is needed to verify the effectiveness or maintenance of the remedial actions undertaken as necessary.

13. Provide notice to any impacted landowner(s) of the following items:

i. within 7 days of submission of any proposed workplan(s) submitted to the Director for approval; and

ii. within 7 days of the approval of any workplan(s) by the Director.

14. Provide notice to any impacted landowner(s) at least seven (7) days before the implementation of any work on the approved Chedoke Creek Workplan or the approved Cootes Paradise Workplan;

15. Within seven (7) days of any work on the Chedoke Creek Workplan and the Cootes Paradise Workplan, provide written confirmation to Director, that implementation of the approved workplan(s) has commenced.

16. Within (2) days of any limitations or changes being identified to the approved workplans, notify the Director and within two (2) weeks, submit, in writing for review and acceptance, any proposed changes to an approved workplan with the relevant information to support any proposed changes. Written acceptance by the Director of the proposed changes is required prior to implementation of any proposed changes.

17. Prior to the first of each month, provide to the Director written, monthly progress updates on the progress made to comply with this order.

18. In conjunction with the written monthly progress updates, the City shall meet with the Director within 7 days of the submission of the monthly report to discuss the progress reports.

19. Post this order on the web site of the City for public viewing within 24 hours of it being served and it shall remain posted unless otherwise directed by the Director.

A. While this order is in effect, a copy or copies of this order shall be posted in a conspicuous place.

B. While the order is in effect, report in writing, to the District or Area Office, any significant changes of operation, emission, ownership, tenancy or other legal status of the facility or operation.

Request for Hearing

You may require a hearing before the Environmental Review Tribunal if, within 15 days of service of this order, you serve written notice of your appeal on the Environmental Review Tribunal and the Director. Your notice must state the portions of the order for which a hearing is required and the grounds on which you intend to rely at the hearing. Except by leave of the Environmental Review Tribunal, you are not entitled to appeal a portion of the order or to rely on grounds of appeal that are not stated in the notice requiring the hearing. Unless stayed by the Environmental Review Tribunal, the order is effective from the date of service.

Written notice requiring a hearing must be served personally or by mail upon:

The Secretary Environmental Review Tribunal 655 Bay Street, 15th Floor Toronto, ON M5G 1E5	and	Director Ministry of the Environment, Conservation and Parks 119 King St. W., 9th floor Hamilton, ON, L8P 4Y7 Fax: (905) 521-7806

Where service is made by mail, the service shall be deemed to be made on the fifth day after the date of mailing and the time for requiring a hearing is not extended by choosing service by mail.

For your Information

The procedures to request a hearing and other information provided above are intended as a guide. The legislation should be consulted for additional details and accurate references.

Reasons for Response

I altered work ordered item Items No. 1, No. 2, No. 3 and No.8 of the Order allow the City of Hamilton more time to follow their internal procurement and funding process to retain the Qualified Person within a reasonable period of time. Additional time was granted, at the City's request, to allow the City more time to work with the Qualified Person to complete the Chedoke Creek Workplan and the Cootes Paradise Report.

I altered work ordered Item No. 10 of the Order to allow at least six (6) weeks, or such other date approved by the Director, for the submission of the Cootes Paradise Workplan in relation to the approved remediation/mitigation measures for Cootes Paradise/Western Hamilton Harbour Area. The additional time will allow the City more time to develop the Cootes Paradise Workplan in consultation with the Qualified person and accommodate their internal approval processes.

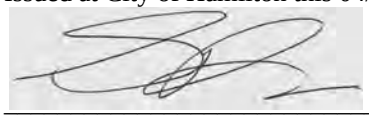
Item No. 16 of the order was revoked as I agree with the City that the requirements were duplicative, and that the monthly update meetings required by Item No. 17 (formerly No. 18 of the Order) will provide the necessary updates to me and the Ministry on the City's progress in complying with the order. Item No. 17, No. 18, No. 19 and No. 20 of the Order were renumbered accordingly.

I am confirming work ordered Items No. 4, No. 5, No. 6, No. 7, No. 9, No. 11, No. 12, No. 13, No. 14, No. 15, No. 17, No. 18, No. 19 and No. 20 of the Order.

A meeting was held on December 3, 2020 between City officials Andrew Grice, Cari Vanderperk and Mark Bainbridge, and me along with Ministry staff, in response to the request for review of the Order. I discussed the requirements of the Order in detail, including in relation to the clarifications sought by the City in its request for review, with support from Ministry officials in attendance. The City was given opportunity to ask questions of me and Ministry officials regarding the work ordered, and I discussed expectations of the Order moving forward. I am of the view that given the nature of the discussions, and the City's understanding of the work that is required of them, I did not see a need to alter any other terms of the order.

I note that Item No. 2, No. 3, No. 6, No. 7, No.8, No. 10, No. 12, No. 13, No. 15, No. 17, No. 18, No. 19 and No. 20 were altered to refer to the Director, as opposed to the Provincial Officer, for the purposes of administering the requirements of the order, and so I am apprised of progress made to comply with the Order.

Issued at City of Hamilton this 04/12/2020 (dd/mm/yyyy).



Stephen Burt

Badge # 1504

Hamilton District

Provincial Officer's Report

Order Number
1-OW6SS

To:
HAMILTON, CITY OF
700 WOODWARD Ave N
HAMILTON ON L8H 6P4
Canada

HAMILTON, CITY OF
71 MAIN STREET WEST, 1st Floor
HAMILTON, ONTARIO L8P 4Y5
Canada

Site:
Chedoke Creek, downstream of the Main/King Combined Sewer Overflow discharge pipe, the eastern end of Cootes Paradise and western end of Hamilton Harbour, and as further described in the Provincial Officer Report under section entitled “Description of the Site and the Orderees”.

Observations

1. Authority to Issue Order

This Order is being issued pursuant to my authority under sections 157, 157.1 and 196 of the Environmental Protection Act and under sections 16, 16.1, and 104 of the Ontario Water Resources Act.

2. Definitions

For the purpose of this Order, the following terms shall have the meanings described below:

"adverse effect" means one or more of:
(a) impairment of the quality of the natural environment for any use that can be made of it,
(b) injury or damage to property or to plant or animal life,
(c) harm or material discomfort to any person,
(d) an adverse effect on the health of any person,
(e) impairment of the safety of any person,
(f) rendering any property or plant or animal life unfit for human use,
(g) loss of enjoyment of normal use of property, and
(h) interference with the normal conduct of business.

"cBOD" means Carbonaceous Biochemical Oxygen Demand

"City" means the City of Hamilton.

"Combined Sewers" means pipes that collect and convey both wastewater from residential, commercial, institutional and industrial buildings and facilities (including infiltration and inflow) and stormwater runoff through a single-pipe system;

"Combined Sewer Overflow (CSO)" means a discharge to the environment from a Combined Sewer system that usually occurs as a result of precipitation when the capacity of the combined sewer is exceeded.

"combined sewer system" is a wastewater collection system which conveys sanitary wastewaters (domestic, commercial and industrial wastewaters) and stormwater runoff through a single pipe system to a Sewage Treatment Plant (STP) or treatment works. Combined sewer systems which have been partially separated and in which roof leaders or foundation drains contribute stormwater inflow to the sewer system conveying sanitary flows are still defined as combined sewer systems in Procedure F-5-5.

"discharge", when used as a verb, includes add, deposit, emit or leak and, when used as a noun, includes addition, deposit, emission or leak; ("rejet", "rejeter")

"DO" means Dissolved Oxygen

"Dry weather flow" is sewage flow resulting from both: 1) Sanitary wastewater (combined input of industrial, domestic and commercial flows); and 2) Infiltration and inflows from foundation drains or other drains occurring during periods with an absence of rainfall or snowmelt.

"EPA" means the Environmental Protection Act, R.S.O. 1990, c. E.19.

"ERA" means Ecological Risk Assessment.

"HATCH" means HATCH Limited.

"HATCH reports" means the following reports:
- Report entitled "Quantification of Volume and Contaminant Loadings" dated September 28, 2018 by HATCH Limited;
- Report entitled "Main-King CSO Tank Overflow Volume Estimates" by HATCH Limited dated April 14th, 2020.

Ministry" or "MECP" means the Ontario Ministry of Environment, Conservation and Parks.

"municipality" means the City of Hamilton

"operator" means a person who adjusts, inspects or evaluates a process that controls the effectiveness or efficiency of a facility, and includes a person who adjusts or directs the flow, pressure or quality of the wastewater within a wastewater collection facility;

"Order" means this Provincial Officer's Order 1-OW6SS, as it may be amended.

"overflow event" occurs when there is one or more CSOs from a combined sewer system, resulting from a precipitation event. An intervening time of twelve hours or greater separating a CSO from the last prior CSO at the same location is considered to separate one overflow event from another.

"owner" means a municipality or person having authority to construct, maintain, operate, repair, improve or extend water works or sewage works; ("propriétaire")

"owner of the pollutant" means the owner of the pollutant immediately before the first discharge of the pollutant, whether into the natural environment or not, in a quantity or with a quality abnormal at the location where the discharge occurs, and "owner of a pollutant" has a corresponding meaning; ("propriétaire du polluant", "propriétaire d'un polluant")

"OWRA" means the Ontario Water Resources Act, R.S.O. 1990, c. O.40.

"Partially Separated Sewer Systems" means wastewater collection systems that originally had Combined Sewers and where either only a portion of a system was retrofitted to separate sewers, or in which roof leaders or foundation drains still contribute stormwater inflow to the separated sewer conveying sanitary sewage, and/or a new development area served by separate sewers was added to an area served by Combined Sewers;

"person having control of a pollutant" means the person and the person's employee or agent, if any, having the charge, management or control of a pollutant immediately before the first discharge of the pollutant, whether into the natural environment or not, in a quantity or with a quality abnormal at the location where the discharge occurs, and "person having control of the pollutant" has a corresponding meaning;

"pollutant" means a contaminant other than heat, sound, vibration or radiation, and includes any substance from which a pollutant is derived;

"practicable" means capable of being effected or accomplished;

"Provincial Officer" means the undersigned provincial officer or, in the event that the undersigned is unable to act, any other provincial officer authorized to act pursuant to the EPA and OWRA.

"Provincial Officer's Report" means this 18-page report which comprises part of the Order.

"restore the natural environment", when used with reference to a spill of a pollutant, means restore all forms of life, physical conditions, the natural environment and things existing immediately before the spill of the pollutant that are affected or that may reasonably be expected to be affected by the pollutant, and "restoration of the natural environment", when used with reference to a spill of a pollutant, has a corresponding meaning;

"Sanitary Sewers" means pipes that collect and convey wastewater from residential, commercial, institutional and industrial buildings, and some infiltration and inflow from extraneous sources such as groundwater and surface runoff through means other than stormwater catch basins;

"Separate Sewer Systems" means wastewater collection systems that comprised of Sanitary Sewers while runoff from precipitation and snowmelt are separately collected in Storm Sewers;

"sewage" includes drainage, storm water, commercial wastes and industrial wastes and such other matter or substance as is specified by the regulations; ("eaux d'égout")

"sewage works" means any works for the collection, transmission, treatment and disposal of sewage or any part of such works, but does not include plumbing to which the Building Code Act, 1992 applies; ("station d'épuration des eaux d'égout")

"Site" means the site described as: Chedoke Creek, downstream of the Main/King Combined Sewer Overflow discharge pipe, the eastern end of Cootes Paradise and western end of Hamilton Harbour and as further described in the Provincial Officer Report under section entitled

"Description of the Site and the Orderees".

"SLR" means SLR Consulting (Canada) Ltd.

"SLR reports" means the following reports:
- Letter report entitled "Peer Review Report - Chedoke Creek Natural Environment and Sediment Quality Assessment and Remediation Report" dated May 15, 2019 by SLR Consulting (Canada) Ltd.;
- Report entitled "Ecological Risk Assessment (ERA), Chedoke Creek, Hamilton, Ontario" by SLR Consulting (Canada) Ltd. dated February 12, 2020 (including "APPENDIX A Previous Environmental Investigations Sampling Locations");
- Report entitled "Cootes Paradise: Environmental Cootes Evaluation Hamilton, Ontario" by SLR Consulting (Canada) Ltd. dated April 22, 2020; and
- Letter report entitled "Response to Ministry of Environment, Conservation and Parks May 28, 2020 letter entitled Chedoke Creek Spill Response – District Comments" by SLR Consulting
(Canada) Ltd. dated June 12, 2020.

"spill", when used with reference to a pollutant, means a discharge,
(a) into the natural environment,
(b) from or out of a structure, vehicle or other container, and
(c) that is abnormal in quality or quantity in light of all the circumstances of the discharge,
and when used as a verb has a corresponding meaning; ("déversement", "déverser")

"Storm Sewers" means pipes that collect and convey runoff resulting from precipitation and snowmelt (including infiltration and inflow);

"substance" means any solid, liquid or gas, or any combination of any of them.

"TAN" means Total Ammonia Nitrogen

"TKN" means Total Kjeldahl Nitrogen

"TP" means Total Phosphorous

"Tribunal" means the Environmental Review Tribunal

"TSS" means Total Suspended Solids

"Wet weather flow" is the combined sewage flow resulting from:
1. Sanitary wastewater; and
2. Infiltration and inflows from foundation drains or other drains resulting from rainfall or snowmelt; and
3. Stormwater runoff generated by either rainfall or snowmelt that enters the combined sewer system.

"Wood" means Wood Environmental & Infrastructure Solutions a division of Wood Canada Limited.

"Wood reports" means the following reports:
- Report entitled "MECP Order # 1-J25YB Item 1b – Chedoke Creek Natural Environment and Sediment Quality Assessment and Remediation Report" dated January 24, 2019 by Wood Environmental & Infrastructure Solutions;
- Report entitled "MECP Order # 1-J25YB Item 1c – Implementation and Costing Report" dated January 24, 2019 by Wood Environmental & Infrastructure Solutions; and
- Memo entitled "Chedoke Creek Project, Wood Commentary on SLR Peer Review Comments, City of Hamilton" dated May 23, 2019 by Wood Environmental & Infrastructure Solutions.

3. Description of the Site and the Orderees

The City of Hamilton is the owner and operator of two (2) wastewater treatment plants (WWTP) called Dundas WWTP and Woodward WWTP located at 135 King Street West and 700 Woodward Avenue, respectively. Sewage is collected via the wastewater collection system made up of both Separate Sewer Systems and Combined Sewer Systems and Partially Separated Sewer Systems serving the former towns of Stoney Creek, Hamilton, Dundas, Ancaster and Waterdown and other hamlets surrounding the City.

The City of Hamilton is also the owner and operator of the wastewater collection system which includes approximately nine (9) Combined Sewer Overflow (CSO) tanks. CSO tanks are engineered structures designed to hold a portion of combined sewage (sewage and stormwater) during rain events that is in excess of the WWTP capacity. The purpose of providing storage capacity at the CSO tanks is to prevent untreated sewage from discharging to the natural environment. When the rain stops, the sewage is gradually pumped to the WWTP for treatment. Under heavy rain conditions, a CSO tank storage capacity may be exceeded, which may result in combined sewer overflow into the receiving water although at a more diluted concentration than raw sewage. The Main/King CSO Tank and Pumping Station (HCS04) located at 707 King Street West, Hamilton has a combined sewage storage capacity of 75,000 m3.

As detailed later in this Provincial Officer's Report, from January 28, 2014 until July 18, 2018, sewage from the Main/King CSO pumping station was discharged to Chedoke Creek on multiple occasions in the absence of rain and when the capacity of the CSO tank was not exceeded. The sewage flowed from the pumping station into the overflow chamber and out via a 2400 mm discharge pipe traveling west/northwest discharging into Chedoke Creek just north of Glen Road, Hamilton. The spill flowed north in Chedoke Creek discharging into the south-eastern portion of Cootes Paradise with the usual currents going out the Desjardins Canal into the western end of Hamilton Harbour.

The Site is described as: Chedoke Creek, downstream of the Main/King Combined Sewer Overflow discharge pipe, the eastern end of Cootes Paradise and western end of Hamilton Harbour, and as detailed in Appendix A.

Appendix A shows a map of the Site entitled "Chedoke Creek, downstream of the Main/King Combined Sewer Overflow discharge pipe, the eastern end of Cootes Paradise and western end of Hamilton Harbour".

The following are property uses of land surrounding Chedoke Creek:
Neighbouring land uses to the east include Hwy 403 with park land further east (Kay Drage Park/former Landfill);
To the south and west is a mix of residential homes and apartments, institutional properties (long term care facility and former school), and Royal Botanical Garden's park land extending north to Princess Point; and
To the north of Chedoke Creek is Cootes Paradise and additional Royal Botanical Garden (RBG) park land.

4. Events Leading to the Provincial Officer's Order

An estimated volume of 24 billion litres of sewage spilled from the Main/King CSO Tank and associated Pumping Station into Chedoke Creek during the period of January 28, 2014 until July 18, 2018 as a result of the incorrect operation of a valve, and the malfunction of a second gate valve without detection. The purpose of a CSO tank is to collect and retain sewage and storm flows during rain events that would otherwise overwhelm a waste water collection system and thereby prevent untreated sewage from discharging to the natural environment. The associated pumping station then pumps the sewage to the pant when the rain stops, and capacities allow for more flow. Discharges from a CSO tank should not occur during dry weather conditions or during rain events for which the tank capacity has been designed. Because the discharge was abnormal in quality and quantity and unapproved under the OWRA it was determined a spill.

The following chronology is a description of this Provincial Officer's dealings with this spill event since first being assigned to it on July 6, 2018:

Prior to July 6, 2018 the District Office received Annual Reports from the City about the Main/King CSO tank which reported no recent combined sewer overflows. The City also did not report any operating problems encountered and corrective actions taken with respect to the CSO tank as required under condition 4 (c) of the Certificate of Approval (CofA)/Environmental Compliance Approval (ECA) # 3-1455-94-956.

On July 6, 2018, the Spills Action Centre received a public complaint regarding the City discharging sewage into Chedoke Creek and Cootes Paradise. The complaint was forwarded to the Hamilton District Office. The caller reported the presence of sewage odours, worse than he had ever experienced, and raw sewage related plastic debris within Chedoke Creek. Caller reported that the problem had been ongoing since the City installed the CSO tank. The caller indicated that they had also reported the same observations to the City.

On July 9, 2018, Hamilton District Manager, Paul Widmeyer received an email from the Hamilton Health Unit, regarding the health hazard of extremely high E. coli results meeting the criteria of "suspected sewage contamination" in Chedoke Creek with results reported of 3.4 million CFU/100 mL and a trend of historical high results from approximately the end of May 2018.

On July 10, 2018 the Hamilton Health Unit required the City of Hamilton to post warning signs for the public at potential water access points along Chedoke Creek, Princess Point Park, Cootes Paradise Waterfront Trail, Desjardin Canal (which allows flow between Cootes Paradise and Hamilton Harbour) and to remove the canoe/kayak dock at Princess Point Park.

On July 11, 2018 the Hamilton Conservation Authority took samples in the Chedoke Creek watershed at several locations for E. coli and human/bovine bacteria markers in order to isolate the section of Chedoke Creek where the discharge was occurring and determine the source of contamination. Sample results showed high concentrations of E. coli and bacteria readings consistent with human source. Resampling was conducted on July 18, 2018 by the Hamilton Conservation Authority with results also showing high concentrations of E. coli and bacteria readings consistent with human source.

On July 13, 2018, I received a presentation from the Hamilton Harbour Remedial Action Program (HHRAP) committee where the Royal Botanical Gardens (RBG) presented photos of the Chedoke Creek on July 4, 2018 showing a significant amount of sewage solids floating on the surface.

On July 16, 2018, I visited the site at Kay Drage Park bridge with Water Compliance Supervisor, Zafar Bhatti and detected sewage odours and observed sewage debris in Chedoke Creek.

On July 17, 2018, the undersigned Provincial Officer met with City staff at Chedoke Creek outfall and detected strong sewage odours downwind of the outfall and observed significant sewage debris in the creek. City staff identified the sewage as algae. At the Kay Drage Park bridge a slight increase in sewage debris was observed in the creek.

The City had been checking their system and providing update reports from staff suggesting natural organics, algae or sediment reflux all-natural sources and not sewage coming from the sewage system up to July 18th, 2018 but my inspections were on-going to determine the source.

On the morning of July 18, 2018, I visited the upstream portion of the Chedoke Creek outfall at the MTO work site on the east side of the 403 and observed that the water was running clear with no odour.
On July 18, 2018, Calder Engineering Ltd conducted a confined space inspection and sampling of the twin box culvert and connecting and storm sewer pipe from overflow chamber of Main/King CSO tank and Pumping Station located at 707 King Street West. The twin box culvert channels Chedoke Creek under Main Street West to where Chedoke Creek emerges north of Glen Road and receives flow from several different areas. It was this inspection that found sewage flowing into the box sewer from King/Main

CSO tank at an estimated rate of 150 L/sec, while clear water was coming from Chedoke Creek. Further investigation at the Main /King Pump Station found sewage in the CSO tank overflow chamber discharging to a 2400 mm storm discharge culvert. Sewage was entering the overflow chamber through a reported 4.7% open 3000 mm x 3000 mm maintenance gate valve between the overflow chamber and the influent 1950 mm combined sewer entering the pumping station wet well. Once identified the City closed the gate and reported the spill to the Spills Action Centre due to the discharge being of abnormal quality and quantity.

Water Compliance Supervisor Zafar Bhatti and I attended the King/Main CSO tank location on July 18, 2018 to confirm that the discharge had stopped and to conduct a visual inspection of the Chedoke Creek outfall which showed no flow from the east side of the box culvert which had been observed the previous day by the undersigned Provincial Officer. Sewage debris was still observed with sewage odours. Preliminary reports from the City indicated that the gate valve had been open since January 29, 2014. The initial estimated volume of sewage discharged to the creek from January 29, 2014 until the gate valve was fully closed was initially reported as 15.9 billion litres (and more accurately determined to be 24 billion litres later).

The undersigned Provincial Officer also conducted a site visit on July 20, 2018 and found strong sewage odours on Glen Road, downwind of the creek and observed a boom installed by City contractors between Kay Drage Park bridge and the Chedoke Creek Outfall to collect floating materials.

On July 27, 2018, the City confirmed that a gate valve between the sewage pumping station wet well and overflow chamber had been open since January 28, 2014 allowing dry weather flow out of the station. In January 2018 a second gate valve malfunctioned which directed added (wet and dry weather) flow from a large combined sewer into the wet well where the first gate valve was open which allowed the added flow to spill into the overflow chamber and discharging to Chedoke Creek.

A Provincial Officer Order (POO) Number 1-J25YB was issued on August 2, 2018 requiring the City, among other things, to evaluate impacts of the sewage spill to Chedoke Creek from the Main/King CSO tank facility between January 28, 2014 and July 18, 2018. This evaluation required evaluation of impacts to Chedoke Creek from the spill and anticipation/risk of on-going impacts, recommendations for remediation and/or mitigation, if necessary, and regarding the most effective way to complete the remediation and/or mitigation; and associated implementation timeline for any necessary remedial and/or mitigation work by November 30, 2018.

In October 2018, the City submitted a report entitled "Quantification of Volume and Contaminate Loadings" by HATCH dated September 28, 2018 which stated that an estimated 24 billion litres (24 million cubic metres) of raw sanitary sewage and combined sewage was discharged to Chedoke Creek from January 28, 2014 to July 18, 2018. The Total Contaminant Loadings (in Tonnes) for the period from January 28, 2014 to July 18, 2018 were estimated to be 2375 Tonnes of TSS, 47 Tonnes of TP, 159 Tonnes of TAN, 312 Tonnes of TKN and 1373 Tonnes of cBOD.

On January 31, 2019, the City submitted a consultant's (Wood) report (report entitled "MECP Order # 1-J25YB Item 1b – Chedoke Creek Natural Environment and Sediment Quality Assessment and Remediation Report" dated January 24, 2019 by Wood Environmental & Infrastructure Solutions) as a fulfilment of the above Order #1-J25YB, which recommended Direct Removal (section 5.2.5) of settled material by hydraulic dredging. The report stated, "Physical removal of the organic sediment will directly address the three primary sources of potential impairment including nutrient contamination, bacteriological contamination and habitat loss". Options considered in the order of most to least effective were: Direct Removal, Chemical Inactivation, Physical Capping and No Action.

On March 20, 2019, the City reported that a peer review of the original reports was being conducted. On May 30, 2019 I received both: a Peer Review Report by SLR, dated May 15th, 2019; and a memo from Wood, dated May 23, 2019.

On September 19, 2019 as part of the review of the above reports, the Surface Water Specialist of the Technical Support Section and I requested clarification from the City on the identification of a clear conclusion or recommendation for remediation and/or mitigation option the City was proposing. The City had submitted both the Wood report with one recommendation for dredging and the peer review, which recommended no action. No clear indication was provided by the City on which recommendation it was proposing. With no response from the City by September 30th, 2019 I requested a response by October 4th. The City reported on October 1, 2019 that additional sampling work was completed at the site during the last week of September 2019 as a result of the peer review to identify the need for any remedial work.

On October 10, 2019 in a meeting the City informed the Director, me and other Ministry staff that an ERA had been started. I requested a final report and recommendations by November 15th, 2019. The City then informed us that an ERA final report could not be provided until the end of January 2020 as lab analysis and data interpretation/report would take additional time. The Surface Water Specialist of the Technical Support Section in consultation with the Director and I, informed the City that the contaminated sites environmental risk assessment process cannot be used for the determination of spill clean-up requirements as this process does not have the same requirements as a spill to undertake practicable clean-up to restore the natural environment under Section 93 of the EPA. The legal duty to restore the natural environment in section 93 of the EPA helps to prevent a spill site from becoming a

contaminated site and to ensure the owner deals with the spill and its impacts. Some of the analyses undertaken in an ERA can be used to identify areas and extent of impact of a spill, which may be incorporated into the full evaluation of impact and remediation/mitigation options for the spill, but it does not identify level of clean-up required for spills or the practicable measures available to address the impacts of the spill.

In order to ensure appropriate timelines were followed, a Provincial Officer Order (POO) was issued and the City submitted a Request for Review resulting in the Directors decision to issue Director's Order #1-MRRCX on November 28th, 2019 clarifying the work to be conducted with revised time lines of submission of the ERA in Chedoke Creek by February 14, 2020 and Cootes Paradise Environmental Impact Evaluation (EIE) report by May 1, 2020. Work required was:

1. A Chedoke Creek ERA and evaluation of the environmental impact, an identification and evaluation of sewage remaining in the creek, identification of any anticipated on-going environmental impacts to the creek, and a review of options designed to remediate the creek and monitor the environmental condition of the creek, written proposed actions with justification in respect to the remediation and the monitoring of the creek including selected option(s) for environmental remediation and monitoring with supporting documentation/justification and an implementation timeline including significant milestones and any approvals required; and

2. An environmental impact evaluation to Cootes Paradise from the sewage discharged including a written assessment of any anticipated on-going environmental impacts with identification of contaminants related to the sewage spill, any known environmental impacts and an assessment of anticipated on-going environmental impacts from the identified contaminants including a spatial and environmental evaluation of the contaminants remaining (floatables and non floatables) in Cootes Paradise, and any proposed remedial actions and recommendations with justification including timelines with surface water monitoring program.

On February 14, 2020 the City submitted its Chedoke Creek ERA report and letter of position recommending that no further actions or additional remedial work was required to address the effects from the sewage spill or previous effects from the sewage discharge because of the alleged likelihood of recontamination, presence of historical contamination, and potential presence of a species at risk.

On May 28, 2020, the Director provided preliminary comments from the Ministry technical experts to the City and asked the City to provide additional information and clarification in order to complete its review of the Chedoke Creek ERA and better understand the City's methodology used to conclude that no further action or remediation was needed in Chedoke Creek. The request included, but was not limited to:
o Clarification on the assessment of the creek sediment;
o Additional work to verify the presence of a species at risk (Lilliput mussel);
o Additional evidence to support the no-dredging conclusion to address organic material related to the spill; and
o an assessment of any other remedial options considered.

The City and its consultant provided additional information to the Director, me and Ministry staff on June 15, 2020 and maintained that no further action was required.

In a letter dated February 13th, 2020 and in a meeting on March 13, 2020 the Royal Botanical Gardens (RBG), expressed concerns regarding ecological damage, potential extent of contamination to the bed of the marsh, which is owned by RBG, and requested a robust analysis of the spill impact and future remediation efforts. RBG plays a critical role in administering marsh restoration programs, ecological remediation plans and are responsible for the health and safety of visitors, program participants and staff of Cootes Paradise.

On April 30, 2020, the City submitted the required Cootes Paradise EIE and letter of position. It did not recommend any action or additional remedial work to address the effects from the sewage spill because the City believed either impact was short-lived or no adverse impact was sustained on water quality, sediment, aquatic vegetation or fish in Cootes Paradise.

I provided the materials for technical review by Technical Support Section, and as a result of their review comments they advised me that more work is needed to address the impacts of the spill on Chedoke Creek and Cootes Paradise as outlined in section entitled 4.2 Workplan below.

4.1 Environmental Site Investigations and Related Information

To date, the following reports detailing environmental site investigations and related information regarding the Site have been received, reviewed by Ministry Staff, provided for technical review and are listed below:

Documents submitted under Order No. 1-J25YB, dated August 2, 2018
• Report entitled "Quantification of Volume and Contaminant Loadings" dated September 28, 2018 by HATCH Limited;

• Report entitled "MECP Order # 1-J25YB Item 1b – Chedoke Creek Natural Environment and Sediment Quality Assessment and Remediation Report" dated January 24, 2019 by Wood Environmental & Infrastructure Solutions;
• Report entitled "MECP Order # 1-J25YB Item 1c – Implementation and Costing Report" dated January 24, 2019 by Wood Environmental & Infrastructure Solutions;

Additional Letter Reports/Peer Review submitted
• Letter report entitled "Peer Review Report - Chedoke Creek Natural Environment and Sediment Quality Assessment and Remediation Report" dated May 15, 2019 by SLR Consulting (Canada) Ltd.;
• Memo entitled "Chedoke Creek Project, Wood Commentary on SLR Peer Review Comments, City of Hamilton" dated May 23, 2019 by Wood Environmental & Infrastructure Solutions.

Documents submitted under Directors Order No. 1-MRRCX dated November 28, 2019
• Letter from the City entitled "Response to Director's Order 1-MRRCX" Items 1 & 2 submitted on February 14th, 2020 with the following report attachment:
- "Ecological Risk Assessment (ERA), Chedoke Creek, Hamilton, Ontario" by SLR Consulting (Canada) Ltd. dated February 12, 2020 (including "APPENDIX A Previous Environmental Investigations Sampling Locations").
• Report entitled "Main-King CSO Tank Overflow Volume Estimates" by HATCH Limited dated April 14th, 2020.
• Letter from the City entitled "Response to Order No.1-MRRCX, Items 3 and 4" submitted on April 30, 2020 with the following attachments:
- Letter from the City of Hamilton entitled "Director Order Number; Item No. 4, Surface Water Monitoring Program" dated April 30, 2020; and
- Report entitled "Cootes Paradise: Environmental Cootes Evaluation Hamilton, Ontario" by SLR Consulting (Canada) Ltd. dated April 22, 2020.

Confirmation of Position and Methodology Clarification
• Letter from the Ministry to the City entitled "Chedoke Creek Spill Response – District Comments" dated May 28, 2020
• Letter of response from the City entitled "Response to District Comments – Chedoke Creek Spill Response" dated June 15, 2020 with the following attachment:
- Letter entitled "Response to Ministry of Environment, Conservation and Parks May 28, 2020 letter entitled Chedoke Creek Spill Response – District Comments" by SLR Consulting (Canada) Ltd. dated June 12, 2020.

4.2 Work Plan

As previously discussed, I provided the materials for technical review by Technical Support Section, and as a result of their review comments they advised me that more work is needed to address the impacts of the spill on Chedoke Creek and Cootes Paradise as outlined in this section.

Chedoke Creek

The City and its consultants (Wood and SLR) have identified dredging in Chedoke Creek as the only effective option, of the options assessed, to address the increased sewage parameter concentrations in the sediment from the spill. SLR reported that hydraulic dredging could improve sediment quality but identified several items potentially limiting the effectiveness or feasibility of hydraulic dredging and therefore did not recommend dredging, namely: 1) a potential species at risk presence in Chedoke Creek due to its identification in nearby Cootes Paradise; 2) an inability to differentiate sediment contaminated by the spill versus historical contamination; and 3) the likelihood of recontamination from other on-going sources of contamination to the creek.

I asked Ministry technical experts to assess the above potential limitations and was advised that the limitations noted can be addressed with the refinement of targeted dredging locations and mitigation measures or limitations and were not supported as outlined below and based on the information provided. They advised further work is required to assess and address the potential presence of any species at risk in Chedoke Creek that may be subject to dredging. This could include the development of mitigatable measures to protect any species at risk during dredging or avoidance of specific areas for dredging. Consideration on the impact of dredging on species at risk is also given for: if the potential impact from dredging is deemed to be a long-term negative impact; if current conditions are degraded due to historical or spill impacts and already potentially negatively impacting the species; and if there would be a long-term impact improvement despite a short-term negative impact from dredging, in order to determine what and where it is appropriate to dredge. The City is required to address the impacts of the spill and restore the natural environment even if historical contamination (even similar contamination) is present and does not absolve the owner of cleaning up a spill. It is also felt that any recontamination from on-going sources, such as: the closed landfill, combined sewer overflows; potential sanitary sewer cross-connections; and stormwater, are within the City's range of scope and responsibility. Significant improvements have been made to most of these sources (in quantity and quality) in the last 10-15 years, as shown by the improved conditions in the creek and sediment

before the spill. Any on-going sources of contamination are not anticipated to re-contaminate any remediated area to the same level historically seen or to the level seen from the 24 billion litres of sewage seen in this spill and is generally minor in comparison to the loadings seen from the spill.

Some of the key items from the Ministry's technical staff review of the Chedoke Creek ERA and impact assessment are as follows:

• The data interpretation and aggregate data analysis used in assessing pre spill conditions, spill period conditions and post spill conditions did not look at specific year differences (2018 vs 2014-2017) but used mean data analysis over the spill period potentially masking the extent of the impact of the spill seen, particularly in 2018, for some parameters and didn't determine if the pre-spill period used was representative of conditions at the time of the spill.

• Information supported the sediment being impacted by the sewage spill by some of the nutrients;

• Impacted sediment was found to be a moderate to high risk with bacteria, PAH's and copper;

• The contaminant loading of nutrients, cBOD and other sewage related parameters showed ongoing impact on DO levels;

• Elevated TAN levels in Chedoke Creek above pre-spill conditions were on-going.

Cootes Paradise

The consultant's report (SLR) concluded that no further action was required based on some limited monitoring data indicating that Cootes Paradise had returned to pre-spill conditions. Despite a request from the Director, myself and ministry technical staff the report did not consider, a loadings assessment from the spill to understand the magnitude of the loadings added to the system and to have a long-term impact on the system e.g. algal blooms. The additional loadings will undo and delay the improvements from several projects that are being/have been undertaken to improve the conditions in Cootes Paradise to meet HHRAP goals, such as improvements to TP treatment at the Dundas sewage treatment plant. The added loadings may also increase the likelihood and extent of algal blooms for several years. Based on advice received from ministry technical experts, it is not as feasible, for a number of reasons, to undertake a direct restoration of the added loadings to Cootes Paradise and the western Hamilton Harbour area both from the extent and type of the dispersion of TP, and the cost, effectiveness and potential to cause more harm than good in these areas using a direct removal method like dredging. In order to address the impacts of the increased loadings caused by the spill, based on advice received from Ministry experts, other remedial options must be considered and utilized to offset and/or improve the conditions in these systems in an effort to mitigate the added loading and associated impact as a result of the spill, and thus restore the natural environment.

I have considered some of the key items from the Ministry's technical staff review of the Cootes Paradise EIE and are as follows:

• As previously discussed, the data interpretation and aggregate data analysis used in assessing pre spill conditions, spill period conditions and post spill conditions did not look at specific year differences (2018 vs 2014-2017) but used mean data analysis over the spill period potentially masking the extent of the impact of the spill seen.

• Total Phosphorous (TP) and E. coli also showed similar patterns during the spill with TP double the concentration seen during pre and post spill periods for the east end of Cootes Paradise (CP11, CP11.2 and CP1).

• Rough loadings analysis for Total Phosphorous to Cootes Paradise from the spill in the:

o The last 6 months of the spill (January-July 2018) added about 94 kg/d of TP which is approximately double the average annual daily TP loadings (39 kg/day) on top of the normal TP loadings to the system during that time, which may be retained in various forms and recirculated within providing an additional source of nutrients.

o The previous four years of the spill (2014-2017) added approximately half, at about 21 kg/d, of the annual average daily TP loading of 39 kg/d on top of the normal TP loadings to the system during that time; and

o The total spill loading of 47,750 kg, compared to the annual average modelled loading of 14,100 kg/yr, indicated that the loadings from the spill over 4.5 years were equivalent to approximately three (3) years of additional loadings to Cootes Paradise from the point sources (e.g. Dundas sewage treatment plant, combined sewer overflows and the non-point sources (urban and rural stormwater runoff in the tributaries) combined.

• The report did not assess total ammonia nitrogen (TAN) as a contaminant of potential concern for Cootes Paradise. TAN can have other impacts including eutrophication, elevated nutrients supporting greater algal blooms, and can also cause a nitrogenous oxygen demand impacting dissolved oxygen. Data showed levels at CP11 much higher during the spill, e.g. 13.1 mg/L TAN compared to 1.95 mg/L of TAN during pre and post spill with similar trends at CP11.2 and CP1, although to a lesser extent.

• TKN, Ammonia and cBOD would show high input levels to the systems compared to average annual loadings

• The report did not assess the potential for added loadings to the system to impact algal blooms.

• Although diluted throughout a larger area (Chedoke Creek, the eastern portion of Cootes and into Hamilton Harbour to some extent), potential long-term impacts from the additional loadings, particularly for Total Phosphorous were not evaluated.

• The assessment on Chedoke Creek identified that the bulk of the loadings of some parameters, particularly TP, moved beyond Chedoke Creek into Cootes Paradise. Understanding of the currents and water exchange between Cootes Paradise and Hamilton

Harbour indicates that some of the loading also would have moved into Hamilton Harbour.

Considering the above, I am of the view that more work is needed. The work ordered under section 157, in respect of section 93 and section 14 of the EPA, is needed to restore the natural environment as a result of the spill, and to prevent further impairment to the natural environment, and to prevent adverse effects.

The EPA imposes a duty to mitigate and restore the natural environment on the owner of a pollutant and the person having control of a pollutant that is spilled as per section 93 of the EPA which states:

93 (1) The owner of a pollutant and the person having control of a pollutant that is spilled and that causes or is likely to cause an adverse effect shall forthwith do everything practicable to prevent, eliminate and ameliorate the adverse effect and to restore the natural environment.

When duty effective
(2) The duty imposed by subsection (1) comes into force in respect of each of the owner of the pollutant and the person having control of the pollutant immediately when the owner or person, as the case may be, knows or ought to know that the pollutant is spilled and is causing or is likely to cause an adverse effect.

The City is owner of the pollutant and the City's employees and operators were the person(s) having control of the pollutants, namely raw sewage contaminants (including TSS, TP, TAN, TKN and cBOD), that were discharged into the natural environment over approximately 4.5 years (January 28, 2014 and July 18, 2018) from its sewage works. The discharge of 24 billion litres of sewage was not authorized under the OWRA. As previously discussed, the discharges were occurring at all times, during both dry weather and wet weather conditions regardless of the CSO tank's operating level. The discharged volume of the dry weather flow alone, raw sanitary sewage, was 2.9 billion litres which is abnormal to be discharged to the natural environment considering this volume under normal operating conditions would have received full treatment at the wastewater treatment plant. The estimated normal CSO operation volume during the spill period (2014-2018), for the Main-King CSO if it was operating properly, was modelled by HATCH to be about 0.321 billion litres in total for those five years. Sanitary sewage flow of approximately 2.9 billion litres alone added approximately a loading of 771 tonnes of TSS, 502 tonnes of cBOD, 13 tonnes of TP, and 101 tonnes of TKN into Chedoke Creek. This discharge was further augmented by wet weather flow making a total volume of the spill 24 billion litres with total loadings of 2375 tonnes of TSS, 1373 tonnes of cBOD, 47 tonnes of TP, and 312 tonnes of TKN with no treatment by the WWTP or CSO tank. I consider these volumes and loadings excessive and abnormal in quality and quantity. As a result of the discharge, sewage was spilled into the Chedoke Creek causing adverse effects, including impairment to the quality of the natural environment, including waters (e.g. Chedoke Creek and Cootes Paradise), for any use that can be made of it, impairment to the safety of any person, and loss of enjoyment of normal use of property. Examples include odour complaints from RBG and the public due to raw sewage debris floating in the water and on the shore. As a result of the discharge, technical review by ministry experts have determined an adverse effect was observed as a result of the spill and if the natural environment is not restored the remaining spilled contaminants may cause further adverse effect.

As previously discussed, in July 2018, the City began remediation efforts along the surface of Chedoke Creek which included the installation of booms and removal of floating sewage by boat and hydrovac trucks. A seasonal boom was put in place to capture any further associated sewage floatables discharged. The operator station inspection program has been revised and assessments on critical valves have been completed in the system and maintenance prioritized. I am advised by the Ministry's technical experts that these efforts have not restored the natural environment to the pre-spill conditions as required under Section 93 of the EPA due to ongoing evidence of sewage parameter concentrations present above pre-spill conditions for some parameters and on-going low DO conditions.

Accordingly, the City was requested on several occasions, in writing and during meetings to assess and make recommendations to remediate the impacts of the spill (Order No. 1-J25YB dated August 2, 2018, Order No. 1-J3XAY dated November 21, 2019, Directors Order No. 1-MRRCX dated November 28, 2019 and letter dated May 28, 2020 entitled "Chedoke Creek Spill Response – District Comments".)

In addition, the City was in contravention of s.14 of the EPA in relation to the spill, which has caused and may cause an adverse effect as discussed above.

Pursuant to section 30(1) of the OWRA every person that discharges or causes or permits the discharge of any material of any kind into or in any waters or on any shore or bank thereof or into or in any place that may impair the quality of the water of any waters is guilty of an offence.

The discharge of sewage from the Main/King CSO described above constituted a contravention of section 30 of the OWRA. The City as the owner and operator discharged or caused or permitted the discharge of a material/sewage into or in any waters, Chedoke

Creek and Cootes Paradise/Hamilton Harbour, has impaired and may continue to impair the quality of the water further if work is not done.

For the purposes of the OWRA, the quality of water is deemed impaired by the discharge of material, where certain conditions are met as set out in section 1(3) of the OWRA. In the circumstances of this spill, the quality of water is deemed impaired for Chedoke Creek and its connected waterways/natural environment for the following: there was a degradation in the appearance and odour of the water; and the quality of the water was impaired by the discharge of 24 billion litres of sewage that entered the water directly and caused or may cause injury to or interference with any living organism that lives in or comes in contact with or as a result of it using or consuming the water or sediment that is in contact with the water.

For the purposes of section 30 of the OWRA, I am of the view, after having consulted with ministry experts, that the spill caused or may cause impairment to the system and therefore the items identified in the Order are required and more work is needed. Some of the identified impairments or potential impairments also include: 1) The sediment has been identified as having moderate to high risk for effects to some organisms from PAHs. Elevated levels of bacteria have or may have impacted uses or continue to do so; 2) Elevated TAN and nitrite levels in the water and added TKN levels in the sediment will continue to have an added nutrient source, impact DO levels, and add to the eutrophication of the system, all of which may continue to impact organisms in the water and sediment; and 3) the added nutrient loadings, particularly TP, at the significance of the loading to the entire system, will continue to increase the risk in the frequency and size of algal blooms which may impair the water for its use or cause injury as a result of algal blooms.

Considering the above noted on-going impacts and continuing potential impairment, I am of the opinion, after consultation with Ministry staff and technical experts, that a "no action" recommendation by the City does not discharge its obligation to restore the natural environment nor does it address or prevent potential adverse effects, or may impair or continued impairment of the natural environment, including waters.

Thus, further action is necessary to restore the natural environment in relation to Chedoke Creek and that further action is needed to offset the impacts of the spill to Cootes Paradise. Accordingly, I require the City to undertake remedial measures outlined in the accompanied Provincial Officer's Order to restore the natural environment in Chedoke Creek as a result of the spill and take steps to determine what is required in relation to Cootes Paradise and implement those steps once an appropriate course of action is determined.

Based on previous significant public interest, and the need to keep the public informed, the Order also requires posting on the City's website with progress reports, as needed. Progress reports and meetings with the Ministry are outlined to improve collaborative communication and information sharing during spill response workplan development, remediation and ensure timely progress towards restoring the natural environment. Landowner notifications are also required to improve communications with stakeholders.

5. Legal Basis for the Order and Provincial Officer's Opinion

I reasonably believe that the City of Hamilton has contravened or is contravening those provisions of the EPA as outlined in the Offences, Suspected Violation(s)/Offences section of this report.
And
I further reasonably believe that the City of Hamilton has contravened or is contravening those provisions of the OWRA as outlined in the Offences, Suspected Violation(s)/Offences section of this report.
And
I further reasonably believe that the requirements in this Order are in the public interest in order to prevent any further discharge of material into Chedoke Creek, Cootes Paradise and Hamilton Harbour, that may impair the quality of any water;
And
I further reasonably believe the requirements specified in this Order are necessary:

i) to prevent, or reduce the risk of any adverse effect on the natural environment from contaminated sediment which sediment was the direct result of the spill or spills to the Chedoke Creek from the Main/King CSO and which will continue to discharge compounds into the natural environment from the Site; and/or

ii) to prevent, decrease or eliminate an adverse effect that may result from the presence of such contaminants in, on or under the Site.

6.0 Attachments
The attachments listed below form part of the Order:
Appendix A – Site Map "Chedoke Creek, downstream of the Main/King Combined Sewer Overflow discharge pipe, the eastern end of Cootes Paradise and western end of Hamilton Harbour"