



MECP Order # 1-J25Yb Item 1c
Implementation and Costing Report

Hamilton, Ontario
Project # TPB188127

Prepared for:

City of Hamilton

71 Main Street West, Hamilton, Ontario L8P 4Y5

January 24, 2019

Chedoke Creek Implementation and Costing Report

City of Hamilton
Project # TPB188127

Prepared for:

City of Hamilton
71 Main Street West, Hamilton, Ontario L8P 4Y5

Prepared by:

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1/24/2019

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January 24, 2019

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**Re: MECP Order # 1-J25YB Item Deliverable 1c – Implementation
and Costing Report, City of Hamilton**

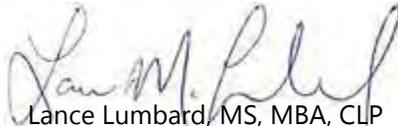
Dear Sir:

Wood Environment & Infrastructure Solutions (Wood) is pleased to submit the attached report for the City of Hamilton to submit to the Ministry of the Environment, Conservation, and Parks (MECP) in partial fulfilment of Provincial Officer's Order # 1-J25YB.

We thank the City for its insights and support in preparing this document. Should you have any further comments, please feel free to contact any of the undersigned.

Sincerely,

**Wood Environment & Infrastructure Solutions
a Division of Wood Canada Limited**

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1.0 Introduction

Wood Environment & Infrastructure Solutions (Wood) has been retained by the City of Hamilton to provide services specifically related to the assessment of the combined sewer overflow (CSO) event into Chedoke Creek for the period of January, 2014 to July, 2018 and the preparation of a Conceptual Remedial Action Plan, in response to the Ministry of the Environment, Conservation and Parks (MECP) Provincial Officer's Order (# 1-J25YB). This report provides an outline of an Implementation Plan for the preferred remediation alternative of physical removal of the organic sediment within Chedoke Creek as detailed in Chedoke Creek Natural Environment and Sediment Quality Assessment and Remediation Report. The Implementation Plan discusses the Process, anticipated Timelines, Approval Requirements, Construction Sequencing, Cost Estimates, and other Construction considerations.

2.0 Process

Currently, the assessment and remediation planning for the subject reach of the Chedoke Creek is being conducted in response to MECP Order # 1-J25YB. It is expected that the City of Hamilton will continue to consult with MECP on the various documents and information required as part of the Provincial Officer's Order. Over the course of this consultation, it is anticipated that a consensus will be reached on the form of the remedial action plan and associated implementation responsibilities. Notwithstanding the foregoing, it is recognized that the City of Hamilton, in addressing this Provincial Officer's Order, has been conducting the assessment in the absence of broad consultation with agencies, stakeholders and the public and it is fully expected that there will be requirements for broader engagement of stakeholders to this undertaking. Given the foregoing, it is expected that there would be benefits from conducting an Environmental Assessment of the problem and associated solutions. Further dialogue on this process and the application of a Municipal Class Environmental Assessment or Individual Assessment is recommended with MECP over the course of the review of the documents associated with the Provincial Officer's Order.

A key issue relates to the extended timelines associated with conducting such an assessment. The Chedoke Creek Natural Environment and Sediment Quality Assessment and Remediation Report indicated that sediment is resident in the subject reach of the Chedoke Creek. Notwithstanding, that report also notes that some of the organic material within the subject reach of the Chedoke Creek may be associated with the 2014 – 2018 discharge event, however it is acknowledged that the sediment within the Chedoke Creek is likely to have been derived from multiple sources, as outlined therein. That report also indicates that the longer this sediment is exposed to the environment the greater the risk of continued impairment. It is suggested that if the City of Hamilton and MECP agree that an Environmental Assessment is appropriate, that the reports prepared in response to the Provincial Officer's Order be used as the basis for the problem definition, system characterization, and alternative assessment, with some re-structuring to allow for context and compliance with the Provincial Environmental Assessment procedures. Given this approach, the primary action which will be required to fulfill the principles and objectives of the Environmental Assessment will involve more comprehensive stakeholder consultation.

The consultation is anticipated to include the following groups:

- Regulators
 - Ministry of the Environment, Conservation, and Parks (MECP)
 - Ministry of Natural Resources and Forestry (MNRF)
 - Hamilton Conservation Authority (HCA)
 - Ministry of Transportation Ontario (MTO)

- Fisheries and Oceans Canada (DFO)
- Indigenous Communities
- Key Stakeholders
 - Royal Botanical Gardens (RBG)
- Interest Groups
 - Bay Area Restoration Council (BARC)Hamilton Harbour Remedial Action Plan (HHRAP)
 - HWD School Board (Vanier school immediately adjacent to remediation area)
- General Public
 - Park Users
 - Area Property Holders and residents

Given the unique characteristics and attributes of this undertaking (unplanned operational condition of municipal infrastructure), it will be important to consult with MECP on the appropriate process and schedule of undertakings, and whether this activity can be considered a "class" undertaking. Given that this matter is largely in response to a failure of municipal infrastructure, it is by extension considered that the Municipal Class EA is most appropriate, but as noted this should be confirmed with MECP. It is anticipated that the project could potentially be conducted as a Schedule B undertaking, in that impacts are expected to be "positive", as the project will be largely remedial in nature, hence the potential for adverse effects will be minimized.

In conducting an Environmental Assessment (subject to the MECP's concurrence), and using documents and information prepared in response to the Provincial Officer's Order, it is expected that the City of Hamilton can meet the requirements of the Environmental Assessment Act and thereby address the key principles of successful environmental planning, including:

- Consultation with effected parties early in, and throughout, the process, such that the planning process is a cooperative venture
- Consideration of a reasonable range of alternatives, both the functionally different alternatives to, and alternative methods of, implementing the solution
- Identification and consideration of the effects of each alternative on all aspects of the environment
- Systematic evaluation of alternatives in terms of their advantages and disadvantages to determine their net environmental effects
- Provision of clear and complete documentation of the planning process followed with respect to the project

3.0 Timelines

The timelines for implementation will be highly conditional on the decision related to conducting an Environmental Assessment and the associated level of study, through consultation with MECP. Given that significant work has been conducted to fulfil the requirements associated with the Provincial Officer's Order, a significant amount of information exists which can be reutilized as part of an Environmental Assessment. That said, there remains a requirement for considerable consultation with those parties cited in Section 2.0 and perhaps others, including the need for a minimum of two (2) formal points of consultation with the Public.

Furthermore, the level of input and commentary on the solutions from stakeholders and regulators cannot be predicted, nor can the ultimate solution be presupposed, hence there needs to be an allowance for a reasonable timeline for executing the work. The following provides an outline of reasonable timelines to execute the work as it is currently understood:

Class Environmental Assessment	8 to 12 months
Design	4 months
Approvals	6 months
Procurement / Tender and Construction	4 to 6 months
Total	22 – 28 months

While the timelines cited above are considered attainable, the various components to the undertaking need to occur in a expeditious manner, however given the engagement of the City to-date and the comprehensiveness of the information prepared in response to the Provincial Officer's Order, it is expected that these timelines will be attainable. As noted in earlier dialogue with City staff, construction would be best conducted in the Fall, early-Winter period, given that flow rates will be less flashy and management of sediment will generally be more predictable.

4.0 Approvals

The proposed remediation project as outlined in Chedoke Creek Natural Environment and Sediment Quality Assessment and Remediation Report is anticipated to require input and/or approvals from various regulators including but not limited to the HCA, MNRF, MECP, MTO, as well as DFO. The following provides an overview of the expected involvement for these regulators and associated timelines.

4.1 Hamilton Conservation Authority

The proposed project is within HCA jurisdiction and within a regulated area. As such, it is assumed a work permit application under the *Conservations Authorities Act* (CAA), based on HCA's Fill Regulations will be required. As an initial step, figures of the proposed work areas should be submitted to HCA to request their review to determine/confirm if the proposed activities require permitting under the CAA. A work permit application requires detailed design drawings, work plans and hydraulic calculations (specific to the short-term impacts associated with raising water levels), including how the activities are proposed to be constructed, as well as staging, site access and details regarding appropriate erosion and sediment control practices. Based on experience, a proponent should anticipate a two to three month review period for a work permit under the CAA from HCA.

Public lands include any lands under the control and management of the MNRF, referred to as Crown Lands, including the beds of most lakes and rivers in Ontario. A work permit under the *Public Lands Act* (PLA) is required for dredging shore lands, including removal of rocks/boulders from shore lands or the bottom of a lake or stream. In the Hamilton area, the HCA works with MNRF to review and approve work permits under the PLA to ensure that the requirements of the PLA and CAA are met, and the management of natural resources is achieved. The PLC work permit application process can be completed concurrently with the CAA work permit application for work in regulated areas, discussed above.

4.2 Ministry of Natural Resources and Forestry

As noted in Section 2.0, the City of Hamilton in consultation with MECP, will likely endeavour to conduct an Environmental Assessment (EA) for the project (Class or Individual). It is noteworthy that MNRF has a similar process related to resource stewardship which can be offered as guidance in this context but not used, as it would not allow for the municipal context related to infrastructure management, which is outlined in the Municipal Class EA. Notwithstanding for context, the Class EA for Resource Stewardship and Facility Development Projects framework provided by MNRF, includes a project screening mechanism by which proponents can evaluate their proposed undertakings, such as water-related excavation and dredging which will rehabilitate fish habitat. This inherently demonstrates that dredging, treatment and disposal of removed material and replacement of material into fish habitat are well understood practices that are included within the Category A projects under the MNRF Class EA for Resource Stewardship and Facility Development Projects framework of the EA Act, hence would similarly be expected to constitute approved activities under the Municipal Class EA procedures. In MNRF's experience, the Category A projects have low potential for significant negative environmental effects (social, economic, or natural environment) or agency or public concern. Planning and implementation of these projects is allowed to proceed in accordance with conditions imposed by MNRF to mitigate negative effects (e.g., in-water timing restrictions, HCA permitting) without further public review or approval. Consequently, the MNRF is usually involved with pre-assigned Category A projects in a very limited manner and does not typically have further requirements under this Class EA process. It is proposed that the MNRF Class EA process be used for context in the dialogue with MECP on the best approach to address the needs of the *Environmental Assessment Act*.

Furthermore, activities in water that support fish are subject to provincial and federal in-water works timing constraints (MNRF 2013; DFO 2013). The timing windows for in-water works are based on the fish species

spawning periods and regional location of the fish habitat. Chedoke Creek is located within the Southern Region (federal and provincial regions are the same). The spring spawning period timing window to avoid in-water works (using known or likely fish species presence) can begin as early as April 1 (e.g., Northern Pike habitat) and extends as late as July 15 (e.g., Basses, Other/Unknown spring spawning species). RBG annual fish community data from Chedoke Creek and Cootes Paradise have confirmed the presence of spring spawning species with cool to warm water thermal regime preferences. As such, the anticipated timing window when in-water work is likely to be restricted based on species presence and MNRF Region is between April 1 and July 15. Meaning, in-water project activities may occur between July 16 and March 31, pending confirmation from the local MNRF district office.

In addition to the in-water timing windows, a fish salvage and relocation program will be required to move fish from the proposed work areas (ref. Management Units #1 through #3 as outlined in Chedoke Creek Natural Environment and Sediment Quality Assessment and Remediation Report) between the coffer dams and relocate them alive to downstream reaches of the creek or to Cootes Paradise, thereby minimizing potential for fish mortality. Reasonable effort must be made to capture and relocate fish from the work areas and based on experience a target for fish salvage efforts is to obtain an 80% reduction in fish densities within the salvaged areas which satisfies Regulator requirements. The fish salvage program will require a Licence to Collect Fish for Scientific Purposes from the local MNRF District office and may require a Licence to Stock Fish, as determined by MNRF on a case-by-case basis. This licensing process commonly requires development of a site-specific fish salvage protocol, identifying salvages areas, species likely to be encountered and identification of candidate release locations, as well as fish care and handling procedures.

The types of work requiring a *Lakes and Rivers Improvement Act* (LRIA) Section 14 or 16 approval include channelization of rivers, which encompasses dredging. However, LRIA approval is not required to undertake channelization within the area of a conservation authority, provided the area of the conservation authority is subject to a regulation made under the authority of Section 28 of the CAA (Ontario Regulation 454/96). Consequently, the proposed project is anticipated to require authorization from the HCA under the CAA in lieu of an MNRF LRIA approval.

4.3 Ministry of the Environment, Conservation, and Parks

The Permit to Take Water (PTTW) program is administered by the MECP and governed by the *Ontario Water Resources Act* (OWRA) and the *Water Taking and Transfer Regulation* (O. Reg. 387/04), made under the OWRA and O. Reg. 63/16, made under the *Environmental Protection Act*. The proposed hydraulic dredging would likely be considered a short-term water taking activity and would not require a PTTW if it can be demonstrated that;

- water taking is less than 50,000 litres of water per day;
- MECP agrees the proposed works are considered part of dewatering for construction purposes; and
- The water is returned to the same watercourse and meets discharge criteria. (note that based on the current concept presented in Chedoke Creek Natural Environment and Sediment Quality Assessment and Remediation Report, the water would not be directly returned to the adjacent waterway (Chedoke Creek) and rather directed to the WWTP and discharged to Hamilton Harbour)

Once the preferred management approach is established, including the specific operative elements it can be determined as to whether a PTTW will be required.

In addition to the PTTW, it will also be necessary to assess whether a revised Certificate of Approval (now Environmental Compliance Authorization) would be required for the temporary discharge to the sewer or leachate collection systems. Normally, MECP does not require these forms of amendments for temporary works, however this should be confirmed through the EA and subsequent dialogue with MECP.

The MECP has a responsibility under the *Environmental Assessment Act* to assess and review proposed undertakings. As outlined in Section 2.0, an Environmental Assessment (Class or Individual) is anticipated to be required, and the details on scope and type will need to be developed consultatively with MECP, to address the requirements of the Environmental Assessment Act.

4.4 Ministry of Transportation Ontario

Consultation with MTO will be required to define the related requirements associated with Highway Corridor Management. Specifically grading adjacent to Provincial Highways is controlled by the MTO under the Public Transportation and Highway Improvement Act. In accordance with Sections 34 and 38 of the Act, and with specific consideration for the preliminary proposed works associated with Chedoke Creek dredging, the MTO may require that a Highway Corridor Management Permit be issued by the Ministry.

Recognizing the proximity of the site to Highway 403, a co-ordinated application will need to be made to the MTO upon completion of the Class EA Report for the overall works, with particular focus on those works which fall within the zones requiring Ministry approval based upon proximity the Ministry's right-of-way and interchange ramps.

4.5 Fisheries and Oceans Canada

Activities near water are also governed by DFO and typically include a self-assessment as an initial step to determine whether project activities are likely to cause *serious harm* to fish as defined by subsection 35(1) of the *Fisheries Act*. Serious harm is defined as the death of fish or any permanent alteration to, or destruction of, fish habitat. It is anticipated the proposed dredging project will be recognized as habitat restoration by DFO, which is listed under the project activities and criteria where DFO review is not required. However, a Request for Project Review (RFR) to the Fisheries Protection Program (the Program) of DFO would confirm whether the proposed project is likely to cause serious harm to fish and fish habitat. The RFR also reviews the project to determine whether it is likely to affect listed aquatic species at risk, any part of their critical habitat or the residences of their individuals in a manner which is prohibited under sections 32, 33 and subsection 58(1) of the *Species at Risk Act*, unless authorized. A maximum review period for an RFR has not been defined by DFO; however, based on experience, a response is commonly received within 35 to 45 days following submission. The DFO decision options and associated timelines for an RFR are outlined below:

- Work determined not to cause serious harm – proponent receives confirmation from the Program and can implement the project in the manner and during the timeframe described within the RFR to ensure no serious harm to fish or prohibited effects on listed aquatic species at risk occurs. The response typically includes a caveat that should proposed project plans change or if information was omitted within the RFR, further review by the Program may be required.
- Work determined to potentially cause serious harm – the DFO will assign a biologist to the file and the proponent will be required to develop a Fish Habitat Offset Plan, complete and submit a Fisheries Act Authorization application form and submit a Letter of Credit for DFO review. The DFO has a 60-day review period following submission of the above documents to assess for completeness;
 - If accepted as complete, DFO has a 90-day review/consultation period during which the limit of 90 days could be extended indefinitely should further consultation with stakeholders or Indigenous groups be required. Pending outcomes from this review/consultation period, DFO can issue the *Fisheries Act* Authorization to complete the work.

To be clear, it is anticipated that the proposed remediation project, with appropriate mitigation strategies and following best management practices will not be determined to cause serious harm, and will not require a *Fisheries Act* Authorization.



5.0 Construction Sequencing and Cost Estimates

Physical removal of the organic sediment inferred to be sourced, largely from the spill event (but acknowledged to be in part from legacy conditions), within Chedoke Creek will directly address the three primary sources of potential impairment including nutrient contamination, bacteriological contamination, and habitat loss. As noted in Chedoke Creek Natural Environment and Sediment Quality Assessment and Remediation Report, it is anticipated that introduction of future contaminants due to CSO discharge events will not accumulate to the same degree as the current condition since the CSOs occur predominantly during wet weather periods thus inherently under conditions of higher flow and lower concentrations. This differs from the conditions during the spill event which were continuous and also during dry weather periods associated with lower flow rates and higher concentrations. While, dredging can be accomplished either through mechanical means or by use of hydraulic dredge equipment, hydraulic dredging (as outlined in Chedoke Creek Natural Environment and Sediment Quality Assessment and Remediation Report) is recommended in this reach of the Chedoke Creek over mechanical means for several reasons. Mechanical dredging would not be practicable due to width of the creek, the density of riparian vegetation, and most importantly the 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, after initial separation of coarse material such as gravel, sand, and debris, dredge slurry from a hydraulic dredge can be relatively easily routed to the Woodward Wastewater Treatment Plant for dewatering and ultimate disposal/treatment, 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 (ref. Chedoke Creek Natural Environment and Sediment Quality Assessment and Remediation Report for further details).

5.1 Proposed Project Sequence

The following is an outline of a possible project sequence of operations for the efficient removal of the target sediments down to a specific elevation without the need to disturb areas outside of the necessary dredge footprint, although the selected contractor will ultimately be responsible for specific means and methods.

Given the importance of maintaining workable water depths for sediment removal by dredging, the approximately 1,275 m (+/-) channel will likely be divided into at least three sections or "management units." Management unit sizes and number will vary based on the size of the proposed hydraulic dredging equipment and pumps, the selected contractor will mobilize to the site.

Hydraulic dredging will be expected to begin starting from the southern end of the subject reach of the Chedoke Creek near the outfall/plunge pool, working northward towards the junction with Cootes Paradise. The first management unit is proposed to extend north from the outfall/plunge pool roughly 425 m (+/-) to point south of Macklin Street North, as it enters Kay Drage Park. The second management unit would extend 320 m (+/-) from the end of the first unit, ending approximately 30 m north of the private road that connects Macklin Street North to Kay Drage Park. The third unit would likely extend north, roughly 520 m (+/-) to the junction with Cootes Paradise.

At the northern end of each management section, starting with unit one, the selected contractor would install a cofferdam system. Before dredging, the water level in each management unit would be raised and maintained at an elevation 2 to 3 m above the top of the sediment to allow a hydraulic dredge to be deployed and operated. The water needed to elevate the subject management unit will be sourced from

either natural creek flows or alternatively can be pumped south from Cootes Paradise. The selected contractor must take care not to raise the water levels to the point that could cause flooding, disrupt the operation of the outfall/plunge pool, or interfere with the recently installed leachate system outfall that lines a portion of the eastern bank of Chedoke Creek. This aspect of the design will need to be carefully coordinated with the HCA and City through detailed hydraulic assessments and development of associated contingency plans and procedures.

During the dredging operation within each management unit, the hydraulic dredge is proposed to sweep the creek bottom and send a slurry of dredged material and mostly water to a temporary work yard area referred to as the dredge material management area (DMMA). Preliminary calculations based only on the amount and types of sediment to be dredged, indicate that a DMMA would cover approximately 3,000 to 6,000 m² (+/-) and consist of several small temporary storage areas and a larger open work area. If available, additional storage area may prove to be beneficial to reduce overall transportation costs but this is not anticipated to be necessary.

Based on Wood's preliminary review of the upland areas available, the central or northern portions of Kay Drage Park would be a good location for the construction the DMMA (assumed for the Conceptual Restoration Plan per the Chedoke Creek Natural Environment and Sediment Quality Assessment and Remediation Report) within the Kay Drage Park area (naturally further evaluation of alternatives and impact management, related to the execution of an Environmental Assessment, would confirm this preference). Importantly, this location would allow for direct road access, movement of construction equipment, and direct hydraulic pipeline access for the transportation of the dredge slurry and the return of targeted sediment back to the Woodward Wastewater Treatment Plant for final processing and disposal.

Areas of approximately 1,000 m² or larger with potential hydraulic pipeline access to Chedoke Creek and direct access to a sanitary sewer line or sewer force main, which lay adjacent to Chedoke Creek, are necessary for the material handling locations. Currently, the Kay Drage Park project area meets these criteria. Determining the final Kay Drage Park project area, operational creek heights, site layouts, etc. will require agreements with the City of Hamilton and users of the Kay Drage Park, additional data collection, and analysis of the proposed site Kay Drage Park area footprint. Following this site-specific data collection, it will be necessary to conduct the engineering design, acquire permits, and develop final tender and construction documents (plans and specifications).

At the Kay Drage Park DMMA, the inflowing dredged slurry will be fed to a series of mechanical dewatering equipment (filter presses, sand shakers, hydrocyclones, etc.), of the selected contractor's choosing, to separate debris, gravel, sand, from the incoming slurry. It is assumed that the separated debris will be directly transported and disposed of in the proper waste handling (landfill) location. If the gravel and sand passes the required sediment sampling tests, they can then be stored and then used as needed. Alternatively, the collected gravel and sand can be either returned to the creek bottom or used in future remediation projects. The remaining effluent, comprised of the targeted sediments and dredged water would then be routed (pumped) back to the Woodward Wastewater Treatment Plant for final processing and disposal. The City of Hamilton's Sewer Use By-Law (14-090) will need to be considered as related to influent quality. Given that the City is the owner operator of the Woodward WWTP, it is anticipated that subject to testing and integrated dialogue between the plant operators and the City team responsible for Chedoke Creek clean-up, that a reasonable approach can be established to accommodate the discharge. Further consultation will be required accordingly.

As noted earlier, the DMMA will require direct hydraulic pipeline access from Chedoke Creek to the Woodward Wastewater Treatment Plant. The DMMA will require direct road access for the movement of construction equipment. The DMMA will ideally have a total volumetric temporary storage capacity of at least 5,000 m³ (+/-) which would allow for continuous dredging seven days a week during daylight hours.

The DMMA site could be partially lighted to allow the selected contractor to continuously process the dredged material seven days a week, 24 hours a day.

The slurry stream would be directed through the selected contractor's series of mechanical dewatering techniques (e.g., hydrocyclones, filter presses) at the DMMA site. The coarse dredged material (gravel, sandy sediments, and debris) needs to be captured by the mechanical dewatering techniques and would be sorted, stacked, and temporarily stored. Afterwards, this coarse dredged material would be transported to the final disposal location (to be determined based on quality and composition). The remaining processed slurry stream would then be directed to the Woodward Wastewater Treatment Plant for final treatment and disposal.

The selected contractor will install erosion and sediment control best management practices to minimize soil erosion and discharge of soil bearing water runoff or airborne dust to adjacent properties to the dredged material handling/dewatering site. The selected contractor will be responsible to return all construction related area to the previous site condition as defined by the contract documents.

5.2 Order of Magnitude Engineering and Construction Cost Estimate

Wood has prepared a preliminary Order of Magnitude Engineering and Construction Cost Estimate herein referred to as an "estimate," which covers hydraulically dredging fine-grained nutrient-rich organic sediments within the subject reach of the Chedoke Creek (ref. Appendix A).

For specialized construction items such as dredging and dredged material management, Wood's cost estimating team has utilized available information and knowledge of means and methods along with production rates observed on similar projects, to assist in deriving unit costs and production rates. To further assist with this estimation, Wood's cost estimating team has contacted three (3) reputable dredging and sediment removal firms and two temporary cofferdam installation firms who operate throughout the United States and Canada, to aid in verifying general rates and further support cost estimating to mobilize/demobilize personnel and equipment to the project site.

The provided preliminary estimate includes all of the currently foreseeable project costs: including Environmental Assessment, Engineering Design and related data collection, and construction activities comprised of mobilization/demobilization; pre- and post-construction surveys (pre- and post-dredging and pre- and post-structural material placement area); maintenance of traffic; Kay Drage Park staging area preparation; upland erosion controls and soil tracking prevention devices; cofferdam system installation and removal; dredging; mechanical separation (debris, gravel, and sand); transportation/disposal of collected material (debris, gravel, and sand); rehabilitation of staging areas; and general labour.

The estimate includes a 20 percent construction contingency (typically a 20 to 30 percent contingency is applied to these forms of infrastructure projects at the conceptual stage with the contingency being reduced as the initial design is advanced and unknowns/uncertainties are reduced) and 10 percent contingency for final engineering, permitting, construction supervision, and project closeout costs.

For this preliminary estimate, Wood has made the following assumptions based on data collected, meetings with regulatory agencies and City of Hamilton staff, and other readily available external literature and discussions. The estimate for the preliminary dredging and DMMA plans presented in Appendix A has been prepared based on the following assumptions and stipulations.

- The preliminary estimate is consistent with the recommendations made to the City of Hamilton by Wood as outlined in the Chedoke Creek Natural Environment and Sediment Quality Assessment and Remediation Report.

- Before permitting and bid document creation and submission, it will be necessary to conduct additional data collection, engineering analysis, and update the draft remediation plan based on the data collection findings. This may alter the proposed design, ultimate site volume, and cost.
- The City of Hamilton will be able to acquire permits that allow the project to proceed as outlined above, which includes:
 - Acquiring the necessary agreements to use the Kay Drage Park (or any other location as per the outcomes of the Class EA).
 - Permitting the treatment of the dredged sediments within the wastewater system.
 - Final disposal agreements for all separated debris, gravel, and sand at the City Landfill
- The City of Hamilton will secure support that the proposed design (dam and hydraulic dredge) is acceptable to City and HCA stormwater and floodplain management coordinators.
- Wood's Construction Administration / Project Closeout effort assumes a contiguous 2 to 3-month construction period, which may prove to be unattainable due to unforeseen or unanticipated site conditions.
- An independent surveyor will establish (pre- and post-construction) horizontal and vertical limits and establish/verify existing elevations for payment applications. A similar survey (pre-and post-construction) will establish that the placement areas have been constructed and restored as required.
- The selected contractor will use a series of mechanical dewatering equipment to separate debris, gravel, and sand, from the incoming slurry. The remaining effluent, composed of the targeted sediments and dredged water would then be routed (pumped) back to the Woodward Wastewater Treatment Plant for final processing and disposal.
- The selected contractor's means and methods must indicate how the selected contractor will maintain proper water levels within each management unit.
- All currently available data indicate that the selected contractor will excavate roughly 5,600 m³ of fine-grained organic sediments and a similar thin layer of creek bed containing mineral sand and other inorganic material (approximately 6,300 m³). For the purposes of this estimate, a dredge volume of 12,000 m³ is assumed.
- For the purposes of this estimate, it is assumed that the selected contractor will dispose of 50 % of the total volume of material (i.e. structural grade material (debris, gravel, and sand)) in an approved placement area with the balance (50%) to be placed in a suitable landfill. In no case should material be placed outside of permitted placement areas.
- This estimate assumes that the contractor will not be required to monitor environmental resources during construction activities.
- The preliminary estimate presented herein includes a 20 percent construction contingency and 10 percent contingency for construction supervision and permit closeout costs.

Based on the verification of all the listed assumptions and the project proceeding as outlined above, the analyses suggest a preliminary engineering and construction estimate of \$2,110,000 for the proposed dredging project as outlined in this document.

As with most dredge projects of this scale, dredged material transportation, dewatering, and final placement of the dredged material are generally the most challenging and costly elements. The proposed construction

activities will remove approximately 12,000 m³ of sediment from Chedoke Creek, which is a construction cost of around \$137.50 per m³ of sediment removed.

5.3 Limitations and Risks

The conceptual dredging project is based on limited historic data and field investigations to characterize the ecological, physical, and chemical conditions within Chedoke Creek. In addition, loading estimates for total suspended solids, total Kjeldahl nitrogen, and total phosphorus were calculated for the duration of the discharge event. Together, these data suggest that the organic material within Chedoke Creek is similar to the Main/King CSO event discharge after settling and consolidation. However, it is unclear what portion of the material within the creek may have been contributed from other sources.

Limited ecological and chemical data exist for Chedoke Creek prior to the discharge event beginning in 2014. Impacts to Chedoke Creek prior to 2014 are probable because the system has been significantly altered from its natural condition to facilitate drainage from developed areas. These alterations include multiple stormwater outfalls and CSOs which have likely contributed pollutants to Chedoke Creek.

Continued evaluation of water quality and additional evaluation of the current sediment conditions are recommended to further refine the project design. Continued water quality monitoring is also recommended although several years of additional water quality data may be required to provide a statistically valid analysis.

Given the potential risks associated with public contact and need for special handling and disposal, a standard methodology for upland dewatering and stockpiling of dredged solids is not recommended. As noted previously, wastewater conveyance infrastructure is located near the project area and is considered to provide a safe, convenient, and economic means of handling the dredge slurry from Chedoke Creek. The use of this conveyance infrastructure will be subject to assessment to adequately meet the conditions of the City's Sewer Use By-Law and also provide details and verification of the hydraulic operations during construction.

Final permits and the final design will require agreements with any land owners whose property may be affected by the remediation such as Kay Drage Park should it be selected as the preferred location. Following this site-specific data collection, it will be necessary to perform the requisite engineering design, acquiring permits, and develop final bid and construction documents (plans and specifications).

Also, additional detailed pre-dredge sediment thickness surveys and volume calculations will be required prior to project commencement and following project completion, which may significantly alter the proposed design, ultimate site volume, and cost.

6.0 Construction Considerations

The construction phase of the cofferdam and the sizing and installation of equipment for the DMMA are considered the two most complex processes in the construction sequence and they are further outlined in this section. The first phase of construction will constitute the selected contractor mobilizing to the DMMA site and the subject reach of the Chedoke Creek.

The next step in the process will consist of the construction of the DMMA. For the purpose of this conceptual remediation plan assessment, the Kay Drage Park has been identified as a potential good site for the DMMA; clearly however this site will need to be reviewed along with others as part of a broader based assessment (Class EA). For the purpose of the following discussion of construction considerations, it has been assumed that the Kay Drage Park would be the preferred site. The Kay Drage Park DMMA will require construction of a direct hydraulic pipeline access to, and from, the Chedoke Creek. The DMMA will also require unimpeded direct road access for the movement of construction equipment. The DMMA site should be partially lighted to allow the selected contractor to continuously process the dredged material seven days a week, 24 hours a day.

The dredge project should be constructed to avoid unnecessary impacts to the existing ecosystem within Chedoke Creek and downstream. Turbidity control is of primary concern with any dredge project. Hydraulic dredging is generally much less prone to turbidity issues than mechanical dredging because most of the disturbed material is entrained by the suction head. Turbidity will be controlled by the contractor using the cofferdam systems which will be arranged to maximize settling time within the work area prior to releasing discharges downstream.

The dredge and associated equipment will be staged, deployed, and operated in a way that limits disturbance of the riparian habitat. In most cases, it is likely that the dredge and associated equipment will be transferred to Chedoke Creek using a crane. Pipelines will be transported, installed, and fixed in place using a corridor that results in the least ecological disturbance.

Additional impact avoidance measures will be reviewed during the pre-design and detailed design stage. This review will also include an assessment of the pumping and sand removal process that will likely be a part of the overall dredge process stream. Ultimate placement of sandy material will be evaluated based on its physical and chemical properties.

Appendix A

Preliminary Order of Magnitude Engineering and Construction Cost Estimate for Hydraulic Dredging

Appendix A: Preliminary Order of Magnitude Engineering and Construction Cost Estimate

Client: City of Hamilton

Prepared by: RJW/RBS

Project: Chedoke Creek Sewage Study and Remedial Action Plan

Date: January 7, 2019

Project No.: TPB188127

Revision 2.00

Preliminary Order of Magnitude Engineering & Construction Cost Estimate¹

Reviewed by: LML

Item	Description	Plan Qty.	Unit	Unit Price	Total
1.00	ENGINEERING ITEMS:				
0.01	Class EA Study	1	LS	\$200,000	\$200,000
1.01	Data Collection & Conceptual Design ²	1	LS	\$81,300	\$81,300
1.02	Permitting	1	LS	\$14,500	\$14,500
1.03	Final Engineering Design ³	1	LS	\$30,000	\$30,000
1.04	Final Order of Magnitude Construction Cost ⁴	1	LS	\$2,900	\$2,900
1.05	Construction Plans & Specifications	1	LS	\$30,000	\$30,000
1.06	Bidding Assistance	1	LS	\$2,800	\$2,800
1.07	Construction Administration / Project Closeout ⁵	1	LS	\$95,000	\$95,000
Subtotal (Engineering Items):					\$456,500
2.00	GENERAL ITEMS:				
2.01	Mobilization/Demobilization	1	LS	\$98,300	\$98,300
2.02	Construction Surveys (pre- & post-dredging and pre- and post structural material placement area) ⁶	4	LS	\$9,900	\$39,600
2.03	Maintenance of Traffic	1	LS	\$13,100	\$13,100
Subtotal (General Items):					\$151,000
3.00	DREDGING, TEMPORARY HANDLING, & DISPOSAL:				
3.01	Kay Drage Park Staging Area Preparation ⁷	1	LS	\$9,500	\$9,500
3.02	Upland Erosion Controls & Soil Tracking Prevention Device	1	LS	\$21,700	\$21,700
3.03	Cofferdam System Installation and Removal ⁸	1	LS	\$170,000	\$170,000
3.04	Material Removal (Dredging) ⁹	12,000	m ³	\$29.50	\$354,000
3.05	Mechanical separation of debris, gravel, & sand ¹⁰	12,000	m ³	\$5.90	\$70,800
3.06	Transportation of Collected Material (debris, gravel, & sand) to approved landfill ¹¹	6,300	m ³	\$8.00	\$50,400
3.07	Allowance for 50% of material to be Landfilled (Tipping fees and transportation)	3,150	m ³	\$140.00	\$441,000
3.08	Rehabilitation of Staging Areas ¹²	1	LS	\$25,000	\$25,000
3.09	Labour	1	LS	\$45,900	\$45,900
Subtotal (Dredging Items):					\$1,190,000
Project Total (with contingency¹³)					\$2,110,000
Approximate Dredge Volume (m³):		12,000			
Average Construction Cost per m³:		\$137.50			

Notes:

Appendix A: Preliminary Order of Magnitude Engineering and Construction Cost Estimate

- 1 The preliminary Order of Magnitude Engineering and Construction Cost Estimate ("estimate")
- 2 Collect any final data and create conceptual plans and narratives suitable for permitting. Data collection and the conceptual plans will cover all elements of the proposed project.
- 3 Before bid document submission need to update the draft construction drawings and specifications based on all permitting conditions. This may significantly alter the final engineering design.
- 4 Short letter memorandum and worksheets summarizing order of magnitude construction cost estimate, which will be used for final budgeting purposes.
- 5 Construction Administration / Project Closeout effort assumes a contiguous 3-month construction period, which may prove to be unattainable due to unforeseen or unanticipated site conditions.
- 6 A hydrographic construction survey will establish (pre- and post-construction) horizontal and vertical limits and establish/verify existing elevations for payment applications. A similar survey (pre-and post-construction) will establish that the placement areas have been constructed as required.
- 7 The selected contractor will use a series of mechanical dewatering equipment to separate debris, gravel, sand, from the incoming slurry. The remaining effluent, composed of the targeted sediments and dredged water would then be routed (pumped) back to the Woodward Wastewater Treatment Plant for final processing and disposal.
- 8 The selected contractor's means and methods must indicate how the selected contractor will maintain proper water levels within each management unit.
- 9 All currently available data indicates that the selected contractor will excavate roughly 5,600 m³ of fine-grained organic sediments and a similar thin layer of the natural creek bed (approximately 6,300 m³). For the purposes of this estimate, a dredge volume of 12,000 m³ is assumed.
- 10 The selected contractor's means and methods must indicate, in detail, how the selected contractor will manage the dredge slurry while within the Kay Drage Park site and route the slurry onto the Woodward Wastewater Treatment Plant for final processing and disposal.
- 11 For the purposes of this estimate, it is assumed that the selected contractor will dispose of any structural grade material in an approved placement area (50% to go to approved City Landfill). In no case should material be placed in outside of the
- 12 This estimate assumes that the contractor will not be required to monitor environmental resources during construction activities.
- 13 A 20 percent construction contingency & 10 percent contingency for construction supervision & permit closeout costs has been added.





wood.