SLR Consulting (Canada) Ltd.
200-300 Town Centre Boulevard
Markham, ON, L3R 5Z6
Tel: 905-415-7248

Peer Review Report

To:	**Mani Seradj, M.A.Sc., P.Eng.** Project Manager – Watershed Management	**From:**	SLR Consulting (Canada) Ltd.
Company:	City of Hamilton		
cc:		**Date:**	May 15, 2019
Subject:	**PEER REVIEW REPORT – CHEDOKE CREEK NATURAL ENVIRONMENT AND SEDIMENT QUALITY ASSESSMENT AND REMEDIATION REPORT**		

1.0 INTRODUCTION

On behalf of the City of Hamilton, SLR Consulting (Canada) Ltd. (SLR) has conducted a peer review of Wood Environmental & Infrastructure Solutions (Wood) report titled, *MECP Order # 1-J25YB Item 1b Chedoke Creek Natural Environment and Sediment Quality Assessment and Remediation Report, City of Hamilton*, dated January 24, 2019.

1.1 Background

On August 2, 2018, the Ministry of Environment, Conservation and Parks (MECP) issued Provincial Officer's Order #1-J25YB (the Order) to the City in relation to the accidental discharge of untreated wastewater from the Main Street and King Street combined sewer overflow (CSO) facility to Chedoke Creek. The Order included requirements for the:

- Quantification of the volume and contaminant loadings associated with the sewage discharged from the Main-King CSO facility to Chedoke Creek between January 28, 2014 and July 18, 2018; and,
- Evaluation of the impacts to Chedoke Creek from the accidental sewage discharge.

To fulfil these Order requirements, the City retained Wood Environment and Infrastructure Solutions (Wood) (and their sub consultant Hatch) to quantify the spill volume and contaminant loadings associated with the wastewater discharge, and to complete a site assessment, impact assessment, and development of a remedial plan if needed (Wood, 2019). The following documents have been prepared:

- *Final Report for Wood Group/City of Hamilton - Quantification of Volume and Contaminant Loadings*, dated September 28, 2018 by Hatch.
- *Chedoke Creek Natural Environment and Sediment Quality Assessment and Remediation Report*, dated January 24, 2019 by Wood.

The City has asked SLR to provide peer review services related to the investigation and mitigation recommendations presented in the *MECP Order # 1-J25YB Item 1b Chedoke Creek Natural Environment and Sediment Quality Assessment and Remediation Report* (the Report). SLR has not reviewed the MECP Order.

1.2 Review Objectives

The purpose of the peer review was not to replicate the work that was completed by Wood, nor to prepare and provide revised recommendations. In conducting this peer review SLR was asked to:

- Provide an opinion on the appropriateness and completeness of the investigation scope and the methods that were applied during the investigation;
- Conduct an independent review of the work completed by Wood to investigate the significance and scale of impacts to the creek system, including streambed sediment, water quality and natural environment related to the wastewater discharge event; and,
- Provide an opinion on the appropriateness and completeness of the conclusions and recommendations made in the Wood report, including the ecological risks posed by the deposits identified in the Creek, proposed remedial alternatives, and the recommendation to physically remove (i.e. dredge) the organic sediment from Chedoke Creek.

SLR notes that the evaluation of each environmental media is generally thorough. The comments provided in this memorandum are based on our review which was completed over a limited timeframe and focused on the above objectives. The review was based on the information provided in the Wood report only. It is possible that additional information not reviewed by SLR would address some of the comments.

1.3 Format of SLR Review

The information presented in this memorandum is outlined as follow:

- Section 2.0 outlines comments on the appropriateness and completeness of the scope of investigation and the investigation methods that were applied.
- Sections 3.1 to 3.5 provide comments pertaining to sediment quality, benthic invertebrate community, fish community, aquatic habitat and surface water quality.
- Sections 4.1 and 4.2 provide comments regarding the conclusion and recommendations.

In addition, Table 1 after the text of this memorandum provides further detailed comments for consideration.

2.0 SCOPE OF INVESTIGATION AND INVESTIGATION METHOD

2.1 Scope of Investigation

The overall scope of investigation by Wood was relatively comprehensive in that it included five lines of evidence (LOEs): sediment physical characteristics and analytical chemistry, surface water analytical chemistry, benthic invertebrate community, fish community and aquatic habitat observations. Each LOE was evaluated separately in the report prepared by Wood, however, very little integration of findings among LOEs was provided.

Based on the information reviewed, it seems that the analytical chemistry was the only LOE used to evaluate the potential impacts associated with the CSO event. The Wood report indicates that the benthic invertebrate community and fish community LOEs were used to describe current condition in Chedoke Creek and as such to serve as "*a baseline for future assessment of potential improvements, following the implementation of remediation options*".

It appears that the benthic invertebrate community and fish community LOEs were not used to support an evaluation of the potential adverse effects associated with the exposure to Chedoke Creek sediment contamination. The evaluation of water quality was based on available analytical data for samples collected by third-parties between 1999 and 2018. The surface water quality analysis seems to have been used to demonstrate that a change in water quality (increase or decrease in concentrations) occurred at select locations before, during and/or after the CSO event. It appears that the water quality analysis was not used to support an evaluation of the potential adverse effects to aquatic life under current conditions or to evaluate the potential contribution of the sediment contamination to the water column. Finally, although aquatic habitat observations were provided in the Wood report, this information does not seem to have been used to support the interpretation of the benthic invertebrate community or fish community LOEs.

2.2 Method of Investigation

SLR understands that the purpose of the assessment was to evaluate the current conditions in Chedoke Creek, assess the extent of impact associated with discharge from the CSO event into Chedoke Creek (that occurred for the period January 2014 to July 2018) and ultimately to support remediation design alternatives, if appropriate. As such, it would be appropriate to include a section on what overall approach was used to evaluate the potential adverse effects resulting from exposure to the sediment contamination for the receptors of concern.

The Ontario Ministry of Environment, Conservation and Parks (MECP) has published guidelines relevant to contaminated sediment including: Guidelines for Identifying, Assessing and Managing Contaminated Sediment in Ontario: An Integrated Approach (OMOE (Ontario Ministry of Environment (now MECP)) 2008). It is unclear what approach was followed in the Wood report to assess the environmental impacts associated with the sediment contamination and if these guidelines were considered.

Although, the methodology for sample collection and data analysis has been provided for each of the abiotic and biotic components, there does not appear to be a description of the overall approach to evaluate the current impacts of the CSO event. In addition, no apparent criteria were provided as part of the methodology to distinguish recent effects from those expected downstream from CSO operating within regulatory compliance, nor to identify the parts of the study area that require management, nor to select the remedial options if required.

As Wood correctly identified the existence of other sources of contamination (e.g., other CSOs, urban runoff, erosion), the study design should include comparisons to appropriate reference location(s) to support the evaluation of impacts. While it may not be feasible to isolate all sources of contaminants, this is not the fundamental issue requiring resolution. To determine whether and to what extent remedial actions are required it is more important to identify how conditions differ upstream and downstream from the CSO under investigation (which may not be possible in some cases) and how conditions differ between a properly functioning, and permitted CSO, and the CSO under investigation, than to distinguish sources of all contaminants. Given the importance of this issue, the Wood report should state why differences in conditions upstream and downstream from the Main-King CSO, or for another stream with similar urban characteristics (i.e., reference CSO) were not, or cannot, be characterized. If adequate reference location(s)

cannot be used to evaluate the impacts, the report should outline what alternative methodology was used.

The following list briefly outlines the items which would provide a clear process for analyses and criteria for decision making if included as part of the overall approach and study design:

- Description of provincial and/or federal guidance documents relevant to the study.
- Selection of the receptors of potential concern (human and/or ecological) and a description of the protection goal for these receptors, as well as assessment endpoints.
- Selection of the lines of evidence and measurement endpoints. This would support the selection or exclusion of lines of evidence typically used to assess sediment contamination (e.g., toxicity test, benthic community structure assessment).
- Description of the approach used to assess the potential adverse effects for each of the LOE, including the extent and magnitude of effects. This is warranted because the overall study design does not seem to use reference site(s) in Chedoke Creek or in another urban creek with similar characteristics. Guidance on the assessment and management of contaminated sediment generally require comparisons to reference sites to support the evaluation of adverse effects. This is of importance for an urban system such as Chedoke Creek which is known to receive various point-source and non-point-source inputs.
- Description of the overall weight of evidence (WOE) approach to evaluate the potential adverse effects. The report does not provide an integration of the different LOE to support an evaluation of potential risks to ecological receptors exposed to sediment contamination.
- Description of the approach to evaluate and select the remedial options (e.g., selection criteria, closure of data gaps).

3.0 BIOTIC AND ABIOTIC STUDIES

SLR was asked to review the work completed by Wood to investigate the significance and scale of impacts to the creek system, including streambed sediment, water quality and natural environment related to the wastewater discharge event. Our main comments associated with the sediment quality, benthic invertebrate community, fish community, aquatic habitat and water quality investigations are provided in the following subsections. Additional comments are provided in Table 1 (after the text of this memorandum).

3.1 Sediment

The interpretation of sediment quality focuses on comparing the concentrations in the grab and/or core samples to the Provincial Sediment Quality Guidelines (PSQGs); however, the discussion does not clearly identify parameters that are potential drivers of risk or discuss the areal extent or magnitude of potential adverse effects. The vertical distribution of contaminants of potential concern (COPC) should also have been considered to support the effect assessment because most sediment-dwelling organisms live in the surficial sediment (<10 cm). This is consistent with OMOE guidelines (OMOE, 2008) indicating: "*Benthic community structure assessments will also not be possible for sediments deeper than about 10 cm because the vast majority of the sediment-dwelling organisms live in shallower depths than 10 cm although some organisms (e.g., some bivalves) can burrow much deeper*." In addition, the report shows that generally, the nutrients, metals and PAHs contamination has not been delineated vertically. The implications of the COPC distribution and of the lack of vertical delineation should be discussed further, especially because

dredging has been selected as the preferred remedial options (e.g., would higher COPC concentrations be exposed after dredging?).

The evaluation of the nutrients (TKN and TP) shows that concentrations exceed the lowest effects level (LEL) but are below the severe effects level (SEL). The Wood report notes that the "*sediments contain a level of contamination that can be tolerated by the majority of sediment-dwelling organisms, but not necessarily stress-intolerant taxa*." Additional considerations should be given to whether stress-intolerant taxa would be expected, notwithstanding the event, to inhabit the study area based on the historical ongoing sources of nutrients or potential limitations imposed by the urban habitat characteristics.

The report provides a generic description of impact for metals: "*unlike nutrients, metals pose a direct toxicity to living organism and removal of soft sediment material containing these metals would likely be beneficial to the ecological conditions within Chedoke Creek and downstream*". This generic statement should be supported by the biological assessment results and/or toxicity tests, as per OMOE (now MECP) guidance mentioned above.

3.2 Benthic Invertebrate Community

The Wood report indicated that the benthic invertebrate LOE was collected to establish the baseline condition against which any improvements resulting from dredging could be measured. The benthic invertebrate results recognize presence of taxa tolerant to environmental stress but not whether presence and abundance is outside the range of expectations for urban stream within the study area. This is considered an important point, as the Wood report recognizes that sediment contamination has occurred prior to the Main/King CSO event and that other potential sources are ongoing (e.g., "*other operating CSOs (e.g. Royal Tank) located upstream, 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)".*

The benthic invertebrates LOE is identified as one of the LOE carrying the highest weight in assessing and managing contaminated sediment (OMOE, 2008). It is unclear why the study design did not consider this LOE to evaluate the potential effects associated with the sediment contamination in Chedoke Creek and to determine whether and to what extent mitigation associated with the CSO event is required.

3.3 Fish Community

Assessment of fish communities was undertaken using data collected by the Royal Botanical Gardens (RBG) from 2001 continuing through 2018. These collections allowed for comparison of fish community characteristics prior to and during the CSO event into Chedoke Creek from January 2014 until July 2018. Before-after and upstream-downstream comparisons represent a powerful study design to assess effects of spill events such as the one reviewed here, however owing to an extended culvert upstream from the CSO, comparable upstream fish collection may not be possible and only before and during overflow fish data comparisons could occur.

The Wood report developed several metrics to inform data interpretation and indicate general aquatic ecosystem health. The report proposed these metrics as a '*general indicator of health, and to provide a baseline for comparison to the same metrics following remedial actions*' (page 5). While these indicator metrics may collectively allow an interpretation of ecosystem health, some of the metrics are undefined, thus limiting usefulness to identify effects associated with the

CSO event. For example, the report identified tolerant species (carp, suckers, sunfish, bass) without characterizing tolerance (e.g., to warm or cold water temperatures, general habitat degradation, general urbanization, high levels of metals, nutrients, PAHs, DO, BOD). Characterization of fish species tolerance in the Wood report does not incorporate nuanced classification, thus cannot support fine scale interpretation of results.

Indicators such as abundance, species richness and total catch may be useful as general indicators of health, however the MECP Provincial Officer's Order specifically required '*evaluation of impacts to Chedoke Creek from sewage discharged from the Main-King CSO facility to Chedoke Creek'*. Specificity of this direction provided Wood the opportunity to explore, develop and evaluate diagnostic indicators to assess effects related to sewage releases. Wood could revise their report to identify what steps, if any, were taken to develop specific indicators to link changes in fish community characteristics to specific impacts associated with sewage discharge.

The Wood report neither characterizes variation associated with fish collections from various locations over time, or in comparison to reference locations, nor specifies what amount of change in fish community characteristics would be considered significant. Figure 4-3 and Figure 4-4 show variation in fish community indicators for four locations from 2001 to 2018 but without characterization of variation and threshold criteria for change, meaningful interpretation of the data is difficult and may appear arbitrary.

The Wood report states that *"the relative proportion of piscivore species at transects C1 and C2 within the creek has increased recently (2017 to 2018), possibly suggesting recent improvement of environmental quality, since the proportion of top-piscivores are indicative of healthy fish communities*". This description of current conditions would suggest the need for further monitoring rather than support remediation such as immediate sediment removal.

3.4 Aquatic Habitat

Recorded observations show an upstream to downstream transition in channel morphology and flow. Upstream near the CSO the stream channel showed sloping banks, flat bottom, meandering thalweg and boulders throughout the channel. Further downstream the bank included an armour stone wall, riparian vegetation and instream large woody debris. Overhanging trees provided cover and instream structure in the form of eroded tree roots occurred approximately 200m downstream from the CSO. Waterflow toward Cootes Paradise was no longer evident approximately 400 to 500m downstream from the CSO implying water elevation in Chedoke Creek equilibrated with water elevation in Cootes Paradise.

Change in water movement from upstream flowing conditions to downstream still water conditions may imply change from dynamic upstream sediment transport to downstream zone of sediment deposition. These changes in habitat may influence composition of fish and benthic communities independent of the CSO event, however the potential implications were not discussed.

3.5 Surface Water Quality

The Wood report does not include an objective related to water quality analysis. The analysis of water quality provided in the Wood report focuses on statistical comparisons of the water quality at select locations before and after the Gate 1 opening.

The report refers to "*degraded conditions in the water column*" (p. 19). This statement is not supported by comparisons of surface water analytical results to federal or provincial water quality

guidelines (CCME or PWQO). The most recent surface water quality dataset (post event) has not been used to identify surface water COPC, to evaluate the extent and magnitude of exceedances above applicable guidelines nor to relates the findings to the receptors that can be exposed to the surface water COPC, such as benthic invertebrates and fish.

4.0 REPORT CONCLUSIONS AND RECOMMENDATIONS

4.1 Report Conclusions

As indicated in the introduction of this memorandum, SLR was asked to provide an opinion on the appropriateness and completeness of the conclusions made in the Wood report, including the ecological risks posed by the deposits identified in Chedoke Creek, proposed remedial alternatives, and the recommendation to physically remove the organic sediment within Chedoke Creek.

The Wood report lacks a conclusion section between the interpretation of results and the recommendations and thus the report's conclusions are not apparent. In addition, as discussed in Section 2.0 of this memorandum, the approach did not seem to follow the typical guidelines for the assessment and management of sediment contamination which represents a valid basis for a decision as to whether and to what extent mitigation is required; thus, a determination on whether the sediment pose an unacceptable risk to ecological receptors is not made in the report.

While several LOE are discussed in the Wood report, the evaluation of impacts seems to be based on chemistry only. The observations made for each environmental media are not assessed and incorporated into an integrated conclusion to determine if adverse effects are occurring: to identify the ecological receptors potentially at risk, to evaluate the nature, severity, and areal extent of such adverse effects; and to identify the risk drivers causing or substantially contributing to adverse effects. As per one of the OMOE (now MECP) guiding principles "*any remediation decisions will be based primarily on biology, not chemistry, since chemical PSQGs (or other criteria in the absence of a PSQG value) are not clean-up numbers by themselves and need to be used in a risk assessment framework*" (OMOE, 2008).

4.2 Report Recommendations

The Wood report identified, described and assessed remedial options including no-action (e.g., do nothing option), physical capping, chemical inactivation and direct removal (e.g., dredging). As a result of a comparative assessment of remedial alternatives, the Wood report recommended complete removal of sediment in Chedoke Creek by hydraulic dredging as the primary means of remediation.

Based on the information reviewed, SLR agrees with the assessment concluding that physical capping and chemical inactivation are not the preferred remedial options, if remediation is required. However, SLR is of the opinion that the uncertainties associated with the current assessment do not fully support the direct removal of sediment option.

There is a high level of uncertainty associated with the sources of COPC (bacteria, nutrients, metals and PAHs); the Wood report recognized that enrichment has occurred prior to the Main/King CSO event and that other potential sources are ongoing.

An apparent incongruity appears between Sections 1 to 4 and Section 5 (Remedial Action Plan) of the Wood report. Sections 1 to 4 describe methods and results associated with assessment of sediment quality, water quality and natural environment (benthic invertebrate and fish

communities). Findings related to sediment quality, water quality and natural environment show high levels of uncertainty, and some potential evidence of stress. Some findings also show some potential evidence of recovery; however, these statements are provided with caution because robust approaches to provide more certainty in these conclusions were not applied. In any case, compelling evidence supporting direct sediment removal was not provided in the report.

Incongruity appears in Section 5 because support for the Remedial Action Plan appears not to rest on the basis of findings from sediment, water and natural environment analyses focused on Chedoke Creek but rather from speculation on the fate and potential impact of potential loadings to Cootes Paradise that appear inconclusive: '*It is unclear whether the Cootes Paradise stations CP-1, CP-2, and CP-20, have been directly impacted by the Chedoke Creek discharge event* (Wood 2019).

In addition, because of ongoing sources of contamination, it is unclear if sediment dredging will ameliorate the current conditions or if the potential for recontamination has been evaluated. The report suggests that sediment removal will likely not restore Chedoke Creek. Section 5.2.1. of the report reads: "*As noted earlier, the source of the material is not certain and conditions prior to the spill event suggest that the ecological conditions of Chedoke Creek had already been significantly impacted, so removal is not likely to restore Chedoke Creek*". The Wood report indicates that sediment removal would be beneficial to the downstream receiving environment, Cootes Paradise. A high level of uncertainty is associated with this statement because nutrient enrichment has occurred in Cootes Paradise prior to the event and because it appears that most of the TP mass load (about 90%) has already been solubilized or transported downstream. In addition, the report does not discuss whether sediments in Chedoke Creek are in a state of relative equilibrium in terms of sediment transport, which could also influence interpretations and conclusions.

A discussion of the presence of higher concentrations of COPCs at depth and lack of vertical delineation seems to be missing from the analysis of the direct removal option. Based on the information provided in the Wood report it is unclear if all three management units will be remediated equally or if the remediation of selected areas, based on the severity of effects, has been considered. Other options such as partial or no sediment removal in association with a risk assessment do not seem to have been considered and should be evaluated further.

5.0 CLOSURE

SLR is pleased to carry out this review on behalf of the City of Hamilton. Should you have any questions, please do not hesitate to contact the SLR team members listed below:

Team Member	Role	Contact Information
Celine Totman, M.Sc., R.P.Bio Senior Scientist	Sediment and Surface Water Lead	(604) 738-2500 ctotman@slrconsulting.com
Gord Wichert, Ph.D., R.P.Bio. Senior Ecologist	Fisheries and Aquatic Habitat Lead	(905) 415-7248 gwichert@slrconsulting.com
Kimberley Tasker, M.Sc., R.P.Bio. Senior Ecologist	Benthic Invertebrate Lead	(905) 415-7248 ktasker@slrconsulting.com

Table 1: Additional SLR Review Comments

Wood Report Reference Location	Wood Statement	SLR Comment(s)
General Comments		
NA	NA	Rather than provide a description of the study area for context and understanding, the report commenced with a stated purpose of the investigation and methods for characterization of sediment quality and natural environment. The report would benefit from a brief description of the study area and its surroundings including land use, terrestrial and aquatic features and a figure showing the Chedoke Creek watershed, perhaps with a detailed inset showing the study area and location of the Main-King CSO relative to Chedoke Creek.
Sediment – Physical Characteristics		
2.1.1 Sediment Thickness, Characterization and Bathymetry	NA	The depth of the soft sediment has been measured based on sediment core refusal and used to provide an estimate of the soft sediment volume. The report recognizes uncertainty in the method used to estimate the volume of soft sediment as the coring locations were selected to provide sediment chemistry rather than sediment bathymetry information. While imagery for Chedoke Creek in 2013 and 2017 was provided it is unclear if this was used to inform the discussion on the Creek morphology and habitat. For example, Figure 5-3 shows the presence of depositional areas on the west side of the Creek in 2013 within the study area. In addition, although particle size information has been collected it is unclear if this information was used to inform the evaluation of sediment transport. Finally, the ongoing contribution of fines from other sources upstream of the study area (e.g., storm events, erosion, additional CSOs) does not seem to have been considered.
Sediment – Analytical Chemistry		
2.1.2 Sediment Quality	NA	The sediment samples were submitted for analysis of parameters generally associated with CSO evaluation. SLR recognizes that it is not practical to include all contaminants of potential concern (COPC) that are known to be associated with municipal wastewater discharges (e.g., pharmaceuticals and personal care products; endocrine disrupting compounds). Additional sediment variables that could have been added to the list include total organic carbon (TOC), AVS and hydrogen sulphides. These would provide additional information for interpreting the sediment chemistry data (e.g., bioavailability of COPC) and the concentrations of organics in the sediment.

Section 2.1 and Table B1-2a to Table B1-2f	NA	The evaluation of sediment quality was conducted according to recommended methods: comparison of analytical results to the Provincial Sediment Quality Guidelines (PSQGs), lowest effect level (LEL) and severe effect level (SEL), as presented in Table B1-2a to Table B1-2f. The evaluation of the analytical results for metals should also have included comparisons to background sediment concentrations for metals published by Ontario Ministry of Environment (OMOE, 2008). Comparisons to background would show that at some of the sampling locations, select metals exceeded the LEL but were below the natural background concentrations (e.g., cadmium, copper, nickel); thus, would not be considered metals of concern for the given sampling location(s).
Section 3.2, Figures 3-2 to 3-5 and Tables B1-2a to B1-2f.	NA	The interpretation of sediment quality focuses on comparing the concentrations in the grab and/or core samples to the PSQGs and the evaluation of potential effects is limited. The discussion does not clearly identify parameters that are potential drivers of risk or discuss the magnitude of potential adverse effects. Potential adverse effects are discussed in general terms and do not relate to site-specific exposure of ecological receptors. As per one of OMOE (now MECP) guiding principles "*any remediation decisions will be based primarily on biology, not chemistry, since chemical PSQGs (or other criteria in the absence of a PSQG value) are not clean-up numbers by themselves and need to be used in a risk assessment framework*" (OMOE, 2008)
Section 3.2 (page 9) and Figure 3-2	*"low dissolved oxygen concentration associated with the organic sediments in Chedoke Creek likely reduces the diversity of benthic invertebrates and favours a few tolerant species. This, in turn, limits the available food sources for fish*." *"The highest porewater BOD results were found at sample transect C-5/G-6 immediately upstream of the Princess Point bridge, as shown on Figure 3-2, with the next highest BOD value observed at the G-3 sample transect located upstream of the Kay Drage Park bridge. These results indicate organic compounds are present in higher amounts at these sample locations and therefore require more oxygen for microbial metabolism, which typically suggests impaired environmental quality."*	The process of organic waste degradation, its measurement through biochemical oxygen demand (BOD) and its effects on dissolved oxygen (DO) levels are clearly explained in Section 3.2. The Canadian Council of Ministers of the Environment (CCME) has derived guidelines for DO. These guidelines should be used to support the statement on DO as well as describing the extent of the potential adverse effect. Chedoke Creek is described as a warm water system. The CCME DO guidelines for warm water system specify lowest acceptable DO concentrations of 6 mg/L for early life stages biota and 5.5. mg/L for other life stages. Based on an interpretation of Figure 3-2, location G6 appears to be below the guideline for early life stages but not for other life stages. Location G3 appears to have DO concentration above the minimum guidelines, this appears to contradict the statement made on the effect of DO.

Page 9	"…pathogenic contamination of the sediments within Chedoke Creek may present an ongoing risk to human health."	The presence of bacteria in sediment within the creek is identified, in the report, as a potential ongoing risk to human health via direct contact. While the term "risk" is used, a risk assessment including an evaluation of the potential human receptors and potential exposure pathways is not provided in the report.
Page 11	*"Unlike nutrients, metals pose a direct toxicity to living organism and removal of soft sediment material containing these metals would likely be beneficial to the ecological conditions within Chedoke Creek and downstream*".	This generic statement should be supported by the biological assessment results (benthic invertebrates) and/or toxicity tests as per OMOE (2008) guidance on managing contaminated sediment.
Appendix B1	NA	Quality assurance/quality control criteria were not presented in the report (e.g., blind field duplicates).
Appendix B1	Table notes for Tables B1-2a to 2f indicate that exceedances of the SEL were formatted as bold, underlined and shaded.	It seems that this rule has not been applied consistently, for example copper exceedances above the SEL were not consistently underlined.
Appendix B1	NA	SEL have been provided for PAHs, those were not shown in Table B1-2a to 2f. All the PAHs in sediment are below the SEL (assumed at 1% TOC).
Benthic Invertebrate Community		
2.2.1 Method	NA	The date at which the sediment grab samples were collected does not seem to have been provided. The time of sampling has potential implications on the species observed (e.g., period of emergence of some taxa as adults). This timing will also be important for any comparative analyses with future monitoring events.
4.1 Results	NA	The report uses several metrics to inform data interpretation and indicate general aquatic ecosystem health (%EPT, Simpson's Diversity Index, Hilsenhoff Biotic Index) which are common and appropriate for this study. However, once normalized for differences in physical habitat, there are no statistical analyses of these metrics among sampling locations.
Table B1-3	NA	Sediment grab samples were collected concurrently and submitted for analytical chemistry, particulate size and benthic invertebrate community structure analysis. Seven grab samples were collected for benthic invertebrate analysis. Particle size distribution results for Grab 7 seems to be missing. Analytical chemistry for Grabs 6 and 7 seems to be missing.

Section 4.1	NA	SLR agrees that chironomids and oligochaetes are generally considered tolerant to pollution. Although each group contains species with varying tolerance levels, certain taxa may be indicators of pollution. The analysis does not seem to discuss *genera* known to associate with elevated nutrient levels. Such analyses may be more diagnostic than general tolerance indicators and may demonstrate relationships between the CSO event and the benthic invertebrate biota.
Section 4.1 and Figure 4-1	*"Differences in habitat complexity are known to influence community metrics, such as taxa richness*"	The report presents information on sediment grain size associated with benthic invertebrate sample collections and notes that upstream sample locations contain coarser substrates than downstream sampling locations. Figure 4-1 shows a general upstream to downstream decline in Simpson's Diversity and Total Invertebrate Density. The report states, '*Differences in habitat complexity are known to influence community metrics, such as taxa richness*', but neither describes *how* habitat complexity influences community metrics, nor *whether* observed differences are within the expected range of variation. The benthic invertebrate results recognize presence of taxa tolerant to environmental stress but not whether presence and abundance is outside the range of expectations for locations within the study area.
Fish Community		
Section 4.2 (page 19)	generalist and specialist species	The report also refers to generalist and specialist species but does not define whether these species represent specialization, or generalization, in terms of habitat use, spawning or young rearing requirements, feeding habits, or other factors.
Section 4.2 (page 19)	"Tolerant species commonly include carps, suckers, sunfishes and basses (…)"	The report refers to sunfishes and basses as '*tolerant species*' (page 19). Fausch et al. (1990), a reference cited in the report, identified bass (sunfish are in the same family as bass) as indicators of high quality stream reaches because they were the first fish species to disappear downstream from sewage outfalls, this in contradiction to how bass and sunfish are used in the report.
Section 4.2	NA	The report should explain why integrative analyses of fish and water quality data were not considered. For example, the report shows results for total suspended solids (TSS). Given that fish exhibit a stress response to TSS ranging from behavioural avoidance to altered feeding habitats and physiological changes that can result in death when exposed to high TSS for sufficient duration (Newcombe and Jensen 1996), findings from fish community analyses could have been compared with water quality results to confirm whether findings corroborate anticipated trends. Fish species also show a range of sensitivity to dissolved oxygen, turbidity and other parameters associated with sewage discharge, and have demonstrated differences in relative abundance in response to effects of sewage discharge and sewage treatment in Toronto area waters (Wichert 1994; Wichert 1995).
Water Quality		

Section 4.4	Water quality plots	The analysis of water quality focuses on statistical comparisons of the water quality at select locations before and after the Gate 1 opening. The comparisons are provided as time series plots for select parameters and locations. An overall depiction of the concentrations of each parameter along the full length of the Creek (upstream, at CP-11 and downstream) seems to be missing from the report. In addition, the available plots do not include comparisons against federal or provincial water quality guidelines (CCME or PWQO) for the protection of aquatic life (e.g., a line representing the PWQO could be added to the plot).
Section 4.4	Water quality plots	The water quality plots seem to indicate that analytical data are available for late 2018, after the gate's correction (September and/or October 2018), these data were not used to evaluate the current water quality against federal or provincial water quality guidelines for the protection of aquatic life. For this reason, an identification of the potential COPCs under current conditions in surface water is not available from the report.
Section 4.4 (page22) and Figure 4-23; Figure 4-17	*"TSS concentrations appear fairly similar between 2009 and 2018 at stations CP-1, CP-2 and CP-20*" (downstream locations).	Figure 4-23 seems to show that TSS concentrations at CP-20 were lower during the event.
Section 4.4 (page22) and Figure 4-17	*"In general, the medians at stations CP-11 for TP, E. coli and TSS were lowest prior to 2014, increased between 2014 and 2017, increased again in early 2018 and decreased in late 2018*".	While this seems to be the case for TP and *E. coli*, Figure 4-17, shows the opposite for TSS. The median for TSS was higher prior to 2014 and decreased between 2014 and 2018. There seem to be uncertainties regarding the sources and variability of TSS in Chedoke Creek. This is an important point because the soft sediment in the study area has been attributed to TSS load discharged to Chedoke Creek between 2014 and 2018.

References

Newcombe, C.P. and J.O. Jensen. 1996. Channel Suspended Sediment and Fisheries: a Synthesis for Quantitative Assessment of Risk and Impact. North American Journal of Fisheries Management 16: 693-727.

OMOE (Ontario Ministry of Environment now Ministry of Environment, Conservation and Parks). 2008. Guidelines for Identifying, Assessing and Managing Contaminated Sediment in Ontario: An Integrated Approach.

Wichert, G.A. 1995. Effects of Improved Sewage Effluent Management and Urbanization on Fish Associations of Toronto Streams. North American Journal of Fisheries Management 15: 440-456.

Wichert, G. A. 1994. Fish as Indicators of Ecological Sustainability: Historical Sequences in Toronto Area Streams. Water Pollution Research Journal of Canada 29: 599-617