Municipality of Chatham-Kent

Finance, Budget and Information Technology and Transformation

Financial Services

To: Mayor and Members of Council

From: Matt Torrance, MBA, CPA, CGA
Director, Financial Services

Date: June 14, 2021

Subject: Environmental Property – 189 Elm Street, Bothwell

Recommendations

It is recommended that:

1. Administration be directed to proceed with environmental remedial site work as recommended by Golder & Associates regarding 189 Elm Street, Bothwell at an estimated cost of $83,189 including non-refundable HST.

2. Administration be directed to proceed with the 5 year groundwater monitoring program as recommended by Golder & Associates regarding 189 Elm Street, Bothwell at an estimated cost of $82,171 including non-refundable HST.

3. The costs related to the remedial site work and groundwater monitoring program be funded from the Property Disposition Reserve.

Background

The former commercial property located at 189 Elm Street in Bothwell was vested to the Municipality of Chatham-Kent on July 15, 2009 due to a failed tax sale. The site was historically operated as a garage and gasoline service station. In July 2012, the Technical Standards and Safety Authority (TSSA) attended the site and indicated that out-of-use Underground Storage Tanks (USTs) were still present at the site. At that time, the TSSA issued an inspection report requiring that the property owner (Municipality of Chatham-Kent) remove any USTs that may be present, and fully delineate impacts to soil and/or groundwater related to historical operations. The USTs and associated piping were removed in 2014.

Environmental subsurface investigations and monitoring activities have been conducted at the site by Golder & Associates (Golder) since 2015. Previous investigations indicated that the historical operation of a gasoline service station on-site resulted in petroleum hydrocarbon (PHCs) impacts to the soil and groundwater quality characteristic of gasoline (PHC F1-F2 and benzene, toluene, ethylbenzene, and xylenes, collectively referred to as BTEX).

In response to a Provincial Order issued by the Ministry of the Environment, Conservation and Parks (MECP), a subsequent investigation was conducted by Golder between 2018 and

2019 with the objective to delineate the off-site PHCs and BTEX soil and groundwater impacts, and to assess the soil vapour intrusion pathway and potential for indoor air quality impacts to the down gradient residential properties.

Based on analytical soil and groundwater data, PHCs/BTEX soil impacts originating from the site extend south to the neighbouring property of 248 Gordon Street North with off-site benzene impacts detected from the depth interval of 3.7 to 4.3 metres below ground surface, which was below the groundwater table. A PHCs/BTEX impacted groundwater plume was delineated from the site to extend north within the municipal roadway of Elm Street West and to the south to the down gradient properties. Seasonal variability in PHCs/BTEX groundwater concentrations were observed in the samples collected over the course of the investigation and was attributed to potential dilution impacts related to precipitation as indicated by the seasonal high groundwater elevations recorded in the winter and spring months. However, based on the PHCs/BTEX concentrations measured in soil vapour samples collected, the PHC/BTEX impacted groundwater plume identified was not anticipated to pose a significant risk to indoor air quality at the down gradient residences.

The limits of the contaminant plume have been appropriately delineated and the results of soil vapour sampling at these properties did not identify a significant risk to human health relating to soil vapour from the PHC groundwater plume.

Comments

Based on further email and telephone communications with the Ministry of the Environment, Conservation and Parks, they have requested the Municipality provide on a voluntary basis a remedial action plan to address the off-site PHC groundwater plume.

The recommended remedial strategy detailed in the attached report indicates that the remediation of the off-site groundwater plume is likely achievable via in situ amendment of on-site soil to promote enhanced aerobic bioremediation of the PHC/BTEX impacted groundwater plume at the down gradient of the site. The recommendation includes the use of an oxygen release compound (ORC) to oxygenate the groundwater emanating from the site. The ORC technology would be implemented through a network of trenches excavated on site and backfilled with the ORC and site soil.

The remediation work would be followed with longer-term environmental monitoring and would be required to assess the on-going effectiveness of the ORC application in reducing on- and off-site PHC and BTEX concentrations in groundwater. The proposed groundwater monitoring program is comprised of three elements:

- Establishing a “baseline” at or shortly after the time of ORC application
- Semi-annual monitoring and sampling of select groundwater wells to evaluate remedial performance
- Bi-annual groundwater quality monitoring to evaluate plume stability

The remediation and monitoring plan detailed in the attached report has been presented to the Ministry of Environment, Conservation and Parks and there is agreement in principle that the plan is acceptable. However, the Ministry wants to review the work plan in greater detail before the work is implemented.

As part of the consultation, Golder presented the Municipality with other remediation options. These options consisted primarily of excavating and removing between 1000 and 3000 tonnes of soil from the site. These options would have resulted in higher costs and likely potential for longer on-going monitoring of 10-15 years or more.

Areas of Strategic Focus and Critical Success Factors

The recommendations in this report support the following areas of strategic focus:

☒ Economic Prosperity:
Chatham-Kent is an innovative and thriving community with a diversified economy

☐ A Healthy and Safe Community:
Chatham-Kent is a healthy and safe community with sustainable population growth

☐ People and Culture:
Chatham-Kent is recognized as a culturally vibrant, dynamic, and creative community

☒ Environmental Sustainability:
Chatham-Kent is a community that is environmentally sustainable and promotes stewardship of our natural resources

The recommendations in this report support the following critical success factors:

☒ Financial Sustainability:
The Corporation of the Municipality of Chatham-Kent is financially sustainable

☒ Open, Transparent and Effective Governance:
The Corporation of the Municipality of Chatham-Kent is open, transparent and effectively governed with efficient and bold, visionary leadership

☐ Has the potential to support all areas of strategic focus & critical success factors

☐ Neutral issues (does not support negatively or positively)

Consultation

Legal Services was consulted in the preparation of this report.

Financial Implications

The estimated costs related to remediation and monitoring is $165,360 over a five year period. The costs will be funded from the Property Disposition Reserve.

Since 2013, Chatham-Kent has incurred $212,871 in expenses related to site clean-up, testing and monitoring on this property.

Prepared by:

Matt Torrance, MBA, CPA, CGA
Director, Financial Services

Reviewed by:

Gord Quinton, MBA, CPA, CGA
Chief Financial Officer, Treasurer

Attachment: Proposed Scope of Work, Golder

C: Dave Taylor, Director, Legal Services

P:\RTC\F&PS\Finance\2021\RTC023 - Environmental Property - 189 Elm St Bothwell

April 30, 2021 Proposal No. CX21450968-P01

Matt Torrance, MBA, CPA, CGA
Director, Financial Services
Municipality of Chatham-Kent
PO Box 640, 315 King Street West
Chatham, ON, N7M5K8

PROPOSED SCOPE OF WORK AND ESTIMATED COSTS
ENHANCED BIOREMEDIATION AND GROUNDWATER MONITORING
189 ELM STREET WEST, BOTHWELL, ONTARIO

Dear Mr. Torrance,

This proposal provides the Municipality of Chatham-Kent (the Municipality) with a work plan and cost estimate for Golder Associates Ltd. (Golder) to carry out groundwater remediation and environmental monitoring activities at 189 Elm Street West in Bothwell, Ontario (the "Site") (Figure 1).

1.0 BACKGROUND AND OBJECTIVES

1.1 Site Description and Investigation History

The Site is comprised of a vacant, 0.27 acre (approximately 1,100 square metres) property located in a primarily residential part of Bothwell, Ontario. The Site is bounded by Elm Street West to the north, Gordon Street North to the west, a residential property to the south, and a laneway, followed by residential properties to the east.

Environmental subsurface investigations and monitoring activities have been conducted at the Site by Golder since 2015[1], following the removal of a former underground storage tank (UST) and associated piping in 2014. Findings from the previous investigations suggested that historical operation of a gasoline service station on-site resulted in petroleum hydrocarbon (PHCs) impacts to on-site soil and groundwater quality characteristic of gasoline (PHC F1-F2 and benzene, toluene, ethylbenzene, and xylenes, collectively referred to as BTEX), most notably benzene.

In response to Provincial Order No. 8586-B2MNCT, dated September 20, 2018, issued by the Ministry of the Environment, Conservation and Parks (MECP), regarding the Site, a subsequent investigation was completed by Golder[2], between 2018 and 2019. The objectives of that investigation were to delineate the off-site PHCs and

[1] Golder Associates Ltd. 2015. "*Environmental Subsurface Investigation, 189 Elm Street West, Bothwell, Ontario*", dated October 2015. Prepared for the Municipality of Chatham-Kent. Golder reference number 1311340005-2000-R02.

[2] Golder Associates Ltd. 2020. "*Environmental Subsurface Investigation, 189 Elm Street West, Bothwell, Ontario*", dated March 2020. Prepared for the Municipality of Chatham-Kent. Golder reference number 1311340005-2000-R03.

BTEX soil and groundwater impacts, and to assess the soil vapour intrusion pathway and potential for indoor air quality impacts to the downgradient residential properties (i.e., 248 Gordon Street North [MN 248] and 188 Oak Street West [MN 188]) due to PHCs/BTEX-impacted soil and groundwater identified at the Site. The location of the Site, downgradient residences and historical sampling locations are illustrated on Figure 1.

Based on the analytical soil and groundwater data (provided in 2015 and 2020), PHCs/BTEX soil impacts originating from the Site extend south to the neighbouring property of 248 Gordon Street North, with off-site benzene impacts detected from the depth interval of 3.7 to 4.3 metres below ground surface (mbgs) which was below the groundwater table. A PHCs/BTEX-impacted groundwater plume was delineated from the Site to extend north, within the municipal roadway of Elm Street West, and to the south, to the downgradient properties at MN 248 and MN 188. Seasonal variability in PHCs/BTEX groundwater concentrations was observed in samples collected over the course of the investigation[3], and was attributed to potential dilution impacts related to precipitation, as indicated by the seasonal high groundwater elevations recorded in the winter and spring months (compared to lower groundwater elevations measured in the summer months). However, based on the PHCs/BTEX concentrations measured in soil vapour samples collected from MN 248 and MN 188, the PHCs/BTEX-impacted groundwater plume identified was not anticipated to pose a significant risk to indoor air quality at the downgradient residences.

Conclusions

Petroleum hydrocarbon impacts, originating at the Site and relating to historical service station and vehicle maintenance activities, have migrated via groundwater onto adjacent properties south of the Site: 248 Gordon Street North and 188 Oak Street West. The limits of the contaminant plume have been appropriately delineated and, as outlined above, the results of soil vapour sampling at both properties did not identify a significant risk to human health relating to soil vapour from the PHC groundwater plume.

However, based on email and telephone communications with the MECP, it is understood that they have requested that the Municipality provide, on a voluntary basis, a remedial action plan to address the off-site PHC groundwater plume.

Recommended Remedial Strategy

Based on Golder's experience on similar projects throughout southwestern Ontario, remediation of the off-site groundwater plume is likely achievable via in situ amendment of on-site soil to promote enhanced aerobic (natural) bioremediation of the PHC/BTEX impacted groundwater plume at and downgradient of the Site. The proposed remedial design includes the use of an oxygen release compound (ORC) to oxygenate the groundwater and enhance the rate of natural biodegradation of PHCs and BTEX in groundwater emanating from the Site. As detailed below, the ORC technology would be implemented through a network of trenches excavated on Site and backfilled with the ORC and Site soil. Following the remediation, longer-term environmental monitoring would be required to assess the on-going effectiveness of the ORC application in reducing on- and off-site PHC and BTEX concentrations in groundwater. A detailed scope of work and explanation of the proposed methods are provided in the following sections.

[3] As part of Golder's 2019 investigation, four groundwater monitoring events were conducted on November 8, 2018, February 22, 2019, July 23, 2019, and November 9, 2019.

1.2 Background on using ORC for Enhanced Aerobic Bioremediation

Enhanced aerobic bioremediation is an in-situ treatment that involves the addition of oxygen to the subsurface to accelerate the naturally occurring degradation of petroleum hydrocarbons by aerobic bacteria. A number of oxygen-delivery techniques are available, including ORCs, which have been known to increase the rate of biodegradation of PHCs from one to several orders of magnitude above natural biodegradation rates. The various technologies may be employed in both the saturated and unsaturated zone to remediate PHC constituents adsorbed to the soil matrix or dissolved in groundwater. Enhanced aerobic bioremediation technologies are mostly used to remediate light- to mid-weight petroleum products in the dissolved or adsorbed phase rather than heavier petroleum products or free-phase contamination. Enhanced biodegradation is relatively slow to remediate compared to other technologies and may or may not be able to reduce off-site groundwater concentrations to background or very low levels, especially if the PHCs source zones are still in place[4].

ORCs are one of the most commonly implemented techniques for enhanced aerobic bioremediation. The most common compounds include calcium and magnesium peroxides which slowly release oxygen when saturated by groundwater. ORCs may be introduced into the subsurface by, for example: placing the ORC directly in drilled boreholes or excavations; injecting an ORC slurry into direct-push boreholes; mixing ORCs with contaminated soil; or, suspending the ORC in permeable “socks” within monitoring wells (a combination of these approaches is also viable)[4].

Advantages for the use of ORCs for remediation is that they are relatively simple to employ with minimal engineering design and no mechanical or electrical requirements needed during operation, thereby keeping capital costs low and system operating costs negligible. However, effectiveness of the technology is dependent on the aquifer hydraulic regime since the additional oxygen is distributed throughout the aquifer largely through advective groundwater flow (i.e., effectiveness may be limited in low-permeability aquifers with small groundwater flow gradients).

Highly-adsorbed contaminants are difficult to remediate. The time required to reach remedial objectives may take from one to several years depending on the hydraulic regime and geochemistry, contaminant concentrations present and final remedial targets, resulting in the need for longer-term monitoring and associated costs. Further, while ORCs are considered non-toxic, impacts to groundwater chemistry (e.g., elevated groundwater pH) have potential to affect downgradient receptors as well as biodegradation products, although at this site there is not likely to be nearby receptors that are sensitive to elevated pH in groundwater.

Specific health and safety controls would be required during implementation of the ORC remedial design, such as isolation of the work areas from trespassers during the emplacement program and wearing of appropriate personal protective equipment (PPE) by site workers due to the high-pH of peroxide-based solids and slurries.

2.0 PROPOSED REMEDIAL STRATEGY AND SCOPE OF WORK

Based on the findings of Golder’s previous investigations at the Site, and our experience with using ORCs at similar sites, we propose that a network of excavations, backfilled below the water table with a mixture of calcium

[4] United States Environmental Protection Agency (EPA). *“How to Evaluate Alternative Cleanup Technologies for Underground Storage Tanks, A Guide for Corrective Action Plan Reviewers. Chapter XII Enhanced Aerobic Bioremediation”*. EPA 510-B-17-003, dated October 2017. Accessed online January 25, 2021.

peroxide ORC and native soils, be implemented at the Site. Details of the proposed remedial design are outlined in the following scope of work and are illustrated on Figure 1.

The proposed scope of work and associated costs for remediation at the Site consists of two main parts, (1) the remedial activities, and (2) the groundwater monitoring program, which are outlined separately below. Based on the time required for the enhanced aerobic bioremediation (via trenches backfilled with ORCs) to be effective, an initial 5-year groundwater monitoring program is proposed, with annual data interpretation and reporting to refine, if warranted, the monitoring network and/or sampling frequency for future years' monitoring work.

The work activities described herein will be conducted in accordance with Golder's Quality Assurance Plan (QAP) and Standard Operating Procedures (SOPs), and consistent with the groundwater monitoring activities carried out to date at the Site (and adjacent properties). All field work will be carried out by, or under, the full-time supervision of experienced Golder personnel.

2.1 Site Remediation Activities (Application of Oxygen Releasing Compound Material)

2.1.1 Remedial Design:

- **Outline:** We are proposing a preliminary design of 11 trench excavations (approximately 6-metres long by 3-metres wide in dimension at ground surface), placed in a staggered grid within the PHC and BTEX soil impacts and groundwater plume identified at the Site. Based on our previous investigations, we anticipate trenches excavated to depths ranging up to 3.0 to 3.5 mbgs would allow for emplacement of the ORC and soil mixture below the water table at a target depth of 2.5 to 3.0 mbgs.
- **Field Verification:** Final trench placement will be confirmed following a field survey, by Golder field staff, to mark out the proposed layout prior to trench excavation and ORC addition (as per Figure 1).
- **Final Design:** The final remedial design for the ORC implementation will be outlined, including a description of the final grading plan, for the Municipality's records, in the form of a technical memorandum.

2.1.2 Field Preparation and Execution:

- Preparation and implementation of a project-specific health and safety plan.
- **Contractor procurement**: For trench excavation, ORC addition and mixing in place, and trench backfilling and site restoration. The contractor will also be responsible for ensuring the clearance of underground utilities (public and private).
- **Procurement of ORC**: Based on our experience with other ORC applications, calcium peroxide powder (CALGRO™) will be procured for this project and delivered to the Site for emplacement within the excavated trenches.
- **Excavation, ORC Application and Site Restoration:** Excavation of the trenches will be scheduled to coincide with delivery of the ORC material, as outlined above. Following placement of the ORC materials, the trenches will be backfilled using excavated material from the Site. Shallow, visually non-impacted fill material will be segregated so that it is placed on top of each completed trench. It is estimated that the excavation, ORC placement and backfilling will be carried out over two days.

- **Import / Export of Soil Material:** Based on the proposed remedial strategy, no excess (i.e., surplus) soils are anticipated (i.e., that might require off-site management) and no additional backfill material will be imported to the Site.

2.2 Groundwater Monitoring Program

Based on the anticipated time for remediation of the soil and groundwater impacts to be achieved, an initial 5-year groundwater monitoring program is proposed which is to be initiated following the start of remediation. The proposed groundwater monitoring program is comprised of three elements: (1) establishing a "baseline" at (or shortly after) the time of ORC application; (2) semi-annual monitoring and sampling of select groundwater wells to evaluate remedial performance; and (3) bi-annual groundwater quality monitoring to evaluate plume stability.

The following table provides a general outline of the proposed 5-year monitoring program. Further details of the proposed scope of work are provided in the following sections.

Outline of 5-Year Groundwater Quality Monitoring Program

Year	Description

Year 1	• Baseline Groundwater Monitoring Program (post remediation/ORC application):
	  ○ *Initiate hydrogeological monitoring (groundwater elevations);*
	  ○ *Complete up to 2 rounds of groundwater sampling of core monitoring wells; and*
	  ○ *Complete up to 1 round of sampling sentry wells.*
	• Preparation of (1) annual monitoring report.

Year 2	• Semi-Annual Remedial Performance Monitoring
	  ○ *Continue hydrogeological monitoring (groundwater elevations);*
	  ○ *Complete up to 2 rounds of groundwater sampling of core monitoring wells.*
	• Preparation of (1) annual monitoring report.

Year 3	• Semi-Annual Remedial Performance Monitoring
	  ○ *Continue hydrogeological monitoring (groundwater elevations);*
	  ○ *Complete up to 2 rounds of groundwater sampling of core monitoring wells.*
	• Bi-Annual Plume Stability Monitoring
	  ○ *Complete up to 1 round of sampling sentry wells.*
	• Preparation of (1) annual monitoring report.

Year 4	• Semi-Annual Remedial Performance Monitoring
	  ○ *Continue hydrogeological monitoring (groundwater elevations);*
	  ○ *Complete up to 2 rounds of groundwater sampling of core monitoring wells.*
	• Preparation of (1) annual monitoring report.

Year 5	• Semi-Annual Remedial Performance Monitoring
	  ○ *Continue hydrogeological monitoring (groundwater elevations);*
	  ○ *Complete up to 2 rounds of groundwater sampling of core monitoring wells.*
	• Bi-Annual Plume Stability Monitoring
	  ○ *Complete up to 1 round of sampling sentry wells.*
	• Preparation of (1) annual monitoring report.

Monitoring Well Selection

To monitor the performance of the remedial approach, we propose to carry our groundwater monitoring and sampling at a sub-set of the existing monitoring wells. These wells have been identified as “core” or “sentry” monitoring wells:

- **Core Monitoring Wells:** Six of the existing monitoring wells at the Site and surrounding properties are proposed for semi-annual groundwater monitoring (corresponding to high- and low-water conditions) during the initial 5-year program to assess the effects of the ORC addition to groundwater chemistry (as an indication of potential biodegradation) and PHCs/BTEX concentrations. As shown on Figure 1, the proposed “core” monitoring wells include: MW-103, MW-104, MW-105, MW-207, MW-401 and MW-506 *(MW-401 and MW-506 are both located on private property).*
- **Sentry Monitoring Wells:** In addition to the six “core” monitoring wells, five off-site monitoring wells are proposed as part of a sentry well network. As shown on Figure 1, the proposed “sentry” monitoring wells include: MW-507, MW-508, MW-510, MW-512 and MW-517 *(MW-507, MW-508 and MW-517 are located on private property).*

2.2.1 Baseline Monitoring (Year 1):

As described in more detail below, an initial groundwater monitoring and sampling event is proposed to confirm the baseline conditions for the remedial program and to provide a benchmark for comparison of the longer-term groundwater monitoring results. This baseline will include a hydrogeological assessment as well as sample collection and laboratory analysis:

- **Hydrogeological Assessment:** An initial groundwater monitoring and sampling event is proposed to confirm the baseline conditions for the remedial program and to provide a benchmark for comparison of the longer-term groundwater monitoring results.

  Golder previously estimated[5] the groundwater flow velocity across the Site as being between 2.3 to 11.6 metres per year (m/year) using grain size distribution analysis (Hazen approximation[6]) and groundwater elevations measured in July 2015. However, we propose that single-well response tests be conducted at three existing monitoring wells at the Site and surrounding properties. The single-well responses tests will provide in situ measurement of the undisturbed granular materials at a more representative scale. Therefore, the hydraulic conductivity values obtained will be considered more representative than those previously obtained using the grain size methods.

  As part of the hydrogeological investigation, three of the core monitoring wells will be selected and instrumented with a battery-powered programmable data logging pressure transducer to record seasonal fluctuations in the groundwater table and the response of groundwater levels to precipitation events. The pressure transducers will be installed in Year 1, following completion of the remedial excavation and ORC application activities, and will be programmed for the duration of the 5-year monitoring program. The dataset will be included as part of the annual monitoring and reporting program described herein.

[5] Golder Associates Ltd. 2015. “*Environmental Subsurface Investigation, 189 Elm Street West, Bothwell, Ontario*”, dated October 2015. Prepared for the Municipality of Chatham-Kent. Golder reference number 1311340005-2000-R02.

[6] Freeze, R., & Cherry, J. (1979). *Groundwater*. Englewood Cliffs, New Jersey: Prentice-Hall, Inc.

- **Baseline Groundwater Quality Monitoring (Year 1):** To establish an initial "baseline" for groundwater quality, groundwater samples will be collected from each of the six "core" monitoring wells and five "sentry" wells (11 locations in total) following the installation of the ORC material. Depending on the timing of the ORC installation, a second (semi-annual) groundwater monitoring event (limited to the "core" monitoring wells) will also be carried out in Year 1. The purpose of the semi-annual monitoring (proposed to correspond to relatively high- and low-water conditions) is to help inform future years' sampling schedule and frequency to ensure the most representative (i.e., reduced possible dilution impacts to the analytical dataset) groundwater samples are being collected.

  Groundwater samples will be collected from the core and sentry wells and submitted for laboratory analysis of PHCs and BTEX. As part of the baseline (Year 1) sampling events, groundwater elevations from all on- and off-site wells will be recorded and data from the self-logging pressure transducers (installed as part of the hydrogeological program for long-term monitoring) will be retrieved. Further, during each sampling event, parameters relating to (potential) biodegradation (such as dissolved oxygen, pH, oxidation reduction potential and electrical conductivity) will be measured in the field.

- **Year 1 Reporting:** An investigation and findings report for the hydrogeological investigation and baseline groundwater sampling will be provided to the Municipality, in accordance with the schedule outlined herein.

2.2.2 Remedial Performance Monitoring – Semi-Annual Groundwater Monitoring (Years 2 to 5)

As a continuation of the baseline groundwater quality monitoring outlined above, we propose to monitor groundwater quality at each of the six "core" monitoring wells on semi-annual basis over the course of the 5-year monitoring program. The objective of the semi-annual monitoring at these core locations is to evaluate the performance of the remedial strategy (i.e., the effectiveness of the ORC application over time). *Note: Should conditions suggest that twice-annual monitoring is no longer warranted, the monitoring and sampling frequency may be reduced to just once per year.*

- **Groundwater Quality Monitoring:** For the semi-annual sampling, groundwater samples will be collected from each of the six "core" monitoring wells during inferred "high- and low-water" seasons (anticipated to be winter/spring and summer).

  As with the baseline sampling, groundwater samples will be collected from the core wells and submitted for laboratory analysis of PHCs and BTEX, and groundwater quality parameters indicative of bio-degradation activity will be measured in the field. Groundwater elevations from all on- and off-site wells will be recorded and data from the self-logging pressure transducers (installed as part of the hydrogeological program for long-term monitoring) will be retrieved.

- **Reporting for Remedial Performance Monitoring:** Following each semi-annual sampling event, Golder will inform the Municipality, via email, whether (or not) the interim findings warrant any material changes to the overall monitoring program. Comprehensive, and detailed, findings from each year's groundwater monitoring activities will be provided to the Municipality at the end of each calendar year in a report suitable for provision to the MECP. Based on the monitoring data to that point, the report will evaluate the observable effect of the ORC-enhanced bioremediation on the footprint of the PHC and BTEX groundwater plume. Recommendations for changes to the monitoring program (i.e., sampling locations, frequency), if any, will be provided for discussion and consideration of the Municipality and MECP.

2.2.3 Plume Stability Monitoring – Bi-Annual Groundwater Monitoring (Years 3 and 5)

As a continuation of the baseline groundwater quality monitoring outlined above, and complementary to the remedial performance monitoring, we also propose to continue to monitor groundwater quality at the five selected "sentry" wells on bi-annual basis over the course of the 5-year monitoring program. The objective of the semi-annual monitoring at these core locations is to evaluate the performance of the remedial strategy (i.e., the effectiveness of the ORC application over time). Based on the nature of the remediation technology and aquifer hydrogeological regime at the Site, we anticipate there would be significant reductions in the PHC and BTEX off-site groundwater concentrations within two to three years once the ORC is implemented, and thus, a reduced sampling frequency may be considered acceptable for the broader well network.

- **Groundwater Quality Monitoring:** For the bi-annual sampling event, we propose to collect the groundwater samples from each of the five "sentry" monitoring wells during the inferred "low-water" seasons (anticipated to be the summer sampling event, and at the same time that the six designated "core" monitoring wells are sampled). As with the baseline sampling, groundwater samples will be collected from the sentry wells and submitted for laboratory analysis of PHCs and BTEX, and groundwater quality parameters indicative of bio-degradation activity will be measured in the field. Groundwater elevations from all on- and off-site wells will be recorded and data from the self-logging pressure transducers (installed as part of the hydrogeological program for long-term monitoring) will be retrieved.
- **Reporting for Plume Stability Monitoring:** For each bi-annual sampling event, comprehensive, and detailed, findings from each year's groundwater monitoring activities will be provided to the Municipality at the end of each calendar year in a report suitable for provision to the MECP. The bi-annual reports will also include the collective findings from that year's semi-annual monitoring (i.e., a maximum of one report per year will be prepared in support of the overall groundwater monitoring activities), along with recommendations, if any, for changes to the monitoring program.

3.0 SCHEDULE OF KEY YEAR 1 MILESTONES AND PROPOSED DELIVERABLES

Golder is prepared to initiate the proposed scope of work upon receipt of written authorization to proceed (Appendix A). Pending subcontractor availability and barring any significant weather-related delays, or delays in accessing downgradient private properties (for the groundwater monitoring component of the work), we propose to complete tasks associated with the first year of the remediation and monitoring program (i.e., pre-remediation investigations, remedial design implementation, and seasonal groundwater monitoring) in accordance with the schedule below.

Week 1 of the schedule would commence the week after project award (i.e., receipt of signed authorization to proceed or Purchase Order with mutually agreeable Terms and Conditions).

Task / Milestone	Schedule
Project start-up and initiate preliminary planning, establish tentative ORC delivery / procurement schedule, establish project schedule.	Week 1
Initiate preliminary consultation with MECP *(provide overview of remedial strategy and monitoring plan).*	Week 2

Task / Milestone	Schedule
Site reconnaissance and field verification *(confirm layout for ORC trenches).*	Week 2
Initiate procurement of excavation contractor and ORC materials.	Week 3
Provide final remedial design (***technical memorandum***) to Municipality for review and final approval.	Week 4
Prepare detailed Health and Safety Planning *(for construction).* Contractor to initiate public and private utility locates. Initiate notification of private property owners to secure access (for future groundwater sampling events).	Week 5
Allow up to two weeks for consultation with MECP on remedial strategy and monitoring plan.	Weeks 5-6
Implementation of remedial design *(placement of ORC material in excavated trenches).*	Week 8
Initiate baseline (**Year 1**) hydrogeological study and carry out initial groundwater quality monitoring ("core" and "sentry" well locations). *Preliminary findings from initial sampling (**technical email**) to be provided following receipt of all analytical data.*	Weeks 9-10
Carry out semi-annual performance monitoring: groundwater monitoring event (core well network only) *(assume minimum of 4 months following initial sampling event, anticipate Fall). Preliminary findings from fall sampling (**technical email**) to be provided following receipt of all analytical data.*	Fall 2021 (2 weeks)
Year 1 Summary Report *(technical report summarizing the remedial activities carried out, the findings from the baseline hydrogeological and results of all groundwater quality monitoring carried out)*	Year End 2021 (December)

*Project deliverables are indicated in **bold.***

4.0 SPECIAL CONSIDERATIONS

Golder has adopted (COVID-19 related) field protocols that are consistent with current guidance being provided by the Provincial and Federal public health authorities and are considered protective of the health of Golder's staff, our subcontractors and the public. However, as a result of the COVID-19 pandemic, conditions are subject to change prior to the start of the field program which may have implications for the cost and schedule of the project.

5.0 LIMITATIONS

This letter was prepared for the exclusive use of the Municipality of Chatham-Kent. It is intended to provide a proposed scope of work and costs for an enhanced bioremediation and groundwater monitoring program at 189 Elm Street west in Bothwell, Ontario, at the time that these work tasks are to be completed. Any use of this document by any party other than the Municipality of Chatham-Kent is at the sole risk of such user. Any reliance upon this letter by any party other than the Municipality of Chatham-Kent requires the prior written approval of Golder.

There is no warranty, expressed or implied, by Golder that this proposed scope of work and costs for an enhanced bioremediation and groundwater monitoring program has identified all potential hazards or environmental conditions related to the proposed work at the Site, nor that all issues of environmental compliance or all potential workplace hazards have been addressed. The review of the assessed environmental conditions by others and the interpretation of potential hazards or environmental concerns related to the proposed enhanced bioremediation and groundwater monitoring program at the Site has been made using our understanding of the current Ontario regulations, as well as the results of the chemical analysis of soil and groundwater samples collected at the tested locations within the Study Area (including the Site). This proposed scope of work and costs for an enhanced bioremediation and groundwater monitoring program must be considered in its entirety and no assurance is made regarding changes in conditions subsequent to the time of the environmental investigations and subsequent to this enhanced bioremediation and groundwater monitoring program being completed for the Site.

The environmental conditions described in the historical reports for the Site have been inferred based on conditions observed at a limited number of sampling locations in accessible areas; however, it should be noted that conditions between and beyond sampling locations may vary. In addition, the environmental assessments are dependent upon the accuracy of the analytical data generated through sample analysis and are limited to determining the presence of contaminants for which analyses have been conducted.

Where references have been made to regulatory guidelines and documents, it should be noted that regulatory statutes and guidelines are subject to interpretation and that these guidelines and documents, and their interpretations, may be subject to change over time.

Golder accepts no responsibility for the consequential effects of this proposed scope of work and costs for an enhanced bioremediation and groundwater monitoring program on the real or perceived property value of the Site, on its saleability, or on the ability to gain financing. If new information is discovered during future work, including excavations, borings or other studies, Golder should be requested to re-evaluate the findings and recommendations presented in this letter and any associated Golder reports, and to provide amendments as required.

6.0 CLOSING

We appreciate this continuing opportunity to be of service to the Municipality of Chatham-Kent. It is understood that the work, as proposed herein, will be conducted in accordance with Golder's Authorization to Proceed and Consulting Services Agreement (**Appendix A**). If the terms of this proposal are acceptable to you, please return a signed copy of the attached Authorization to Proceed form to the undersigned. If you have any questions or are in need of additional information to assist in your consideration of this proposal, please feel free to contact Mr. Carl Schroeder (at 519-652-0099).

The estimated cost to carry out the proposed scope of work, including implementation of the enhanced aerobic bioremediation and Year 1 of the groundwater monitoring program (including pre-remediation hydrogeological investigation), is outlined in **Appendix B**. For reference purposes, potential costs for the Year 2 to Year 5 groundwater monitoring activities are also outlined in Appendix B.

Please be aware that Golder has been acquired by and is now a Member of the WSP family of companies. Golder remains a legal entity and is the proposing contracting entity for this proposal. We are in the process of integrating the resources of our companies. Correspondence for this proposal should continue to be addressed to the undersigned.

Yours truly,

Golder Associates Ltd.

Carl Schroeder, M.A.Sc., P.Eng.
Senior Environmental Engineer

Mike Z'Graggen, M.R.M, QPRA
Associate, Environmental Risk & Toxicology

VT/JCC/MZG/ly

Attachments: Attachment A – Authorization to Proceed
Attachment B – Estimated Costs for Proposed Scope of Work
Figure 1 – Proposed Remedial Excavation Layout and Monitoring Plan

cx21450968-p01-rev0-ck rem_bothwell_apr 30 21

APPENDIX A

Authorization to Proceed

Municipality of Chatham-Kent ("Client") and Golder Associates Ltd. ("Golder") agree that the following terms and conditions will apply to any services, including subsequent services and changes, (collectively "Services") to be provided by Golder relating to Proposal No. CX21450968-P01, dated April 30, 2021 (collectively the "Agreement"):

1) **Standard of Care.** Services performed by Golder will be conducted in a manner consistent with that level of care and skill ordinarily exercised by other professionals currently practicing under similar conditions in the same locality, subject to the time limits and financial, physical or other constraints applicable to the Services. No warranty, express or implied is made.

2) **Invoices and Payment Terms.** Unless otherwise specified in the proposal, Golder will submit monthly invoices to Client and a final bill upon completion of Services. Client shall notify Golder within ten (10) days of receipt of invoice of any dispute with the invoice and the parties shall promptly resolve any disputed items. Full payment is due prior to delivery of Golder's final deliverable. Payment on undisputed invoice amounts is due upon receipt of invoice by Client and is past due thirty (30) days from the date of the invoice. Client agrees to pay a finance charge of one and one-half percent (1-1/2%) per month (18% per annum), or the maximum rate allowed by law, on past due accounts. If payment remains past due sixty (60) days from the date of the invoice, then Golder shall have the right to suspend or terminate all Services under this Agreement, without prejudice or penalty. Client will pay all reasonable demobilization and other suspension or termination costs. Client agrees to pay all legal and collection costs incurred by Golder in pursuit of past due payments. Where the cost estimate for the Services is "not to exceed" a specified sum, Golder shall notify Client before each limit is exceeded, and shall not continue to provide Services beyond such limit unless Client authorizes an increase in the amount of the limitation. If a "not to exceed" limitation is broken down into budgets for specific tasks, the task budget may be exceeded without Client authorization as long as the total limitation is not exceeded.

3) **Changes.** Client and Golder recognize that it may be necessary to modify the scope of Services, schedule, and/or cost estimate proposed in this Agreement. Such changes shall change the Services, schedule, and/or the cost, as may be equitable under the circumstances. If after a good faith effort by Golder to negotiate modifications to the scope of Services, schedule, and/or cost estimate, an agreement has not been reached with the Client, then Golder shall have the right to terminate this Agreement, without prejudice or penalty, upon written notice to the Client.

4) **Delays and Force Majeure.** If site or other conditions prevent or inhibit performance of Services or if unrevealed hazardous waste materials or conditions are encountered, Services under this Agreement may be delayed. Client shall not hold Golder responsible for damages or delays in performance caused by acts or omissions of Client, its subcontractors, governmental authorities, regulatory agencies, civil or labour unrest, acts of God, nature, or terror, disruptions of the Internet, Golder's electronic, telecommunications or hosting services or any other events that are beyond the reasonable control of Golder. In the event of any such delay, the contract completion date shall be extended accordingly and Client shall pay Golder for Services performed to the delay commencement date plus reasonable delay charges. Delay charges shall include personnel and equipment rescheduling and/or reassignment adjustments and all other related costs incurred including but not limited to, labour and material escalation, and extended overhead costs, attributable to such delays. Delays in excess of thirty (30) days within the scope of this Article shall, at the option of either party, make this Agreement subject to termination or to renegotiation.

5) **Independent Judgments of Client.** If the Services include the collection of samples and data, then Golder's performance of the Services is subject to Client's assumption of all Subsurface Risks (such risks being more fully described in Article 12), Subsurface Risks). Golder will not be responsible for the independent conclusions, interpretations or decisions of Client, or others, relating to the Services. Under no circumstances do Golder's Services include making any recommendation, or giving any advice as to whether Client should or should not proceed with any transaction regarding any site related to the Services. Client assumes all responsibility and risk associated with decisions it makes based on the Services.

6) **Indemnification**

a) **Indemnification by Golder.** Golder agrees to indemnify Client and its officers, directors, and employees from and against all claims, damages, losses or expenses (including but not limited to reasonable legal fees) arising from personal injury, death, or damage to third-party property to the extent that all claims, damages, losses or expenses are finally determined to result directly from Golder's negligence. Such indemnification, as limited by Article 7) Limitation of Liability, shall be Client's sole and exclusive remedy against Golder.

b) **Indemnification by Client.** To the fullest extent permitted by law, Client shall defend, indemnify and hold Golder (and its parent, subsidiary and affiliate entities, subcontractors, and consultants, and their respective officers, directors, agents and employees) harmless from and against any and all actual or alleged claims, damages (including incidental, consequential, indirect and special damages), losses and expenses (including but not limited to all penalties, attorneys' fees, fines and administrative or civil sanctions, and court and arbitration costs), including but not limited to claims by third parties, arising out of, related to, or resulting from (i) bodily injury or property damage, (ii) economic loss; (iii) investment decisions of Client or third parties in reliance upon Golder's Services, and/or (iv) the acts, errors or omissions of Client, its employees, agents, contractors and subcontractors or others. Provided however, that the foregoing obligations to indemnify and hold harmless shall only apply to the extent such claims, damages, losses, and expenses exceed Golder's limitation of liability as set forth in Article 7 of this Agreement.To the fullest extent permitted by law, such indemnification shall apply regardless of any Golder breach of contract, tort (including negligence), strict liability or any other breach of an obligation or duty under this Agreement or applicable law and whether or not the claim has merit. This provision shall survive Golder's completion of the Services and any termination or expiration of this Agreement.

7) **Limitation of Liability. Client agrees to limit the liability of Golder, its affiliates, and their respective employees, officers, directors, agents, consultants and subcontractors ("Golder Group") to Client, its employees, officers, directors, agents, consultants and subcontractors, whether in contract, tort, or otherwise, which arises from Golder's acts, negligence, errors or omissions, such that the total aggregate liability of the Golder Group to all those named shall not exceed Fifty Thousand Dollars ($50,000) or Golder's total fee for the Services rendered under this Agreement, whichever is greater. Neither party shall be**

responsible to the other for lost revenues, lost profits, cost of capital, claims of customers, loss of data or any other special, indirect, consequential or punitive damages.

8) **Insurance.** Golder maintains insurance coverage with the following limits:

a) Workers' Compensation (statutory limits)
b) Automobile Liability: $1,000,000
c) Commercial General Liability:

Each Occurrence: $1,000,000

Policy Aggregate: $2,000,000

d) Professional Liability Insurance

Any One Claim: $1,000,000

Policy Aggregate: $3,000,000

9) **Professional Work Product.** The Services provided by Golder are intended for one time use only. All documents, including but not limited to, reports, plans, designs, boring logs, field data, field notes, laboratory test data, calculations, and estimates and all electronic media prepared by Golder are considered its professional work product (the "Documents"). Golder retains all rights to the Documents. Client understands and acknowledges that the Documents are not intended or represented by Golder to be suitable for reuse by any party, including, but not limited to, the Client, its employees, agents, subcontractors or subsequent owners on any extension of a specific project not covered by this Agreement or on any other project, whether Client's or otherwise, without Golder's prior written permission. Any reuse unauthorized by Golder will be at Client's sole risk.

10) **Data and Information.** Client shall provide to Golder all reports, data, studies, plans, specifications, documents and other information ("Project Information") which are relevant to the Services. Golder shall be entitled to rely upon the Project Information provided by Client or others, and Golder assumes no responsibility or liability for the accuracy or completeness of such or the impact any inaccurate Project Information may have on Golder's Services.

11) **Right of Entry.** Client will provide for the right of entry for Golder, its subcontractors, and all necessary equipment in order to complete the Services under this Agreement. If Client does not own the site, Client must obtain permission and execute any required documents for Golder to enter the site and perform Services. It is understood by Client that in the normal course of work some surface damage may occur, the restoration of which is not part of this Agreement.

12) **Subsurface Risks -** Special risks, including but not limited to injury to underground structures or utilities and unavoidable contamination, occur whenever engineering or related disciplines are applied to identify subsurface conditions. Even a comprehensive sampling and testing program implemented in accordance with a professional Standard of Care may fail to detect certain conditions. The environmental, geological, geotechnical, geochemical, hydrogeological and other conditions that Golder interprets to exist between and beyond sampling points may differ from those that actually exist.

13) **Disposal of Samples, Materials and Contaminated Equipment.** All samples obtained pursuant to this Agreement remain the property and responsibility of Client. Uncontaminated soil and rock samples or other specimens may be disposed of thirty (30) days after submission of the directly related work product, due pursuant to the proposal. All contaminated samples, materials and equipment (containing or potentially containing hazardous constituents), including, but not limited to soil cuttings, contaminated purge water, and/or other environmental wastes obtained pursuant to this Agreement remain the property and responsibility of Client and shall be returned to Client for proper disposal. Alternate arrangements to assist Client with proper disposal of such equipment, materials and/or samples may be made at Client's direction and expense.

14) **Control of Work and Job-Site Safety.** Golder shall be responsible only for the activities of its employees and subcontractors. Golder's Services under this Agreement are performed for the sole benefit of the Client and no other entity shall have any claim against Golder because of this Agreement or the performance or non-performance of Services hereunder. Golder will not direct, supervise or control the work of other consultants and contractors or their subcontractors. Insofar as job site safety is concerned, Golder is responsible only for the health and safety of its employees and subcontractors. Nothing herein shall be construed to relieve Client or any other consultants or contractors from their responsibilities for maintaining a safe job site. Golder shall not advise on, issue directions regarding, or assume control over safety conditions and programs for others at the job site.

15) **Public Responsibility.** Golder will endeavour to alert Client to any matter of which Golder becomes aware and believes requires Client's immediate attention to help protect public health and safety, or which Golder believes requires Client to notify others, or to otherwise conform with applicable codes, standards, regulations or ordinances. If Client decides to disregard Golder's recommendations in these respects, (i) Golder shall determine in its sole judgment if it has a duty to notify public officials, and (ii) Golder has the right to immediately terminate this Agreement upon written notice to the Client and without penalty.

16) **Notification and Discovery of Hazardous Materials.** Prior to commencing the Services and as part of Project Information defined in Article10), Data and Information, Client shall furnish to Golder all documents and information known to Client that relate to past or existing conditions of the site and surrounding area, including the identity, location, quantity, nature or characteristics of any hazardous materials or suspected hazardous materials or subterranean utilities. Golder may rely on such information and documents. Client hereby warrants that, if it knows or has any reason to assume or suspect that hazardous materials may exist at the project site, it has so informed Golder. Client recognizes that hazardous materials or suspected hazardous materials may be discovered on the project site property or on surrounding properties.

17) **Termination.** Either party may terminate this Agreement as a result of a material breach of the other party if the other party does not commence and continue to cure the breach within thirty (30) days of receipt of written notice of the breach from the non breaching party. In the event of termination, Golder shall be paid for Services performed to the termination notice date, reasonable termination expenses, and a portion of its anticipated profits not less than the percentage of the contract services performed as of the termination notice date. Golder may complete such analyses and records as are necessary to complete its files and may also complete a report on the Services performed to the date of notice of termination or suspension. The expenses of termination or suspension shall include all direct costs of Golder in completing such analyses, records and reports.

18) **Intellectual Property.** To the extent that the Services involve Golder providing Client with the right to use or access proprietary Golder software, programs, information management solutions, hosting services, technology, information or data ("Golder Products"), Golder grants Client during the term of the project a non-exclusive, non-transferable, non-assignable license to use the Golder Products for Client's internal purposes, solely in connection with the Services. Except for this limited license, Golder expressly reserves all other rights in and to the Golder Products. To the extent that the Services involve Client providing Golder with the right to use or access proprietary Client software, programs, technology, information or data ("Client Product"), Client grants Golder a perpetual, non-exclusive, non-transferable, non-assignable, royalty free world-wide license to use and access the Client Product as necessary to provide Client with Services. Golder shall own all Intellectual Property (as hereinafter defined) associated with the Services and the Golder Products together with any modifications, updates or enhancements to said Intellectual Property and grants no right or license to such Intellectual Property to Client except as expressly provided in this Agreement. Client conveys to Golder any interest in any such Intellectual Property rights that, notwithstanding the foregoing, would otherwise be deemed by law to vest in Client. "Intellectual Property" includes patents, patent applications, trademarks, trademark applications, copyrights, moral rights or other rights of authorship and applications to protect or register the same, trade secrets, industrial rights, know-how, privacy rights and any other similar proprietary rights under the laws of any jurisdiction in the world. Golder may use and publish the Client's name and give a general description of the Services rendered by Golder for the purpose of informing other clients and potential clients of Golder's experience and qualifications.

19) **Electronic Information.** Client acknowledges that electronic media is susceptible to unauthorized modification, deterioration, and incompatibility and therefore Client cannot rely upon the electronic media versions of the Documents. In the event of any discrepancy, Golder's hardcopy shall prevail.

20) **Miscellaneous**

a) This Agreement supersedes all other agreements, oral or written, and contains the entire agreement of the parties. No cancellation, modification, amendment, deletion, addition, waiver or other change in this Agreement shall have effect unless specifically set forth in writing signed by the party to be bound thereby. Titles in this Agreement are for convenience only.

b) This Agreement shall be binding upon and inure to the benefit of the parties hereto and their respective successors and assigns provided that it may not be assigned by either party without consent of the other. It is expressly intended and agreed that no third party beneficiaries are created by this Agreement, and that the rights and remedies provided herein shall inure only to the benefit of the parties to this Agreement.

c) Client acknowledges and agrees that Golder can retain subconsultants, who may be affiliated with Golder, to provide Services for the benefit of Golder. Golder will be responsible to Client for the Services and work done by all of its subconsultants and subcontractors, collectively to the maximum amount stated in Article 7) Limitation of Liability. Client agrees that it will only assert claims against and seek to recover losses, damages or other liabilities from Golder and not Golder's affiliated companies. To the maximum extent allowed by law, Client acknowledges and agrees it will not have any legal recourse, and waives any expense, loss, claim, demand, or cause of action, against Golder's affiliated companies, and their employees, agents, officers and directors.

d) No waiver of any right or remedy in respect of any occurrence on one occasion shall be deemed a waiver of such right or remedy in respect of such occurrence on any other occasion.

e) All representations and obligations (including without limitation the obligation of Client to indemnify Golder in Article 6) and the Limitation of Liability in Article 7) shall survive indefinitely the termination of the Agreement. Client acknowledges that it may not use Golder's name or any reference to the Services in any press release or public document without the express, written consent of Golder.

f) Any provision, to the extent found to be unlawful or unenforceable, shall be stricken without affecting any other provision of the Agreement, so that the Agreement will be deemed to be a valid and binding agreement enforceable in accordance with its terms.

g) All questions concerning the validity and operation of this Agreement and the performance of the obligations imposed upon the parties hereunder shall be governed by the laws of _____unless the law of another jurisdiction must apply for this Agreement to be enforceable.

h) All notices required or permitted to be given hereunder, shall be deemed to be properly given if delivered in writing via facsimile machine, e-mail, regular mail, hand delivery or express courier addressed to Client or Golder, as the case may be, at the addressee set forth below in regard to the Client, and as listed on the Proposal in regard to Golder, with postage thereon fully prepaid if sent by mail or express courier.

21) **Authorization to Proceed.** By signing below, Client hereby authorizes Golder to proceed with the Services as outlined in the proposal (referenced above) and in accordance with this Agreement, which includes terms relating to **payment, limitation of liability, insurance and indemnity**, among many other important provisions. Client also represents that any "purchase order" type document which Client may issue subsequent to executing this Agreement, shall be for administrative or accounting convenience only, and that any terms or conditions attached thereto shall not apply, and that all services shall be solely governed by the presently executed agreement.

IN WITNESS WHEREOF, the parties have caused this Agreement to be signed, as of the date and year first set forth above.

GOLDER ASSOCIATES LTD.	Municipality of Chatham-Kent
Signature	Signature
Name:	Name:
Title:	Title:
	Address Invoices to:
Proposal No.: CX21450968-P01	
Proposal Date: April 30, 2021	

APPENDIX B

Estimated Costs for Proposed Scope of Work

SUMMARY OF ESTIMATED COSTS

The following table provides a breakdown of the estimated costs (exclusive of applicable taxes) to implement the enhanced aerobic bioremediation remedial design (Phase 1000), to carry out the hydrogeological investigation and complete Year 1 of the groundwater monitoring program (including hydrogeological assessment) (Phase 2000). As noted, the total cost for the first year of the project is **$103,100** (exclusive of applicable taxes), for which $81,750 is attributed to the remedial program and $21,350 is attributed to the Year 1 (baseline) groundwater monitoring program.

Estimated Costs - Year 1, Remedial Design Implementation and Baseline Groundwater Monitoring

Project Phase / Task	Description	Total Cost
1000	**Enhanced Bioremediation – ORC Application**	
Task 1.1	PM and General Communications *(allowance)*	$1,250
Task 1.2	Regulatory Consultations *(allowance, specific to remedial planning and design consultations)*	$1,500
Task 1.3	Procurement, Planning and Preparation of Remedial Design *(Technical Memo)*	$6,000
Task 1.4	Grid Layout, On-Site Supervision (during implementation)	$7,500
Task 1.5	Contractor Mobilization/Demobilization and ORC Implementation *(excavation/backfill)*	$18,000
Task 1.5	ORC Materials *(assuming six 2,200 lb pallets across 11 trenches)*	$40,000
Task 1.6	Contingency (allow 10%)	$7,500
	Phase 1000 Total Cost	**$81,750**
2000	**Baseline Groundwater Quality Monitoring – Year 1** *(assumes up to two sampling events in Year 1)*	
Task 2.1	PM and Communications	$1,500
Task 2.2	Regulatory Consultations *(annual allowance, specific to annual monitoring)*	$1,500
Task 2.3	Engineering and Field Activities *(two sampling events)*	$5,000
Task 2.4	Data Evaluation and Reporting	$5,500
Task 2.5	Golder Expenses	$4,500
Task 2.6	Laboratory Analysis	$2,600
Task 2.7	Waste Management Allowance (investigation derived wastes, Year 1)	$750
	Phase 2000 Total Cost	**$21,350**
	Total Project Cost (Year 1)	**$103,100**

Alternate Cost Item – Groundwater Monitoring Program Years 2 to 5

Estimated total costs (exclusive of applicable taxes) for subsequent years of the groundwater monitoring program (as outlined in the above sections) are estimated to range between $13,600 to $16,100 per year, depending on whether sampling events for the core well network (years 2 to 5) and/or sentry well network (years 3 and 5) are scheduled. As part of the annual groundwater monitoring and reporting program, Golder will review the monitoring event scope (in terms of sampling locations and monitoring frequency) and recommend changes, if any. Therefore, it is noted that future years' monitoring (and therefore costs) may be revised based on the results obtained during the first year of monitoring. For future years' monitoring (i.e., beyond Year 1 of the program), Golder will provide a separate Change of Scope Request outlining the annual monitoring plan with a detailed cost estimate and supporting rationale for the Municipality's consideration.

Scope of Work and Estimated Total Annual Costs (Years 2 to 5)

Year	Description	Total Estimated Cost
Year 2	• Semi-Annual Remedial Performance Monitoring *(2 rounds of groundwater sampling, core monitoring wells)* • Preparation of (1) annual monitoring report.	$13,600
Year 3	• Semi-Annual Remedial Performance Monitoring *(2 rounds of groundwater sampling, core monitoring wells)* • Bi-Annual Plume Stability Monitoring *(1 round of groundwater sampling, sentry monitoring wells)* • Preparation of (1) annual monitoring report.	$16,100
Year 4	• Semi-Annual Remedial Performance Monitoring *(2 rounds of groundwater sampling, core monitoring wells)* Preparation of (1) annual monitoring report.	$13,600
Year 5	• Semi-Annual Remedial Performance Monitoring *(2 rounds of groundwater sampling, core monitoring wells)* • Bi-Annual Plume Stability Monitoring *(1 round of groundwater sampling, sentry monitoring wells)* • Preparation of (1) annual monitoring report.	$16,100
	Total Project Cost (Years 2 to 5)	**$59,400**

Breakdown of Estimated Annual Costs (Years 2 to 5)

Project Task	Description	Estimated Cost (Year 2 & 4)	Estimated Cost (Year 3 & 5)
Task 1	PM and Communications *(annual allowance)*	$1,500	$1,500
Task 2	Regulatory Consultations *(annual allowance)*	$1,500	$1,500
Task 3	Engineering and Field Activities *(2 sampling events per year)*	$3,750	$4,250
Task 4	Data Evaluation and Reporting (letter report)	$2,500	$4,000
Task 5	Golder Expenses	$1,500	$1,500
Task 6	Laboratory Analysis	$2,100	$2,600
Task 7	Waste Management Allowance (investigation derived wastes, annual)	$750	$750
	Total Annual Cost	**$13,600**	**$16,100**

Client: Municipality of Chatham-Kent

Original Format is Tabloid 279mm x 432mm

25mm

0

DRAFT

ANNOTATED MARK-UP FOR PRELIMINARY CONSIDERATION PURPOSES

MN 178 (UNITED CHURCH OF CANADA)

MN 169

MN 175

MN 160 (BREWER'S RETAIL)

MN 190

MN 188

MN 248

GM 1-1/4" PE

10" W/M

ELM STREET WEST

OAK STREET WEST

GM 2" ST

GORDON STREET NORTH

SITE (MN 189)

FORMER GARAGE (DEMOLISHED 2009)

FORMER FUEL PUMP ISLAND

FORMER UNDERGROUND TANK

ORC FILLED TRENCH

CORE MONITORING WELL

SENTRY MONITORING WELL

BH-204/SP-204

BH-205/SP-205

BH-206/SP-206

BH-203/SP-203

BH-301/SP-301

BH-306/SP-306

BH-202/SP-202

BH-201/SP-201

MW-501 97.05m

MW-502 97.05m

MW-503 97.05m

MW-504 97.03m

MW-505 97.03m

MW-506 97.01m

MW-507 97.01m

MW-508 97.02m

MW-509 96.99m

MW-510 96.99m

MW-511 96.98m

MW-512 96.92m

MW-513 96.90m

MW-514 96.94m

MW-515 96.97m

MW-516 96.80m

MW-517 96.97m

MW-103 97.02m

MW-104 97.16m 97.01m

MW-105 97.70m 97.02m

MW-113 97.67m 97.02m

MW-114

MW-207 97.67m 97.02m

MW-401 97.68m 97.02m

MW-402 97.62m 96.98m

SP-302

SP-303

SP-304

SP-305

SP-307

SP-308

SP-309

SP-310

SP-311

VP-401B

VP-506

VP-517

FH

SCALE IN METRES
0 5 10m
1:400

LEGEND

- APPROXIMATE PROPERTY BOUNDARY
- MONITORING WELL
- VAPOUR MONITOR
- SCREEN POINT SAMPLING (SP 16)
- BOREHOLE/SCREEN POINT
- FH — FIRE HYDRANT
- 97.66m — MEASURED WATER LEVEL - m amsl (FEBRUARY 22, 2019)
- 97.02m — MEASURED WATER LEVEL - m amsl (AUGUST 19, 2019)
- INFERRED SHALLOW GROUNDWATER FLOW DIRECTION

ANALYTICAL LEGEND

GROUNDWATER (NOVEMBER 2018 - NOVEMBER 2019 DATA):

- PHC/BTEX CONCENTRATIONS BELOW MECP TABLE 3 AND TABLE 7 SCS
- PHC/BTEX CONCENTRATIONS EXCEED MECP TABLE 3 AND TABLE 7 SCS
- PHC/BTEX CONCENTRATIONS EXCEED MECP TABLE 7 SCS AND BELOW TABLE 3 SCS
- MONITORING WELL NOT SAMPLED IN 2018 OR 2019 (NOT FOUND)

NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.
2. FUEL RETAILING INFRASTRUCTURE REMOVED ON APRIL 24, 2013.
3. UTILITY LINES ARE SHOWN FOR REFERENCE ONLY (NOT SUITABLE FOR CLEARANCE).
4. * MW-516 NOT USED IN GROUNDWATER INTERPRETATION (ANOMALOUS READING)
5. 100 SERIES ADVANCED JANUARY 2015.
6. 200 SERIES ADVANCED JULY 2015.
7. 400 SERIES ADVANCED FEBRUARY 2019.
8. 500 SERIES ADVANCED JULY 2019.
9. ALL LOCATIONS ARE APPROXIMATE ONLY.

REFERENCE

PLAN BASED ON 2010 ORTHOGRAPHIC PHOTOGRAPH BY FIRST BASE SOLUTIONS.

PROJECT

REMEDIATION AND MONITORING PROPOSAL
189 ELM STREET WEST
BOTHWELL, ONTARIO

TITLE

PROPOSED REMEDIAL EXCAVATION LAYOUT AND MONITORING PLAN

GOLDER

PROJECT No.	CX2145098			FILE No.	CX2145098-P01
				SCALE	AS SHOWN
CADD	DH/AS/ZB	Feb 3/20		REV.	
CHECK					

FIGURE 1