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Potential Remedial Costs Related to the Redevelopment of the Cooper Site Property Stratford, Ontario

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Prepared by

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1.0 Introduction

R.J. Burnside & Associates Limited (Burnside) was retained by the City of Stratford to evaluate the potential remedial costs related to the redevelopment of the Cooper Site property. Burnside undertook a review of available environmental documentation and reports. No site visits or intrusive investigations were conducted as part of the assignment, however, Burnside is familiar with the general site conditions due to long-term consulting services completed on neighbouring properties, as well as work completed on the Cooper Site property in the mid-1990's.

For the purposes of the assessment, Burnside has assumed that the environmental conditions of the property have not changed significantly and that the available information remains valid for completing the evaluation. There have been no significant industrial or commercial operations at the Site since the reports were prepared. Additionally, based upon conversations with the Ministry of Environment (MOE) in October 2007, we understand that there have been no significant submissions of new environmental information since Burnside's mid-1990s reports.

The potential remedial costs are based on the Site being redeveloped for one of the following scenarios, corresponding to the landuse criteria contained within the MOE document "Soil, Groundwater, and Sediment Standards for use Under Part XV.1 of the Environmental Protection Act":

- Residential/Parkland/Institutional Property Use
- Industrial/Commercial/Community Property Use.

All of the anticipated land uses for the property would fall into one of these two property use designations.

This assignment is constrained by a lack of data especially related to the extent of potential impacts to off site properties derived from the Cooper Site.

2.0 Background Information

The subject property is located directly north of St. David Street in Stratford, Ontario and covers an area of approximately 4.65 ha (11.5 acres). The limits of the property are outlined in Figure 1. The Site has had a long history of industrial use and, as a result, there are a number of environmental issues.

Various reports documenting the environmental conditions at and near the Site have been prepared including:

- Cooper Site, Stratford, Ontario, Canada, City of Stratford (undated)
- Final Report, City of Stratford – Cooper Energy Property, Phase I Site Audit, July 24, 1992 Revised December 16, 1992, Sussex Environmental Services Inc.
- Final Report, City of Stratford – Cooper Energy Property, Phase II Clean-up Activities, December 16, 1992, Sussex Environmental Services Inc.
- EM31 Survey at the Cooper Site, Stratford, Ontario, August 16, 1993, Hyd-Eng Geophysics Inc.
- Phase I – Preliminary Environmental Site Assessment, The Cooper Site, Stratford, September 1993, R. J. Burnside & Associates Limited
- Cooper Site/PUC Boundary Area Study, September 1995, R. J. Burnside & Associates Limited
- Phase 2 Environmental Site Assessment, The Cooper Site, Stratford, September 1995, R. J. Burnside & Associates Limited
- Geotechnical Investigation, The Stratford Resort and Spa, St. Patrick Street, Stratford, Ontario for 1101644 Ontario Limited, March 1996, England Naylor Engineering Ltd.
- Geotechnical Investigation, Proposed Parking Structure, Cooper Site, Stratford, Ontario for 1101644 Ontario Limited, April 1996, Naylor Engineering Associates Ltd.
- Stratford Locomotive Shop Building Study, Proposed Retail Development, November 27, 1997, Thomas P. Rylett Limited
- Area of Impacted Soil, Proposed New Parking Lot, July 8, 1998, R. J. Burnside & Associates Limited
- Technical Memorandum, Cooper Site, Stratford – 2006, November 2007, Ministry of the Environment.

The layout of the Cooper Site property and the locations of boreholes, monitoring wells, and test pits obtained from available environmental and geotechnical reports are displayed in Figure 1. This illustrates the nature and extent of the investigative activities conducted to date. Figures 2 and 3 display cross-sections of the property based on the information contained in the reports.

Information regarding the City owned lands that were originally part of the Cooper Site property are displayed in the figures to assist in evaluating the conditions of the subject property.

3.0 Regulatory Considerations

Representatives of the local MOE office indicated, in October 2007 that, although there is historical hydrocarbon and heavy metals contamination in the soil on the Site and some hydrocarbon impacts to the shallow groundwater, there was no conclusive evidence to indicate that contamination on the Cooper Site is causing an adverse effect on human health or the environment or a significant impact to off site properties. The MOE indicated that there are currently no Orders relating to the property, and they did not expect to have any requirement for action based on the currently available information. If new information were to come to light, indicating that the site was having an adverse impact to adjacent properties or the environment, then the MOE would re-examine their position.

A change in land use and redevelopment of the property would be contingent upon:

- The requirements of the Planning Act and local By-Laws
- The requirements of O.Reg 153/04
- Submission of a Record of Site Condition if necessary (i.e. change in landuse) or as required by the Chief Building Official
- Compliance with all other applicable environmental legislation (i.e. Environmental Protection Act and Ontario Water Resources Act).

The change in landuse referred to in O.Reg. 153/04 refers to a change in the actual use of the land, not municipal planning zoning changes.

3.1 Remediation Criteria

Restoration of the property would need to be completed as per the requirements of Ontario Regulation 153/04. The regulation provides contaminant clean-up criteria for various land uses and site scenarios and is referred to in the "Soil, Groundwater and Sediment Standards for use under Part XV.1 of the Environmental Protection Act".

The regulation provides a process used to decide if a site should be considered sensitive. The site sensitivity designation is based upon a review of soil pH, thickness of soil over bedrock, areas of natural significance and proximity of water bodies. These are factors that can affect the assumptions used to develop the MOE's various criteria. Based upon the existing information and a review of the Ontario Regulation 153/04 requirements, the Site would not be considered environmentally sensitive and the use of generic restoration criteria is considered appropriate.

Since groundwater is used for municipal supply purposes, the MOE potable criteria should be applied to provide for the long-term protection of local drinking water sources.

Available soil data indicates the fill could be considered as "coarse textured soils", while the native silty clay soils would be classified as "medium and fine textured soils" as per O.Reg. 153/04. In order to be conservative, it was assumed that all soils would be considered "coarse textured" at this site because the criteria are more stringent.

Accordingly, the appropriate clean-up criterion is deemed to be the Table 2a Full Depth Site Condition Standards in a Potable Groundwater Condition, Coarse Textured Soils for either:

- Residential/Parkland/Institutional Property Use
- Industrial/Commercial/Community Property Use.

The MOE's proposed criteria have been used in the examination of the site conditions and to develop remediation costs. This has been done as: i) these criteria are anticipated to come into force in late 2009 and as a result the future remediation will be completed under these revised standards; and ii) the new criteria are in many cases more stringent and provide a more conservative approach to our evaluation.

For the purposes of this assessment the proposed criteria are used, as it is likely the proposed criteria will be in place when the site is redeveloped. Using the proposed criteria allow for more conservative calculations of potential remedial costs.

3.2 Remedial Options

Remedial options are dependent on the proposed landuse. For the purposes of this assignment, we have assumed a Record of Site Condition will be required. This is based on the understanding that the landuse will change from heavy industrial/vacant landuse to another landuse.

The following flow chart displays the primary redevelopment remedial options.

Redevelopment of the Cooper Site – Remedial Options

Landuse

- Residential /Parkland/Institutional Property Use
  - Remedial Options
    - Clean up to Full Depth Generic Site Condition Standards in a potable groundwater condition
    - Risk Assessment and cleanup to site specific standards with Risk Management
- Industrial/Commercial/Community Property Use
  - Remedial Options
    - Clean up to Full Depth Generic Site Condition Standards in a potable groundwater condition
    - Risk Assessment and cleanup to site specific standards with Risk Management

Although these are the primary remedial options, there are also combinations of strategies that could be used depending on how the site is redeveloped. Stratified site conditions standards could be considered, depending on the end use of the Site, and the owners risk tolerance and preference. The property could be subdivided into parcels of separate land uses with different remedial strategies. However given that final landuse plans have not been developed, the four remedial approaches as mentioned above have been examined.

Clean up to Full Depth Generic Site Condition Standards involves cleaning up the site to meet the criteria outlined in the MOE document "Soil, Groundwater, and Sediment Standards for use Under Part XV.1 of the Environmental Protection Act". This could be considered the level of clean up designed by a risk adverse owner.

Regulations also allow for using a Risk Assessment approach to develop property specific standards for each contaminant found on site that is appropriate for the proposed landuse. In order to conduct a risk assessment, the property needs to be characterized and the proposed landuse plan provided in sufficient detail, so the human health and ecological risks can be identified and risk management measures developed, if required.

If risk management measures are required, the Ministry may issue a Certificate of Property Use which is registered on the property title to ensure the property owner maintains the measures.

The timeline to characterize a property like the Cooper Site and conduct the Risk Assessment process through to completion would be in the order of 1.5 to 2 years.

The Risk Assessment process can potentially result in considerable remediation cost savings, depending on the details of the proposed landuse and owner's preferences and risk tolerance.

3.3 Off Site Impacts

Off-site impacts are a trigger for MOE involvement and the involvement of another party (landowner), with their own concerns and issues. The Festival Hydro property adjacent to the west side of the Cooper Site has documented hydrocarbon impacts near the property boundary interpreted to have originated from the Cooper Site. The north and east sides of the Site are bounded by City owned lands. The south side of the site is bounded by the Goderich-Exeter Railway (Figure 1).

Environmental impacts to additional adjacent lands (other than Festival Hydro) may be present. These impacts, if attributable to industrial activity at the site, are a liability to the owner of the property. The property owner is responsible for the assessment and cleanup of this contamination. There is currently insufficient information to quantify the off-site concerns. Regardless of the future cleanup of the Cooper Site, off-site contamination will continue to be a source of liability to the owner of the Cooper Site and will need to be addressed.

4.0 Summary of Environmental Conditions

The following section describes the geological and environmental conditions of the property based upon the data documented in the historical reports.

4.1 Stratigraphy

The geological profile of the study area includes the following stratigraphic units:

- **Surficial Fill** is present throughout the majority of the property. The fill thickness ranges between 0.5 m and 3.0 m. The fill typically consists of sand and gravel with intermixed slag, and fragments of brick, wood, glass, as well as miscellaneous materials. The concentrations of metals in the fill (usually copper and lead) often exceed the applicable regulatory criteria. In addition, the fill is impacted by petroleum hydrocarbons at a number of locations. Fill thickness at various locations is shown on Figure 1 and displayed on the cross sections in Figures 2 and 3. Figure 4 displays the potential impacted fill and soil volume

- **Till** is comprised of dense native clayey silt/silt till and is present throughout the Stratford area. In the vicinity of the site, the till is approximately 30 m thick. Due its fine grained nature, the till is relatively impermeable and restricts the downward migration of contaminants. The till is visually distinguishable from the overlying fill materials. Some of the upper layers of the till have been impacted with petroleum hydrocarbons

- **Bedrock** (the Detroit River Hydrogeological Unit) is comprised of a limestone formation and is located more than 30 metres below the ground surface. Regional groundwater studies and local assessments of nearby contaminated properties indicate the bedrock aquifer is protected from surface sources of contamination due to the presence of the till unit.

4.2 Fill and Soil Quality

A review of the analytical results indicates that petroleum hydrocarbons, BTEX (benzene, toluene, ethyl benzene and xylenes) and heavy metals (mainly copper and lead) concentrations in the soil and fill exceed the proposed MOE Table 2a Standards for both Residential/Parkland/Institutional Property Use and Industrial/Commercial/Community Property Use.

It should be noted, that the soil criteria have changed since these samples were collected. Soil results total for petroleum hydrocarbons (TPH) were previously expressed as purgeable TPH (up to and including C10), and extractable TPH (C11 to C50) petroleum hydrocarbons. Now the proposed criteria are separated into four hydrocarbon factions:

- F1 (C1 to C10)
- F2 (>C10 to C24)

- F3 (>C24 to C50)
- F4 (>C50).

Purgeable HC were considered reasonably comparable to F1 fraction HC. Extractable HC were considered reasonable comparable to F2 plus F3 fraction HC and F4 was considered comparable to TPH (heavy metals).

There are two main types of soil contamination on the Cooper Site identified to date:

- Heavy metals contamination, primarily from copper and lead, attributed to miscellaneous non-soil materials (slag, brick, glass, burnt materials, etc.) in the fill matrix
- Petroleum hydrocarbon impacted fill and soil from historical releases of fuels and lubricants.

One geotechnical borehole (BH128) also noted a solvent odour in the fill, however the nature of the odour was not verified with laboratory testing. Historical documents indicate solvents were used on the site.

Due to the presence of non-soil like materials, much of the fill on the site would be considered impacted from a chemical, aesthetic or geotechnical perspective. Since the material contains debris and soluble chemical substances, a significant portion of the fill will not be considered inert and will have to be excavated and shipped off-site for disposal at a licensed facility in accordance to Ontario Regulation 347.

Given the variable nature of the fill materials, segregation of non-soil like materials from the fill matrix will be difficult. For the purposes of this estimation, we assume most of the material identified as "fill" on the borehole and test pit logs would be contaminated and/or unsuitable material that would not meet the MOE criteria.

Fill and soil quality data are summarized in Tables 1 and 2.

4.3 Estimated Volume of Impacted Soil and Fill

The volume of impacted fill and soil has been roughly estimated from the available information, specifically borehole and test pit logs.

Table 1 provides a summary of the soil stratigraphy, and sampling results from borehole and observation well data. Table 2 provides a summary of the test pit data. The estimated volume of impacted fill and soil is displayed on Figure 4. The volume is estimated to total approximately 69,000 m^3.

The degree of impacts are difficult to quantify based on the available data.

For the purposes of this assessment, we assume based on the information available as outlined in Tables 1 and 2, that 50 percent of this soil will not meet the Residential/Parkland/ Institutional Property Use Criteria (34,500 m^3).

4.4 Concrete

The Cooper Site was originally developed in the early 1900's for the manufacturing and repair of steam locomotives. Due to the nature of the building and the heavy equipment used, the foundations of the main building are massive concrete structures. There are also some remaining stone foundations. Very little information is available regarding the foundation construction details, however, as shown in Figures 2 and 3, the foundations can, in places, be several meters thick.

Redevelopment of the site will likely require the reprocessing of some or all of the concrete foundations. Other concrete materials such as piping, sidewalks, etc. would also need to be reprocessed. Concrete removal may be required to accommodate future construction activities, underground utilities, geotechnical requirements, and in some cases to allow for the remediation of contaminated soil and/or groundwater.

Reprocessing of the concrete would involve excavation, breaking into large pieces, removal of rebar, and crushing to gravel size. Reprocessed concrete could remain on site as inert fill.

The volume of concrete is roughly estimated as follows:

- Total area of building foundations – 2.4 ha (24,000 m^2)
- Average thickness of concrete – 1.5 m
- Total volume of concrete – 36,000 m^3.

The amount of the concrete that will need to be reprocessed is dependent on the proposed landuse.

4.5 Miscellaneous Materials

Miscellaneous materials which could include metal beams, rebar, building materials, asphalt, wiring, piping, etc., is deemed to be waste. Disposal will be in accordance with the nature of the material as follows:

- Metal beams, pipes, building siding, rebar, etc. – shipped off site as scrap metal
- Asphalt – shipped off site for recycling
- Wood, glass, plastic, building materials, etc. – shipped off site as non-registerable non-hazardous waste
- Asbestos containing materials (transite pipe, insulation, etc.) – shipped off site as asbestos waste.

Sources of these materials would include:

- Above grade structures
- Below grade infrastructure – pipes, wires, rebar, etc.

The amount of miscellaneous materials generated during the remediation process is dependent on the restoration approach. For the purposes of this evaluation, the volume is estimated to be approximately 10 percent of the concrete volume managed as part of the sub-grade demolition process.

5.0 Groundwater

5.1 Water Supply Aquifer

The City of Stratford obtains its water supply from the Detroit River Hydrogeological Unit bedrock aquifer, which is located more than 30 metres below surface. Recent regional groundwater studies and local studies of nearby properties with significant subsurface contamination, indicates the bedrock aquifer is afforded a significant amount of protection from surface sources of contamination by a unit of clayey silt to silt till that is more than 30 m thick. Based on our current understanding of the nature of the contaminants on the Cooper Site and the local hydrogeological environment, there is no significant concern that the contamination identified on site to date could impact the municipal water supply aquifer.

5.2 Shallow Perched Groundwater

A shallow groundwater table exists as a perched layer above the relatively impermeable glacial till. The water table is present in the fill materials and near surface overburden. The depth to shallow groundwater varies from between 1.0 and 4.0 meters below ground surface.

Groundwater flow on the property has not been fully examined, however, based upon studies completed to date and available information for the area, the shallow groundwater on the west side of the site is interpreted to flow north-westerly. Along the south side of the site it may flow more southwesterly.

The groundwater flow in the shallow overburden and fill is strongly influenced by the local topography, the depth of the fill, and presence of subsurface foundations and infrastructure. The fine grained nature of the native soil limits the downward migration of impacted groundwater.

Migration of contaminated shallow groundwater can also occur via pathways around subsurface infrastructure such as sewer and water pipes. The permeable backfill around pipes can act as a migration pathway. There has been insufficient study to date to fully evaluate this issue.

5.3 Groundwater Quality

Petroleum hydrocarbon impacted groundwater has been identified in the vicinity of historical places of use and storage (tanks, pits, sumps, etc.). There has been insufficient study to date to fully characterize the nature and extent of the impacted groundwater. The potential presence of volatile organic compounds (VOC's) related to the historical use of solvents is a significant concern that has not yet been addressed.

In October 1994 and March 1995, water quality samples were collected from the monitoring wells. No samples have been collected since that time. The results indicated that the inorganic, metals and nutrient levels in the groundwater were within acceptable limits. It should be noted, however, that the proposed Table 2a does not contain criteria for general inorganic parameters. The parameters that exceeded the Table 2a criteria for groundwater quality were: BTEX compounds including benzene, toluene, ethyl benzene and xylenes as well as total petroleum hydrocarbons (TPH) in the purgeable range. The purgeable range includes hydrocarbon chains up to and including C10. The elevated concentrations were found in two portions of the site: near the south corner of the site where the former fuel storage tanks were located (OW1S, OW10 and OW12); and along the western property boundary adjacent to Festival Hydro (OW8, OW15, BH2 and BH4). Volatile organic compounds (VOCs) were not included in the analysis of groundwater samples, which is considered a data gap in the characterization of the site.

It should be noted that the water quality samples were collected almost 15 years ago. Since that time the regulatory criteria have changed as well as the laboratory methods for analyzing petroleum hydrocarbons. Assumptions were made in order to compare the old data with the new criteria, however, this information can only be used as a guide to determine potential problem areas. Water quality testing should be repeated using current methods to suit the proposed Standards.

The underlying fine textured soils (variations of the clayey silt till) are restricting the downward and lateral migration of groundwater from this site. This is evidenced by the fact that TPH was detected in the shallow well OW1S but not the deeper well OW1D.

5.4 Summary of Potential Groundwater Issues

There is insufficient data available to effectively characterize the potential environmental issues related to groundwater both on and off site. For the purposes of this assessment, we will assume a significant portion of the perched groundwater on site is impacted.

We will also assume that impacts extend off site onto Goderich Exeter Railway lands to the south, and that there is no significant concerns with off site migration along the other property boundaries.

6.0 Remediation

6.1 Overview

The necessity of conducting remediation is based on two key items:

1. The proposed use of the site:
   - Residential/Parkland/Institutional Property Use
   - Industrial/Commercial/Community Property Use

2. The presence or potential for off site impacts:
   - Off site impacts need to be addressed
   - Proactive controls are required if there is a risk of off site migration in the future.

The potential remediation requirements for the two property use categories as per O.Reg. 153/04 are presented in the following sections.

6.2 Industrial/Commercial/Community Property Use

For the purpose of this assessment, we will assume the change in the use of the land will trigger the need for a Record of Site Condition (RSC). In this case the MOE or the Chief Building Official may trigger this requirement.

When an RSC is required there are two options:

1. Cleanup the site to the generic criteria; or
2. Conduct a Risk Assessment and complete the remediation program using site specific standards supported by a long term risk management strategy.

6.3 Residential/Parkland/Institutional Property Use

If the landuse were to change from industrial to a more sensitive landuse, an RSC would be required. Remediation could be completed using the same two options noted above, namely full depth restoration using the applicable generic criteria or Risk Assessment

7.0 Remedial Methods and Costs

7.1 Residential/Parkland/Institutional Property Use

As discussed previously, there are two basic options for site remediation for Residential/ Parkland/Institutional Property Use: full depth restoration or Risk Assessment. The basic remedial process would include:

- Demolish existing above grade structures
- Excavate, crush and stockpile sub-grade concrete structures (i.e. footings, floor slabs, service tunnels) for use as inert structural fill
- Excavate, transport off-site asphalt materials from former driveways and parking lot areas for recycling
- Excavate, screen and off-site disposal of impacted fill and soil at a licensed facility according to Ontario Regulation 347
- Backfill and compact using stockpiled site-derived inert concrete, regulatory compliant fill, and imported soils.

7.2 Building Demolition

The former Cooper Energy building is still present on the property. The original building and shops were opened in 1871 by the Grand Trunk Railway, which later became part of the Canadian National Railway. Additional expansions occurred in 1907 which resulted in the construction of the existing building with an addition along St. David Street in the 1940's.

The largest part of the building is the former machine and boiler shop which is 42 m (140 feet) wide, 239 m (786 feet) long and 15 m (50 feet) high. Other smaller subsidiary buildings are located on the site most in proximity to the railway line and the main building. The total area of foundation footprints is estimated to be 2.4 ha.

The 1909 and 1949 buildings comprise a massive steel frame with large overhead cranes. The exterior walls and floors are concrete with large window/skylight openings which have been closed in with concrete block. The floor is constructed of concrete - up to 5 meters thick.

It is assumed that redevelopment of the site would require removal of all above grade structures. All steel structural members, roofing and cladding can be separated and shipped off-site for recycling. Brick, concrete, limestone and inert rubble can be separated and stockpiled for crushing and reuse.

Discussions with contractors indicates the demolition and disposal of similar sized buildings (including return on recycling) to be in the order of $\$15/m^2$. The building is approximately 20,360 m^2, which translates to a cost of approximately \$305,400.

7.3 Sub-Grade Demolition

Due to the historical use of the building and the heavy equipment used, the foundations of the main building are massive concrete structures. Very little information is available regarding the foundation construction details, however as shown in Figures 2 and 3, the foundations can reach several meters in thickness.

Redevelopment of the site will require the excavation and processing of some or all of the concrete foundations and walls. Other concrete materials such as side walks, concrete brick etc. would also need to be processed. Concrete removal will be required to accommodate future construction activities, underground utilities, geotechnical requirements, and in some cases to allow remediation of contaminated soil and/or groundwater. It is anticipated that very little of the concrete will be contaminated.

Concrete will be excavated, broken into manageable sizes, stockpiled and then crushed for reuse as fill on the property, pursuant to geotechnical requirements. Efforts will have to be made to remove rebar as part of the crushing process. Burnside has confirmed, through MOE policy documents, that the crushed concrete and brick rubble meets the inert fill classification under O. Reg. 347, therefore can be used to augment engineered structural fill. Inert fill can not include putrescible debris or soluble chemicals. Some blending with imported sand may be required to improve the geotechnical quality.

Contractors indicate the demolition, excavation, and stockpiling of the subgrade structures to be in the order of $20/m^3. Further crushing and processing for reuse would be an additional $25/m^3.

7.4 Miscellaneous Materials

Miscellaneous materials (excluding soil, fill, water, and concrete), which could include metal beams, rebar, building materials, asphalt, wiring, piping, etc., will have to be identified and removed from the Site.

A discussion with contractors indicates the costs to load, transport, and dispose of miscellaneous materials are in the order of $200/m^3.

7.5 Asphalt Materials

The Site may contain asphalt pavement surface in areas such as the former driveways and employee parking lots. These materials will be excavated and shipped off-site for recycling. Alternatively the asphalt can be crushed for blending with aggregate and stockpiled on-site for use in the construction of future parking lots.

7.6 Impacted Fill and Soil

All impacted fill and soil that do not meet the standards (either Generic or Risk Assessment derived) must be removed from the site.

If deemed appropriate, the impacted fill materials can be screened to remove all large recyclable or inert materials and then staged in temporary stockpiles. Available techniques for material segregation include dry screening, and/or manual removal of debris. Metal, wood and miscellaneous objects would be segregated/removed for off-site disposal. Recovered rubble (i.e. concrete and bricks) may be crushed for reuse as a source of aggregate.

Load, transport, and disposal costs are in the order of $\$200/m^3$.

7.7 Contaminated Groundwater

Groundwater and surface water that collects during remedial activities will require containment and treatment, and/or removal from the site. Contaminated surface water is not expected to be a significant issue; however studies to date have identified several areas of contaminated groundwater. Due to the low permeability of the native underlying soil, the majority of the contaminated groundwater is expected to be perched within the permeable fill, in and around the permeable bedding of foundations and subsurface infrastructure (pipes, conduits, and utilities).

Physical excavation and removal of the source areas (contaminated soil and fill) is expected to reduce the overall groundwater impacts; however physical removal of impacted groundwater (pump and treat) and/or in situ remedial technologies (chemical biological injections), may be required to clean-up residual contamination.

Remediation may require dewatering and water handling during excavations that extend below the water table. All water that is pumped and removed from a hydrocarbon impacted area or fill excavation cell will be referred to as wastewater.

7.7.1 Dewatering, Groundwater Pumping, and Disposal

Dewatering through groundwater pumping may be required:

- To enable excavations and backfilling to occur below the water table
- To manage contaminated groundwater.

Dewatering may include:

- A number of fixed (dedicated) extraction wells
- A portable submersible pump and discharge hose that can be moved as the excavation proceeds.

The potential volume of liquid from dewatering during the remediation process will depend on the area of excavation, the average saturated thickness, and the average porosity of the fill material.

For the purpose of this assessment, we will assume that the volume of impacted groundwater to be processed for clean up to Residential/Parkland/Institutional Property Use during remediation is based upon the value of soil removed from the site (34,500 m^3) and a saturated thickness of 0.5 m and a porosity of 0.3. This equates to approximately 5,175 m^3. This corresponds to budgets suggested by contractors working on similar sized projects.

Methods of wastewater disposal include:

- On-site pre-treatment and discharge to either storm sewer or sanitary sewer
- Vacuum truck removal and transportation to a licensed treatment facility.

Additional information is required in order to optimize the wastewater budget estimates. For budgeting purposes, a value of $200.00 per cubic meter is used.

7.8 Backfilling

As the excavation proceeds, suitable backfill (which conforms to the proposed restoration program) will be placed and compacted into the excavated areas to meet new grade elevations.

Acquire, transport, place, and compact clean granular backfill suitable for most applications is estimated at \$25/m^3.

Backfilling using stockpiled processed inert materials from the remedial program (i.e. concrete) is estimated at \$7.50/m^3.

The level of effort and costs are dependent on the landuse and selected remedial alterative (Generic Cleanup or Risk Assessment).

7.9 Environmental Studies, Risk Assessment, Remedial Oversight, Engineering, and Permitting

- Environmental Assessment Studies and Site Characterization
- Risk Assessment (if it is the selected option)
- Remedial Options Analysis depending on proposed land use
- Remedial Oversight and Monitoring
- Engineering Inspection
- Permitting
- Post Remedial Assessment and Record of Site Condition

- Long Term Risk Management Measures (as determined by the Risk Assessment if selected).

8.0 Remedial Cost Estimates

8.1 Overview

As discussed, the cost of remediation depends on the proposed landuse and the risk tolerance of the owner. An owner with a low risk tolerance or with a mandate to achieve a high level of cleanup would opt to follow the Generic Standards. A more risk tolerant owner may consider the Risk Assessment approach with cleanup to site specific standards and a long term Risk Management Strategy.

For illustrative purposes four scenarios have been costed and included in Appendix A. In each case the potential off site impact issue is a significant component of the cost. The costs as shown in four tables in Appendix A are summarized as follows:

- A-1 Remediation Cost Estimate for Residential/Parkland/Institutional Property Use – Generic Standards – approximately $15.5M
- A-2 Remediation Cost Estimate for Residential/Parkland/Institutional Property Use – Risk Assessment – approximately $9.5M
- A-3 Remediation Cost Estimate for Industrial/Commercial/Community Property Use – Generic Standards – approximately $9.1M
- A-4 Remediation Cost Estimate for Industrial/Commercial/Community Property Use – Risk Assessment – approximately $6.3M.

These costs can be considered as a potential range depending on the future landuse and owner's preferences. The "do nothing" option, which would consist of simply removing the building and paving the property, would still (in our opinion, based on the City acquiring the property) require addressing the environmental liabilities. A Risk Assessment is recommended. The off site issues would require immediate attention. As a result, the "do nothing" option would require an environmental assessment and addressing off site impacts. The "do nothing" option would still entail expenditures in the order of approximately $2M.

9.0 Data Gaps and Limitations

Based upon our review of the information the following provides a summary of the data gaps. These will influence both the assumptions used in the development of the restoration approach as well as the costs. Environmental Assessment studies are strongly recommended to investigate these areas of uncertainty and allow for optimization of the restoration approach and development of defensible costs.

- There is very little information available regarding the foundation construction details; however, as shown in Figures 2 and 3, the foundations are estimated to be several meters thick in places. Additional geophysics studies are required within the building footprint and along the foundation to document concrete thicknesses and further quantify the volumes and sub-grade demolition costs

- There is limited information regarding soil conditions beneath the building and we understand that many of the sumps and pits within the building were reportedly filled in after they were cleaned out. It is expected that there would be some contamination in the permeable base materials below the foundations of the sumps and pits. Drilling and sampling around former pits is required to quantify volumes

- The available borehole logs indicate that the fill material can be highly variable in composition and quality. Segregation of inert materials like concrete by screening may be is feasible. Pilot study testing is required to evaluate the fill composition; screening feasibility and overall quality for handling .

- The hydrogeology of the site is poorly documented and additional work is required to determine saturated thickness, distribution of contaminants, groundwater flow direction; contaminant migration, etc. This includes additional sampling and analysis for a broad range of organic (i.e. solvents and polycyclic aromatic hydrocarbons) and inorganic contaminants

- There is a high potential for off site impacts to soil and groundwater primarily from petroleum hydrocarbons and VOC's. This could represent a significant liability that cannot be quantified based on the information available at this time

- Unit costs and estimates were generated from previous recent experience on similar sites and contractor cost estimates from recent projects. Depending on the landuse and site development plans, there is a wide range of potential remedial options and methodologies to meet the needs of the site owner.

10.0 Recommendations

The information available is insufficient to provide an accurate assessment of the potential costs related to the remediation of the Cooper Site property. The nature and extent of the contamination, especially off site, can have a considerable impact on the cost estimates.

The following work is recommended:

- Phase I Environmental Site Assessment
- Phase II Environmental Site Assessment including:
  - Geophysical surveys (to assess subsurface structures)
  - Test pitting (to characterize the fill)
  - Borehole drilling
  - Monitoring well installation
  - Soil and groundwater sampling
  - Surveying
- Assessment of available and innovative remedial technologies
- Determination of final landuse plans
- Bench scale testing of remedial technologies and cost/benefit analysis
- Risk Assessment (if required)
- Remedial Options Analysis and Restoration Plan (based on Risk Assessment Criteria or Generic Criteria)
- Tender Specification Development and Detailed Cost Estimate.

11.0 Limitations

The information and conclusions contained herein are based upon work undertaken by trained professional and technical staff, in accordance with generally accepted engineering and scientific practices current at the time the work was performed.

Burnside does not guarantee the accuracy and reliability of the information provided by other persons or agencies, and does not claim responsibility for undisclosed or non-visible environmental concerns that may result in costs for environmental clean-up or remediation.

The conclusions presented, represent the best technical judgement of Burnside based on the historical data available. The conclusions are based on the site conditions outlined in the documents reviewed. The specific testing and/or sampling locations can only be extrapolated to an undefined limited area around these locations. The extent of the limits are dependent on the soil and groundwater conditions, as well as the history of the site reflecting natural, construction, and other activities. Due to the nature of the investigation and the limited data available, Burnside cannot warrant against undiscovered environmental liabilities.

This report was prepared for the exclusive use of the City of Stratford and they may rely on the findings and conclusions presented, within the constraints of the Limitations. Any use of, reliance on or decisions based on this report by a third party are the responsibility of such third parties. Burnside accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. Reports or memoranda resulting from this assignment are not to be used, in whole or in part, outside the client's organization without prior written permission.

If you have any questions or comments, please contact the undersigned.

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Tables

Table 1
Soil Stratigraphy and Sampling Summary Boreholes and Observation Wells

Location Designation	Drilling Date	Drilled by	Ground Elevation (m asl)	Bottom of borehole (m bgs)	WL date	Water Level (m bgs on log)	Interpreted Thickness of Impacted Fill/Soil	Bottom of Unit (m)	Unit	Odours	Staining	Soil Samples	Soil Analysis	Water Samples	Soils Exceeding March 2007 I/C
BH101	6-Mar-96	ENE	361.42	9.45	11-Mar-96	3.75	4.75	0.15	Concrete						
								3.8	Fill (Black foundry sand cinders, slag)		black to 0.45				
								4.9	Clay, greenish brown		greenish brown				
								5.65	Silty Clay Till, brown						
								7.3	Silty Till, brown						
								8.25	Silt, grey						
								9.45	Silt Till, brown						
BH102	6-Mar-96	ENE	361.4	8.1	na	na	3.65	0.15	Concrete						
								3.8	Fill (Black foundry sand, slag and coal)		black, zones of discolouration				
								4.55	Silty clay, brown						
								5.65	Silty Clay till, brown						
								8.1	Silt Till, brown						
BH103	6-Mar-96	ENE	361.39	8.1	11-Mar-96	3.88	2.86	0.14	Concrete						
								2.9	Fill (black foundry sand, coal, bricks, cinders and slag)		black				
								3.35	Topsoil, black						
								4.4	Silty Clay, brown						
								7	Silty clay till, brown						
								8.1	Silty, grey						
BH104	6-Mar-96	ENE	361.39	10.9	11-Mar-96	4.63	2.9	0.15	Concrete						
								3.05	Fill (Black foundry sand, slag and coal)		Black				
								5.35	Silty Clay till, brown						
								10.9	Silt Till, brown to grey						
BH105	11-Mar-96	ENE	361.39	5.2	na	na	0.97	0.18	Concrete						
								1.15	Fill (black foundry sand)						
								1.85	Concrete						
								3.5	Fill (brown silt)						
								3.95	Topsoil, black						
								5.2	Silty Clay Till, grey						
BH106	7-Mar-96	ENE	361.41	6.55	11-Mar-96	3.25	1.99	0.16	Concrete						
								2.15	Fill (black foundry slag, coal, slag)		Black				
								2.75	Topsoil, black						
								3.2	Silty Clay, rusty brown						
								4.7	Clayey Silt Till, brown						
								6.55	Silty clay till, brown to grey						
BH107	12-Mar-96	ENE	361.33	6.55	na	na	2.2	0.55	Concrete						
								2.75	Fill (sand, Black foundry sand and coal)		Black				
								3.05	Topsoil, black						
								3.5	Silty Clay, grey						
								6.55	Silty clay Till, brown						
BH108	6-Mar-96	ENE	361.35	9.6	na	na	2.3	0.6	Concrete						
								2.9	Fill (black foundry sand, coal, bricks, cinders)		Black				
								3.35	Topsoil, black						
								4.6	Silty clay, brown						
								6.1	Silty Clay Till, brown						
								9.6	Silt, brown						

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Soil Stratigraphy and Sampling Summary Boreholes and Observation Wells

Location Designation	Drilling Date	Drilled by	Ground Elevation (m asl)	Bottom of borehole (m bgs)	WL date	Water Level (m bgs on log)	Interpreted Thickness of Impacted Fill/Soil	Bottom of Unit (m)	Unit	Odours	Staining	Soil Samples	Soil Analysis	Water Samples	Soils Exceeding March 2007 I/C
BH109	12-Mar-96	ENE	361.49	4.6	na	na	2.57	0.18	Concrete						
								2.75	Fill (Black foundry sand, slag, coal, bricks)		Black				
								4.6	Silty Clay Till, brown						
BH110	12-Mar-96	ENE	361.48	5.05	na	na	0.15	0.25	Concrete						
								0.4	Fill (black foundry sand)						
								0.5	Topsoil, black						
								4.55	Silty clay Till, rusty brown						
								5.05	Silt Till, grey						
BH111	12-Mar-96	ENE	361.48	5.05	na	na	0.34	0.26	Concrete						
								0.6	Fill (silty sand, foundry sand, black/brown)		black to brown				
								3.95	Silty Clay Till ,brown						
								5.05	Silt Till grey						
BH112	8-Mar-96	ENE	361.46	9.6	na	na	2.7	0.2	Concrete						
								2.9	Fill (black foundry sand, slag coal, silt)	[redacted]	black				
								3.65	Topsoil, black						
								4.55	Silty Clay, grey						
								5.5	Silty Clay till, grey						
								9.6	Silt Till, grey						
BH113	4-Mar-96	ENE	361.46	9.6	11-Mar-96	3.1	2.39	0.16	Concrete						
								0.35	Fill (black cinders, slag)	[redacted]					
								0.5	Concrete						
								3.05	Fill (Black foundry sand, coal)		Black				
								3.95	Silt Till, brown						
								4.55	Silty Clay till, brown						
								6.1	Clayey Silt Till, brown						
								6.4	Sand, medium to coarse, brown						
								9.6	Silt Till, brown						
BH114	7-Mar-96	ENE	361.49	5.05	na	na	0	1.93	Concrete						
								3.05	Silty clay, brown						
								5.05	Silty Clay Till, brown						
BH115	11-Mar-96	ENE	361.47	5.8	na	na	2.6	0.15	Concrete						
								0.8	Fill (sand, black slag)		Black				
								0.9	Concrete						
								3.65	Fill (sand and fine gravel, wood, crushed gravel, clay)						
								4.2	Topsoil, black						
								4.4	Sand and gravel, brown						
								5.8	Silty Clay Till, grey						
BH116	4-Mar-96	ENE	361.42	7.85	11-Mar-96	2.7	0	2.4	Concrete						
								2.85	Fill (clayey silt, brown)						
								3.15	Concrete						
								7.85	Silty Clay Till, brown to grey						
BH117	4-Mar-96	ENE	361.45	2.05	na	na	1.95	0.1	Concrete						
								2.05	Fill (black cinders and slag, sand)						
BH118	11-Mar-96	ENE	361.41	5.05	na	na	2.85	0.15	Concrete						
								3.05	Fill (black foundry sand and slag, wood)		black				
								3.5							
								5.05							

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Location Designation	Drilling Date	Drilled by	Ground Elevation (m asl)	Bottom of borehole (m bgs)	WL date	Water Level (m bgs on log)	Interpreted Thickness of Impacted Fill/Soil	Bottom of Unit (m)	Unit	Odours	Staining	Soil Samples	Soil Analysis	Water Samples	Soils Exceeding March 2007 I/C
BH119	7-Mar-96	ENE	361.44	5.05	na	na	0.21	0.15	Concrete						
								0.36	Fill (black slag, coal and foundry sand)		Black				
								1.83	Concrete						
								5.05	Silty Clay till, brown						
BH120	4-Mar-96	ENE	361.45	9.6	11-Mar-96	4.65	0.42	0.18	Concrete						
								0.6	Fill (black cinders and slag)		Black				
								1.7	Silt, brown						
								3.2	Silt Till, brown						
								6.1	Silty Clay till, brown						
								9.6	Silt Till , grey						
BH121	5-Mar-96	ENE	361.4	9.6	11-Mar-96	3	2.91	0.14	Concrete						
								3.05	Fill (Black foundry sand, coal, sand silt)		Black				
								9.6	Silt Till, brown						
BH122	7-Mar-96	ENE	361.43	6.55	na	na	2.15	0.15	Concrete						
								0.45	Fill (sand silt, brown)						
								0.6	Concrete						
								2.75	Fill (silty sand, foundry sand, coal, black/brown)	[illegible]	black				
								3.05	Topsoil, black						
								4.6	Silty Clay, brown						
								5.51	Silty Clay till, brown						
								6.55	Silt Till, grey						
BH123	8-Mar-96	ENE	361.42	5.05	na	na	2.85	0.5	Concrete						
								3.35	Fill -sand, brown - foundry sand, coal, cinders - sand, brown		Black				
								5.05	Silty Clay Till, grey						
BH124	5-Mar-96	ENE	361.46	9.6	11-Mar-96	3.43	2.16	0.14	Concrete						
								2.3	Fill (black foundry sand, cinders, slag, coal, silty clay)		Black				
								6.7	Silty Clay Till, brown						
								9.6	Silt Till, grey						
BH125	7-Mar-96	ENE	361.41	5.05	na	na	0	1.02	Concrete						
								1.5	Fill (sandy silt, brown)						
								3.05	Sandy Silt Till, brown						
								5.05	Silty Clay Till, brown to grey						
BH126	5-Mar-96	ENE	361.39	9.6	11-Mar-96	5.88	1.94	0.11	Concrete						
								0.2	Fill (black foundry sand, cinders, slag, coal)		Black				
								0.3	Concrete						
								2.15	Fill (Black foundry sand, slag, bricks)		Black				
								7.9	Silty Clay Till, brown to grey						
								9.6	Silt Till, grey						
BH127	6-Mar-96	ENE	361.44	5.05	na	na	1.95	0.2	Concrete						
								2.15	Fill (sand, gravel, slag, foundry sand)		Black				
								4.7	Silty Clay Till, brown						
								5.05	Sand, fine to coarse, brown						
BH128	8-Mar-96	ENE	361.44	5.05	na	na	0.65	0.15	Concrete						
								0.8	Fill (sand and gravel, brown)	slight solvent odour					
								1.13	Concrete						
								2.3	Clayey Silt Till, brown						
								5.05	Silty Clay Till brown to grey						

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Soil Stratigraphy and Sampling Summary Boreholes and Observation Wells

Location Designation	Drilling Date	Drilled by	Ground Elevation (m asl)	Bottom of borehole (m bgs)	WL date	Water Level (m bgs on log)	Interpreted Thickness of Impacted Fill/Soil	Bottom of Unit (m)	Unit	Odours	Staining	Soil Samples	Soil Analysis	Water Samples	Soils Exceeding March 2007 I/C
BH129	7-Mar-96	ENE	361.44	5.05	11-Mar-96	2.67	0.79	0.11	Concrete						
								0.9	Fill (brown sand and gravel, black slag and foundry sand)		Black				
								1.7	Silty clay, brown						
								2.15	Clayey Silt Till, brown						
								5.05	Silty Clay Till, brown to grey						
BH130	7-Mar-96	ENE	361.44	0.9	na	na	0.3	0.15	Concrete						
								0.45	Fill (silty sand and gravel, brown)						
								0.6	Concrete						
								0.9	Fill (brown sand, some black foundry sand)		Black				
201	29-Mar-06	ENE	359.7	3.5	1-Apr-96	0.31	0.4	0.1	Asphaltic Concrete + sand and gravel			no			
								0.5	Fill (black foundry sand and slag)						
								0.9	Topsoil, black	[redacted]					
								1.5	Silty Clay, grey						
								3.5	Silty clay till, brown						
202	29-Mar-96	ENE	361.46	3.56	1-Apr-96	2.38	1.7	0.3	Asphaltic Concrete + granular			no			
								2	Fill (black foundry sand, gravel, slag and coal)	[redacted]					
								2.3	Topsoil, black						
								3.65	Silty Clay, grey	[redacted]					
203	28-Mar-96	ENE	361.54	1.35	na	dry	1.15	0.2	Asphaltic Concrete			no			
								1.35	Fill(Black foundry sand, gravel), rubble and steel below 3 m)						
203 A	28-Mar-96	ENE	361.54	2.15	na	dry	0	0.09	Asphaltic Concrete			no			
								0.25	Concrete						
								2.15	Concrete rubble Air voids	[redacted]					
203 B	28-Mar-96	ENE	361.47	3.5	1-Apr-96	1.17	2.32	0.13	Asphaltic Concrete + granular			no			
								2.45	Fill (black foundry sand, gravel bricks)	[redacted]					
								2.75	Silt		black staining				
								3.5	Silt Till, brown						
204	28-Mar-96	ENE	361.54	3.5	1-Apr-96	1.1	2.1	0.175	Concrete			no			
								2.3	Fill (Black foundry sand, cinders slag, coal, pieces of mortar below 2.0 m)						
								2.9	Sand, brown fine to coarse						
								3.5	Clayey Silt Till, brown						
205	28-Mar-96	ENE	361.79	3.5	1-Apr-96	1.2	1.55	0.3	Concrete			no			
								0.45	Fill (bricks, rubble)						
								1.2	Fill (black foundry sand, coal and slag)						
								1.5	Fill (silt and gravel, brown)						
								1.85	Fill (wood in black foundry sand, gravel and coal)						
								2.15	Topsoil, black						
								3.05	Clayey Silt Till, brown						
								3.5	Silty clay till, brown						
206	28-Mar-96	ENE	361.49	3.35	1-Apr-96	0.77	1.4	0.33	Concrete + granular A			no			
								0.45	Fill (brown sand and fine gravel)						
								1.05	Fill (Black foundry sand and topsoil)						
								1.5	Fill (pieces of wood)						
								1.85	Fill (wood pieces foundry sand, grey silty clay)						
								2.15	Topsoil, black						
								3.35	Silty clay till, brown						

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Table 1
Soil Stratigraphy and Sampling Summary Boreholes and Observation Wells

Location Designation	Drilling Date	Drilled by	Ground Elevation (m asl)	Bottom of borehole (m bgs)	WL date	Water Level (m bgs on log)	Interpreted Thickness of Impacted Fill/Soil	Bottom of Unit (m)	Unit	Odours	Staining	Soil Samples	Soil Analysis	Water Samples	Soils Exceeding March 2007 I/C
207	28-Mar-96	ENE	361.49	3.35	1-Apr-96	0.75	1.7	0.175	Concrete			no			
								1.85	Fill (black foundry sand, slag, bricks and rubble below 0.9 m)						
								2.3	Topsoil, black						
								3.35	Clayey Silt Till, brown						
208	28-Mar-96	ENE	361.61	3.35	1-Apr-96	0.5	0.7	0.4	Concrete + granular A			no			
								0.9	Fill (black foundry sand)						
								1.5	Fill (clayey silt, grey)						
								1.7	Fill (Wood)						
								2.15	Topsoil, black						
								3.35	Silty clay till, brown						
209	28-Mar-96	ENE	361.48	3.35	1-Apr-96	0.9	0	0.175	Concrete			no			
								0.45	Fill (sand and gravel)						
								1.2	Fill (silty clay, brown/grey)						
								3.35	Silty Clay Till, grey						
210	28-Mar-96	ENE	361.44	3.35	1-Apr-96	1.38	0.5	0.175	Concrete			no			
								0.65	Fill (black foundry sand)						
								2.3	Silty clay till						
								3.35	Clayey Silt Till, brown						
BH1	28-Jul-93	RJB	358.52	5.08	na	na	2.24	0.2	Asphalt			1 GS			
								1.42	Fill (sand and gravel, cinders, ash)	[illegible]	black/rust staining	3 GS			
								5.08	Silty Clay Till, greyish brown						
BH2	25-Jan-95	RJB	359.48	3.05	13-Mar-95	1.3	1.83	1.22	Fill (Topsoil, sand and gravel)			2 GS			
								3.05	Silty Clay Till (disturbed, light to dark brown, black granular material (ash, coal)	[illegible]		3 GS	BTEX TPH		purgeable & extractable HC
BH3	25-Jan-95	RJB	360.56	4.42	na		1.2	1.22	Fill (Topsoil, sand and gravel, slag, glass, paper, steel, copper)			2 GS			
								4.42	Fill (silty clay till) - sheen free product at 3.05 m -water with sheen at 4.42 m	[illegible]	black	6 GS	BTEX TPH		purgeable & extractable HC
BH4	25-Jan-95	RJB	355.93	3.35	25-Jan-95	0.9	3.03	0.32	Fill (brown sand and gravel)						
								3.35	Silty Clay Till - coal black granular material at 1.47 m -refusal at 3.35 m	[illegible]	black below 1.47 m	6 GS	BTEX TPH		purgeable & extractable HC
BH5	25-Jan-95	RJB	360.83	4.26	na	na	4.26	2.13	Fill (Brown topsoil, sand, gravel, coal, slag	[illegible]	black below 0.6 m				
								4.26	Silty Clay Till - sheen on clay hole filled with water to 2.13 m	[illegible]	black	2 GS	BTEX TPH		purgeable & extractable HC
BH6	25-Jan-95	RJB	359.47	3.96	na	na	3.54	0.42	Fill (brown topsoil, sand, gravel)						
								3.96	Silty Clay Till - 1.83 m black granular material (coal/ash)	[illegible]	black below 1.83 m	2 GS	BTEX TPH		purgeable & extractable HC
BH7	25-Jan-95	RJB	359.47	3.05	na	na	2.55	0.5	Fill (Asphalt, sand and gravel)						
								3.05	Fill (black granular fill (coal/ash) - seepage with sheen @2.13 m	[illegible]	Black	2 GS	PAHs BTEX TPH		nil

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Location Designation	Drilling Date	Drilled by	Ground Elevation (m asl)	Bottom of borehole (m bgs)	WL date	Water Level (m bgs on log)	Interpreted Thickness of Impacted Fill/Soil	Bottom of Unit (m)	Unit	Odours	Staining	Soil Samples	Soil Analysis	Water Samples	Soils Exceeding March 2007 I/C
BH8	25-Jan-95	RJB	359.91	3.66	na	na	3.66	3	Fill (sand, gravel, glass, coal, slag) - medium to coarse sand from 1.22 to 1.83 m		Black	1 GS	BTEX TPH		nil
								3.66	Silty Clay Till (beige to grey, black granular material (coal/ash), sheen on clay)	[redacted]		1 GS			
BH9	25-Jan-95	RJB	361.47	8.38	na	na	7.62	0.15	Concrete						
								0.76	Fill (sand and Gravel)						
								8.38	Silty Clay till, brown	[redacted]	Black/brown at 6 m, free product		BTEX TPH		purgeable
BH10	25-Jan-95	RJB	361.47	8.38	na	na	6.86	0.17	Concrete						
								1.52	Fill (sand and gravel)						
								8.38	Silty Clay till, brown	[redacted]	sheen		BTEX TPH		purgeable & extractable HC
BH11	1-Mar-95	RJB	361.13	6.85	na	na	6.85	1.82	Fill (rail slag, sand and gravel, black)		Black				
								6.85	Silty Clay Till, black stained, grey black, sheen	[redacted]	Black, sheen		BTEX (2X) TPH(2X)		nil
BH12	1-Mar-95	RJB	360.58	6.09	na	na	6.09	0.76	Fill (rail slag, sand and gravel, black)	musty	Black				
								6.09	Silty Clay Till, black stained, grey black, grey/green, sheen in fractures	[redacted]	Black, sheen		BTEX TPH		nil
BH13	1-Mar-95	RJB	357.98	2.13	na	na	1.37	0.15	Asphalt		Black				
								0.76	sand and gravel base						
								2.13	Silty Clay Till, beige to grey, sheen	[redacted]			BTEX TPH		nil
BH14	1-Mar-95	RJB	361.47	5.33	na	na	4.95	0.38	Concrete						
								2.59	Fill (Sand and gravel, rail slag, coal, black/brown)						
								5.33	Silty Clay Till, greenish grey	[redacted]	Greenish grey, sheen		BTEX TPH		purgeable HC
BH15	1-Mar-95	RJB	361.47	5.33	na	na	1.96	0.17	Concrete						
								2.13	Fill (sand and gravel, slag, coal, black/brown)						
								5.33	Silty Clay Till, black grey beige		black/grey				
BH16	1-Mar-95	RJB	358.08	5.33	na	na	0	0.1	Asphalt						
								0.6	Sand and gravel						
								5.33	Silty Clay Till, beige grey, brown						
BH17	1-Feb-95	RJB	358.21	5.35	na	na	0	0.15	asphalt						
								0.45	Fill (sand and gravel)						
								5.35	Silty Clay Till, grey beige						
BH18	2-Mar-95	RJB	358.97	2.28	na	na	1.83	0.1	Asphalt						
								0.45	Fill (sand and gravel)						
								2.28	Silty Clay Till, black grey beige, sheen product -refusal on possible utility (gas/water)	[redacted]	Black, sheen		BTEX (2X) TPH (2X)		nil
BH19	2-Mar-95	RJB	361.47	2.03	na	na	0	0.3	Concrete						
								0.6	Fill (sand and gravel) - auger refusal at 2.03 on concrete	musty					
OW1D	28-Jul-93	RJB	361.57	2.44	28-Jul-93	1.8	2.44	1.22	Fill (sand and gravel, cinder, ash) oily sheen	[redacted]	Black	1 GS			
								2.44	Silty Clay Till (soft)	[redacted]	greenish grey	1 GS			
								5.89	Silty Clay Till (firm)			2 GS			

Table 1
Soil Stratigraphy and Sampling Summary Boreholes and Observation Wells

Location Designation	Drilling Date	Drilled by	Ground Elevation (m asl)	Bottom of borehole (m bgs)	WL date	Water Level (m bgs on log)	Interpreted Thickness of Impacted Fill/Soil	Bottom of Unit (m)	Unit	Odours	Staining	Soil Samples	Soil Analysis	Water Samples	Soils Exceeding March 2007 I/C
OW1S	28-Jul-93	RJB	361.57	5.89	28-Jul-93	1.5	2.44	1.22	Fill (sand and gravel, cinder, ash) - oily sheen	[redacted]	Black				
								2.44	Silty Clay Till (soft)	[redacted]	greenish grey				
OW2	28-Jul-93	RJB	361.59	3.81	28-Jul-93	2.7	0	1.5	Fill (sand and gravel, cinders)						
								3.81	Silty Clay Till soft						
OW3	28-Jul-93	RJB	361.41	5.03	28-Jul-93	3.1	0.61	0.61	Fill (sand and gravel, cinders)		Black				
								2.13	Silty Clay Till soft						
								5.03	Silty Clay Till						
OW4	28-Jul-93	RJB	361.45	3.04	28-Jul-93	1.6	2.79	0.25	Topsoil, brown						
								1.47	Fill (sand and gravel, film/sheen)	[redacted]	black		Metals		Pb, Cu
								3.04	Silty Clay Till (fine to coarse sand and gravel - 0.2 m layer of sand at 2.28 m	[redacted]	black becoming greenish grey with depth				
OW5	7-Sep-94	RJB	361.54	3.04	7-Sep-94	0.95	2.79	0.25	Topsoil, brown						
								1.01	Fill (sand and gravel), sheen	[redacted]	black staining		Metals		Pb, Cu
								3.04	Silty Clay Till, sheen	[redacted]	black becoming greenish grey with depth		TPH		nil
OW6	7-Sep-94	RJB	361.32	3.7	7-Sep-94	1.5	2.15	2.15	Fill (Sand and gravel), brown to black				Metals TPH		purgeable HC
								3.7	Silty Clay till, brown to grey						
OW7	7-Sep-94	RJB	361.49	3.64	na	na	2.84	2.84	Fill (Sand and gravel), light brown - pieces of glass, tin, tar paper		black stains		Metals		Zn (2x), Pb (3x), Cu (3x)
								3.64	Silty Clay Till, brown						
OW8		RJB	361.43	5.32	7-Sep-94	2.9	5.12	0.2	Topsoil, brown						
								2.28	Fill (Sand and gravel) - glass coal, cinders, foundry slag, tar paper				Metals		Zn, Pb, Cu, Ba
								5.32	Silty Clay till, beige - film, sheen on sample glove, spoon water and glove at 2.48 m	[redacted]			TPH (2X)		purgeable HC
OW9	8-Sep-94	RJB	361.11	5.92	8-Sep-94	4	2.84	0.2	Topsoil, brown						
								3.04	Fill (sand and gravel) - glass, coal, cinders, foundry slag wood, tar paper, rust staining				Metals		Pb, Ni, Cu
								5.92	Silty Clay Till, beige to buff						
OW10	8-Sep-94	RJB	361.72		8-Sep-94	1.7	1.52	0.2	Topsoil, brown						
								1.72	Fill (Sand and Gravel), black, brown - glass, coal cinders, foundry slag, wood, tar paper, rust staining	[redacted]			Metals TPH		Pb, Cu purgeable HC
								3.64	Silty Clay Till	[redacted]	dark grey, to green ish grey		TPH (2X)		nil
OW11	8-Sep-94	RJB	361.38	3.8	8-Sep-94	1.4	1.17	0.2	Topsoil, brown						
								1.37	Fill (Sand and Gravel), black - glass, coal cinders, ash	burnt odour			Metals TPH		Pb, Cu purgeable & extractable HC
								3.8	Silty Clay Till, greenish grey grading to beige, black staining		greenish grey grading to beige		TPH		nil

Table 1
Soil Stratigraphy and Sampling Summary Boreholes and Observation Wells

Location Designation	Drilling Date	Drilled by	Ground Elevation (m asl)	Bottom of borehole (m bgs)	WL date	Water Level (m bgs on log)	Interpreted Thickness of Impacted Fill/Soil	Bottom of Unit (m)	Unit	Odours	Staining	Soil Samples	Soil Analysis	Water Samples	Soils Exceeding March 2007 I/C
OW12	8-Sep-94	RJB	361.36	3.07	8-Sep-94	1.5	1.12	0.25	Topsoil, brown						
								1.37	Fill (Sand and Gravel), black - rail slag, glass, coal, brick				Metals		Pb, Cu
								3.07	Silty Clay Till, greenish grey grading to beige, black staining		greenish grey grading to beige				
OW13	8-Sep-94	RJB	360.59	3.12	8-Sep-94	1.75	0.78	0.78	Fill (sand and gravel) - rust staining, rail slag, glass, coal, foundry slag				Metals		Pb, Cu
								3.12	Silty Clay Till		black stained grading to beige brown with depth				
OW14	28-Feb-96	RJB	361.47	7.62	1995-03-13	3	0.7	0.15	Concrete						
								0.76	Fill (sand and gravel)						
								7.62	Silty Clay Till, beige to grey, sheen form 3.0 to 3.7 m	[redacted]	sheen 3 to 3.7 m		BTEX TPH (2X)		purgeable HC, extractable (2X)
OW15	2-Mar-95	RJB	358.98	4.57	1995-03-13	0.85	1.83	0.1	Concrete						
								0.45	Fill (sand and gravel)						
								4.57	Silty Clay Till, beige becoming black beige, product in pockets	[redacted]	sheen to 2.28 m				
OW16	2-Mar-95	RJB	361.53	7.01	1995-03-13	3.2	0		no soil logging						

Notes:

d thickness of impacted soil and fill does not include concrete.
:hickness of impacted soil is based on a combination of factors:
- the nature and description of the Fill,
- Documented odours and staining,
- sheen and
- soil quality results.

RJB indicates Burnside
ENE indicates England Naylor Engineering
m asl indicates metres above sea level
m bgl indicates meters below ground level
nted text was used to interpret the presence of impacts

Table 2
Soil Stratigraphy and Sampling Summary Test Pits

Location Designation	Excavation Date	Excavated by	Ground Elevation (masl)	Interpreted Thickness of Impacted Fill/Soil (m)	Bottom of Unit (m bgl)	Unit	Odours	Staining	Water Found	Soil Samples	Water Samples	Soils Exceeding March 2007 I/C and R/P
TP1	28-Jul-93	RJB		1.4	1.1	Fill (sand and Gravel, brown)		black staining	1.1	VOC	no	Benzene, ethyl benzene, xylenes, purgeable HC
					2.13	Silty clay, grey		black staining 1.1 to 1.4 m				
TP2	28-Jul-93	RJB		1.3	1.05	Fill (sand and Gravel, brown) gravel layer at .61 m to 1.11 m		black staining	1.1	Metals	no	Pb,Cu, B
					2.15	Silty clay, black stained becoming grey below 1.3 m		black stained				
TP3	28-Jul-93	RJB		0	0.66	Fill (sand and Gravel, brown)			1.1		no	
					1.5	Silty clay, dark to light grey						
TP4	28-Jul-93	RJB		0	1.1	Fill (sand and gravel, brown to black)			1.1		no	
					1.5	Silty Clay, grey						
TP6	28-Jul-93	RJB		0.9	0.9	Fill (sand and gravel, rebar, black at base)				Metals	no	Pb,Cu, B
					1.82	Silty Clay, grey						
TP7	28-Jul-93	RJB		0.76	0.76	Fill (sand and gravel, black)		Black			no	
					1.85	Silty Sand						
					2.13	Sandy Silt, light brown						
TP10	28-Jul-93	RJB		1	1	Fill (sand and gravel, black)					no	
					2.2	Silty Clay, grey						
TP12	28-Jul-93	RJB		1	1	Fill (silty sand dark brown)		black staining	2.54	Metals	no	Pb,Cu, B
					2.5	Sandy Silt, light brown						
					3.05	Clayey silt, light brown				VOC, TPH		nil
TP14	28-Jul-93	RJB		1.1	1.1	Fill (Sand and gravel, buff colour)				VOC PAHs Metals TPH	no	B, Cu
					1.52	Silty clay, grey						
TP15	28-Jul-93	RJB		0.8	0.8	Fill (silty sand, light grey to brown)		black staining	1.8	Metals	no	Zn, Pb, B, Cu
					2.13	Sandy silt, brown - 1.2 thin black organic layer at 1.2m						
TP16	28-Jul-93	RJB		1.6	0.1	Asphalt			1.5		no	
					1.7	Fill (Sand and gravel, buff colour)		black staining		VOC TPH		nil
					2.13	Silty Clay, light grey						
TP17	28-Jul-93	RJB		2	2	Fill (sand and gravel, brick, dark brown to black) - organic layer at 1.1 m			1.98		no	
					2.13	Silty Clay, brown				Metals		Pb, B, Cu
TP18	28-Jul-93	RJB		2.65	2.65	Fill (sand to silty sand, metal, light brown to black)				PAHs Metals	no	Pb, B, Cu
					3.05	Silty clay, light brown						
TP19	28-Jul-93	RJB		2.8	1.35	Fill (Sand and gravel, brick, wood, cinders)		black			no	
					2.8	Silty Clay - oily sheen on water						
TP20	28-Jul-93	RJB		2.13	1.1	Fill (Silty Sand)			1.1	VOC TPH	no	extractable HC
					2.13	Silty Clay, black becoming light brown below 2.13m						
TP23	6-Sep-94	RJB	361.63	1.73	0.25	Topsoil, brown					no	
					1.98	Fill (Sand and gravel, slag, coal, black, brown, clay brick)			1.77	Metals TPH		Pb, Cu, Ba purgeable HC
TP24	6-Sep-94	RJB	361.33	0.96	0.25	Topsoil, brown					no	
					1.21	Fill (Sand and Gravel, slag, wood, brick, black brown to grey)		black		Metals TPH		Pb, Cu, purgeable & extractable HC
					1.95	Silty Clay till, stained black/brown						
TP25	6-Sep-94	RJB	361.48	1.8	0.45	Topsoil, brown				Metals	no	Pb, Cu, Ba
					0.8	Fill (sand and gravel, slag wood, glass, brick, black/brown, slight sheen)			1.7			
					2.1	Silty Clay till, grey				TPH		purgeable & extractable HC
TP26	6-Sep-94	RJB	361.53	0.8	0.35	Topsoil, brown (pipe)			1.21		no	
					0.8	Fill (sand and gravel, slag, wood, glass, brick, black/brown)				Metals		Pb, Cu
					2	Silty Clay till, grey				TPH		nil
TP27	6-Sep-94	RJB	361.51	1	0.35	Topsoil, brown					no	
					1.2	Fill (Sand and gravel, slag, coal, black/brown)				Metals TPH		Pb, Cu, purgeable HC
					2.08	Silty Clay till, grey - sheen on water entering at 1.21 m			1.21			

Table 2
Soil Stratigraphy and Sampling Summary Test Pits

Location Designation	Excavation Date	Excavated by	Ground Elevation (m asl)	Interpreted Thickness of Impacted Fill/Soil (m)	Bottom of Unit (m bgl)	Unit	Odours	Staining	Water Found	Soil Samples	Water Samples	Soils Exceeding March 2007 I/C and R/P
TP28	6-Sep-94	RJB	361.39	1.6	0.35	Topsoil, brown					no	
					1.16	Fill (Sand and gravel, slag, brick, glass, wire, coal, black/brown, rust staining)				Metals		Pb, Cu
					2.38	Silty Clay till, grey - sheen on water entering at 1.21 m		stained dark grey to black grading to buff at base sheen on water entering at 1.9 m	1.9	TPH		purgeable HC
TP29	6-Sep-94	RJB	361.46	1.85	0.33	Topsoil, brown					no	
					1.21	Fill (sand and gravel, slag, black/brown, rust staining)				Metals		Pb, Cu
					2.18	Silty Clay till, grey		stained dark at the top		TPH		purgeable HC
TP30	6-Sep-94	RJB	361.51	1.04	0.23	Topsoil, brown					no	
					1.27	Fill (sand and gravel, slag, brick coal, tar paper, black/brown, rust staining)				Metals		Cu
					2.13	Silty Clay till, grey		stained dark at the top		TPH		nil
TP31	6-Sep-94	RJB	361.45	1.02	0.25	Topsoil, brown					no	
					1.27	Fill (sand and gravel, granular A, buff)		black staining at 0.45 m		Metals		nil
					1.93	Silty Clay till, dark brow to black becoming grey		stained dark at the top				
TP32	6-Sep-94	RJB	361.44	1	0.2	Topsoil, brown			1.21		no	
					0.63	Fill (sand and gravel, slag, coal, tar paper, black)		black		Metals		Pb, Cu
					2.08	Silty Clay till, black at top, becoming grey - free product seepage at 1.21 m		black at top				
TP35	6-Oct-94	RJB	359.61	1.32	0.27	Asphalt					no	
					0.45	Fill (Sand and gravel, brown)						
					1.77	Fill - coal, slag, metal, brick, black - silty clay till fill, beige	burn coal and wood odour	black at top		Metals oil & grease		nil
TP36	6-Oct-94	RJB	360.2	1.48	0.27	Asphalt					no	
					0.45	Fill (Sand and gravel, brown)						
					1.93	Fill - sand and gravel, coal, slag, metal, brick, black -silty clay till, beige	burnt odour	black at top		Metals TPH		Pb, Cu
TP37	6-Oct-94	RJB	360.4	0.28	0.22	sand and gravel, brown					no	
					0.5	Fill Sand and gravel, coal, slag, scrap metal, wood, brick, black	burnt odour	black				
					2.08	Silty Clay till, grey beige				Metals		Pb, Cu
TP40	6-Oct-94	RJB	361.22	1.98	0.22	Topsoil, dark brown					no	
					2.2	Fill (sand and gravel, coal, slag, glass, metal, copper, wood, brick, black)		black		Metals		Pb, Cu
					4.11	Silty Clay till, beige			4.06			
TP41	6-Oct-94	RJB	361.51	2.66	0.38	Topsoil, dark brown					no	
					0.86	Fill (ash, white from burnt coal, wood)				Metals		Pb, Cu
					3.04	Silty Clay Till, stained light black to grey green (bunker C?) - oil pocket throughout clay, sheen on black water		black greenish grey	2.59	VOC		
TP44	6-Oct-94	RJB	361.43	1.1	0.2	Topsoil, brown					no	
					1.01	Fill (sand and gravel, slag, coal, black, free product) - PVC pipe at 1.06 m stone bedding origin of free product				Metals TPH		Pb, Cu, purgeable HC
					1.9	Silty Clay Till, stained black at top grading to green/grey		stained black at the top grading to grey green				
TP45	6-Oct-94	RJB	361.55	0.71	0.2	Topsoil, brown			1.95		no	
					0.91	Fill (sand and gravel, slag, coal, stained black)				Metals		nil
					2.03	Silty Clay Till, beige - 0.15 m of gravel at 1.67 m						
TP46	6-Oct-94	RJB	361.62	2.23	0.2	Topsoil, brown			2.18		no	
					1.52	Fill (sand and gravel, slag, coal, steel, brick, black/brown) - 2 cm steel pipe with wires at 0.43 m				Metals		Pb, Cu
					2.43	Silty Clay Till, beige				TPH		purgeable HC
TP47	7-Oct-94	RJB	361.56	0.44	0.2	Topsoil, brown			0.6		no	
					0.66	Fill (sand and gravel, slag, coal, steel, brick, black/brown) - 2 cm steel pipe with wires at 0.43 m				Metals		Pb, Cu
					2.48	Silty Clay Till, grey/green, beige		greenish grey				

Table 2
Soil Stratigraphy and Sampling Summary Test Pits

Location Designation	Excavation Date	Excavated by	Ground Elevation (m asl)	Interpreted Thickness of Impacted Fill/Soil (m)	Bottom of Unit (m bgl)	Unit	Odours	Staining	Water Found	Soil Samples	Water Samples	Soils Exceeding March 2007 I/C and R/P
TP48	7-Oct-94	RJB	361.49	2	0.2	Topsoil, brown					no	
					0.6	Fill (sand and gravel, slag, coal, steel, brick, black/brown) - 2 cm steel pipe with wires at 0.43 m						
					2.2	Silty Clay Till, black stained - @ 0.96 m 5 cm PVC pipe east to west		black	1.7			
TP49	7-Oct-94	RJB	361.49	2.33	0.21	Topsoil, brown					no	
					0.6	Fill (sand and gravel, slag, coal, steel, brick, black)		black				
					2.54	Silty Clay Till, black stained - @ 0.88 m 5 cm PVC pipe east to west, granular backfill has odour		black		TPH		purgeable and extractable HC
TP52	7-Oct-94	RJB	361.58	0.3	0.3	Fill (sand and gravel, brown to black) - refusal on old foundation				oil & grease PCBs	no	nil
TP53	7-Oct-94	RJB	361	0.3	0.3	Fill (sand and gravel, glass, brown to black) - refusal on old foundation				oil & grease PCBs	no	PCB
TP54	7-Oct-94	RJB	361.44	2.7	0.22	Fill (Sand, fine to medium, beige)					no	
					2.92	Fill (sand and gravel, slag, coal, steel, copper, brick, glass)				Metals		Pb (2x), Cu (2x), Zn
					3.3	Silty Clay till, brown to orange				Metals		nil
TP55	7-Oct-94	RJB	361.4	2.34	0.2	Topsoil, brown					no	
					2.54	Fill (Sand and Gravel, slag, coal, glass, steel, brick, black and oxidized)		black		Metals		Zn, Pb, Ni, Cu
					3.35	Silty Clay till, grey stained top 0.25 m then brown/beige				Metals		nil (2x)
TP56	7-Oct-94	RJB	361.43	2.54	2.54	Fill (Sand and gravel, coal, glass, steel tube, wood, wires, beige to dark brown) - @ 1.62 m .25 m fire hydrant water main N to S backfilled with fine sand				Metals TPH	no	Pb (2x), Cu (2x), purgeable and extractable HC
					3.17	Silty Clay till, beige/brown						
TP57	7-Oct-94	RJB	361.2	0.25	0.25	Topsoil, brown					no	
					0.5	Fill (sand and gravel, concrete pieces, refusal on old powerhouse foundation)						
TP58	7-Oct-94	RJB	361.02	0.25	0.25	Topsoil, brown					no	
					0.5	Fill (sand and gravel, concrete pieces, refusal on old power house foundation)				Metals		Pb
TP61	7-Oct-94	RJB	361.69	2.48	0.21	Topsoil, brown					no	
					1.21	Fill (sand and gravel, slag, coal, glass, black/brown)		black		Metals		nil
					2.69	Silty Clay till, grey/green		greenish grey		TPH		purgeable HC
TP64	28-Feb-95	RJB	361.49	5.5	1	Fill (brick, slag, coal, glass, steel, sand and gravel, black concrete pieces)					no	
					5.5	Silty Clay till, beige becoming black at 3.2 m - sheen		black below 3.2 m and sheen		BTEX (3X) TPH (3X)		Benzene, Toluene, Ethyl benzene, purgeable HC (2X), extractable HC
TP70	1-Mar-95	RJB	360.8	1.2	1.2	Fill (topsoil, sand and gravel, tar paper, brick, boulders, slag, coal, tin, glass, black)		black			no	
					4	Silty Clay till, beige - boulders 15 to 30 cm at 2.0 m	musty odour		1.2			

Notes:
The interpreted thickness of impacted soil and fill does not include concrete.
The interpreted thickness of impacted soil is based on a combination of factors:
- the nature and description of the Fill,
- Documented odours and staining,
- sheen and
- soil quality results.

RJB indicates Burnside
ENE indicates England Naylor Engineering
m asl indicates metres above sea level
m bgl indicates meters below ground level
Highlighted text was used to interpret the presence of impacts

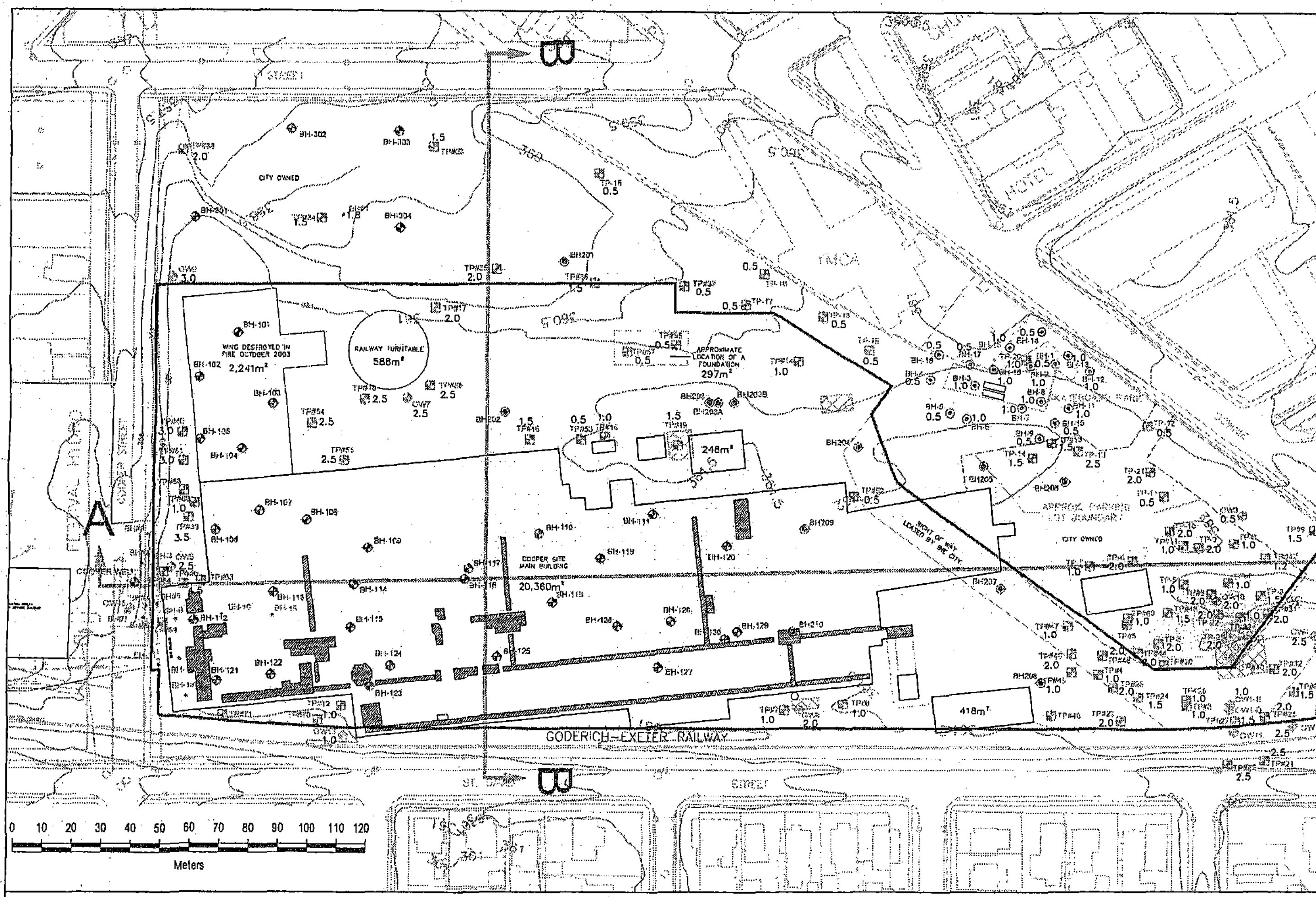
BURNSIDE

Figures

FIGURE 1

CITY OF STRATFORD
COOPER SITE PROPERTY
SITE CONDITIONS - MAY 2009

SITE LAYOUT



LEGEND

- APPROXIMATE COOPER SITE PROPERTY AREA = 4.65 ha (11.5 Acres)
- TEST PIT LOCATION (by Burnside, 1993, 1994 & 1995)
- 4.5 ---- Depth of fill in metres
- BOREHOLE LOCATION LOCATION (by Naylor Engineering, March 1996)
- BOREHOLE LOCATION (by Burnside, 1995)
- BOREHOLE LOCATION (by England Naylor, 1996)
- OBSERVATION WELL LOCATION (by Burnside, 1993, 1994 & 1995)
- TEST PIT LOCATION (by Burnside, 1998)
- BOREHOLE LOCATION (by Burnside, 2004)
- FORMER MUNICIPAL WELL CONVERTED TO A MULTI-LEVEL MONITORING WELL
- APPROXIMATE AREAS EXCAVATED IN 1998
- FORMER UNDERGROUND OR ABOVE GROUND STORAGE TANK
- A A CROSS SECTION ORIENTATION
- FILLED PIT
- ASSUMED SHAFT LOCATION

1:1,500
May 2009
Project Number: HO047599
Prepared by: C. Sheppard

Projection: UTM Zone 17
Datum: NAD83
Verified by: J. Walls

BURNSIDE

HO047599 SITE CONDITIONS MAY 2009 SP.dwg

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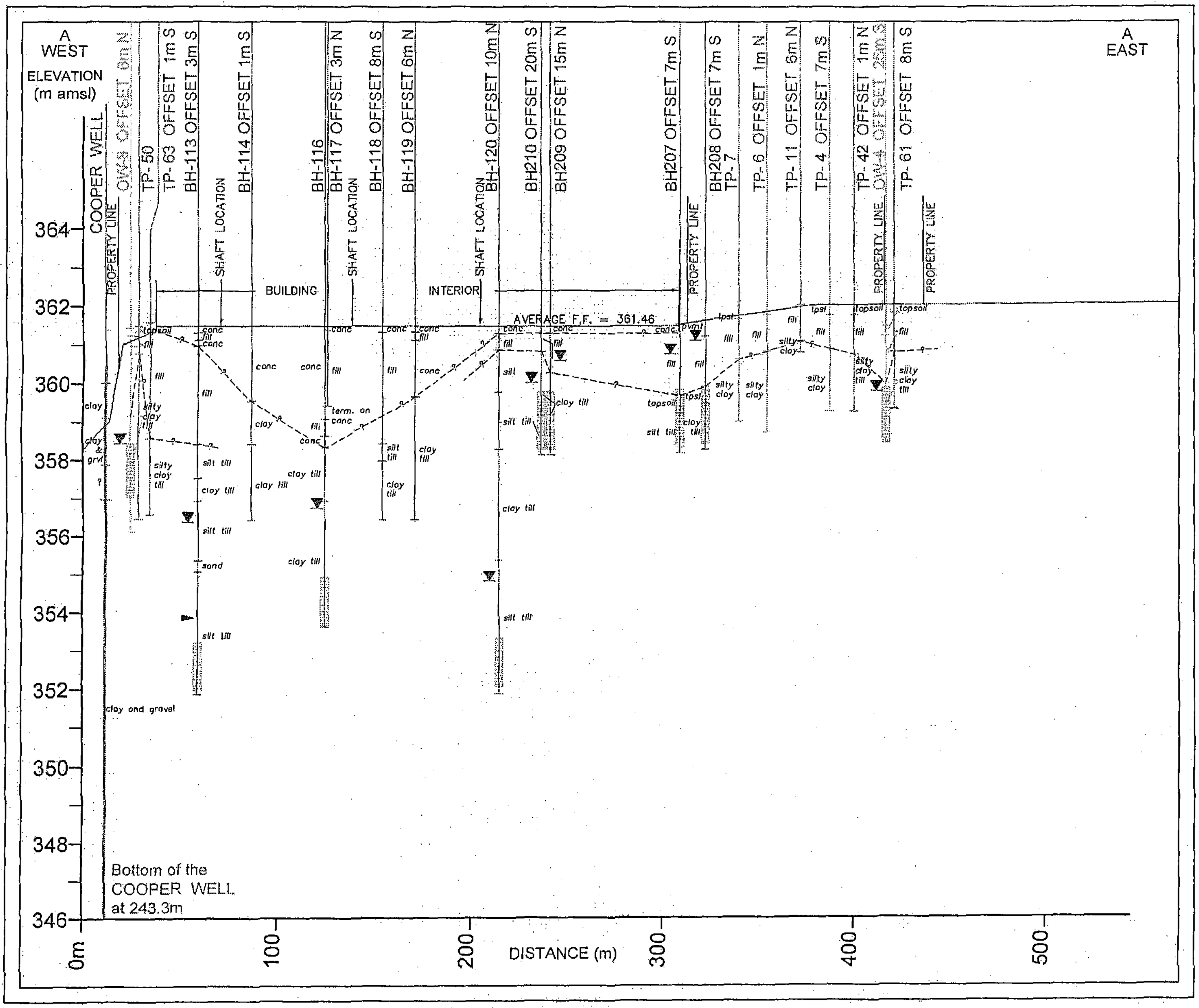

FIGURE 2

CITY OF STRATFORD
COOPER SITE PROPERTY
SITE CONDITIONS - MAY 2009

CROSS SECTION A-A

LEGEND

WELL LOCATION & NUMBER

EXISTING GROUND PROFILE

silty sand — GEOLOGICAL STRATIGRAPHY

STATIC WATER LEVEL
(Most recent reading available)

WATER FOUND LEVEL
(At time of drilling)

WELL SCREEN

Horizontal Scale 1:2,000
Vertical Scale 1:100
Vertical Exaggeration 20x

May 2009
Project Number: HO047599

Prepared by: C. Sheppard Verified by: J. Walls

BURNSIDE

HO047599 SITE CONDITIONS MAY 2009 XSA.dwg

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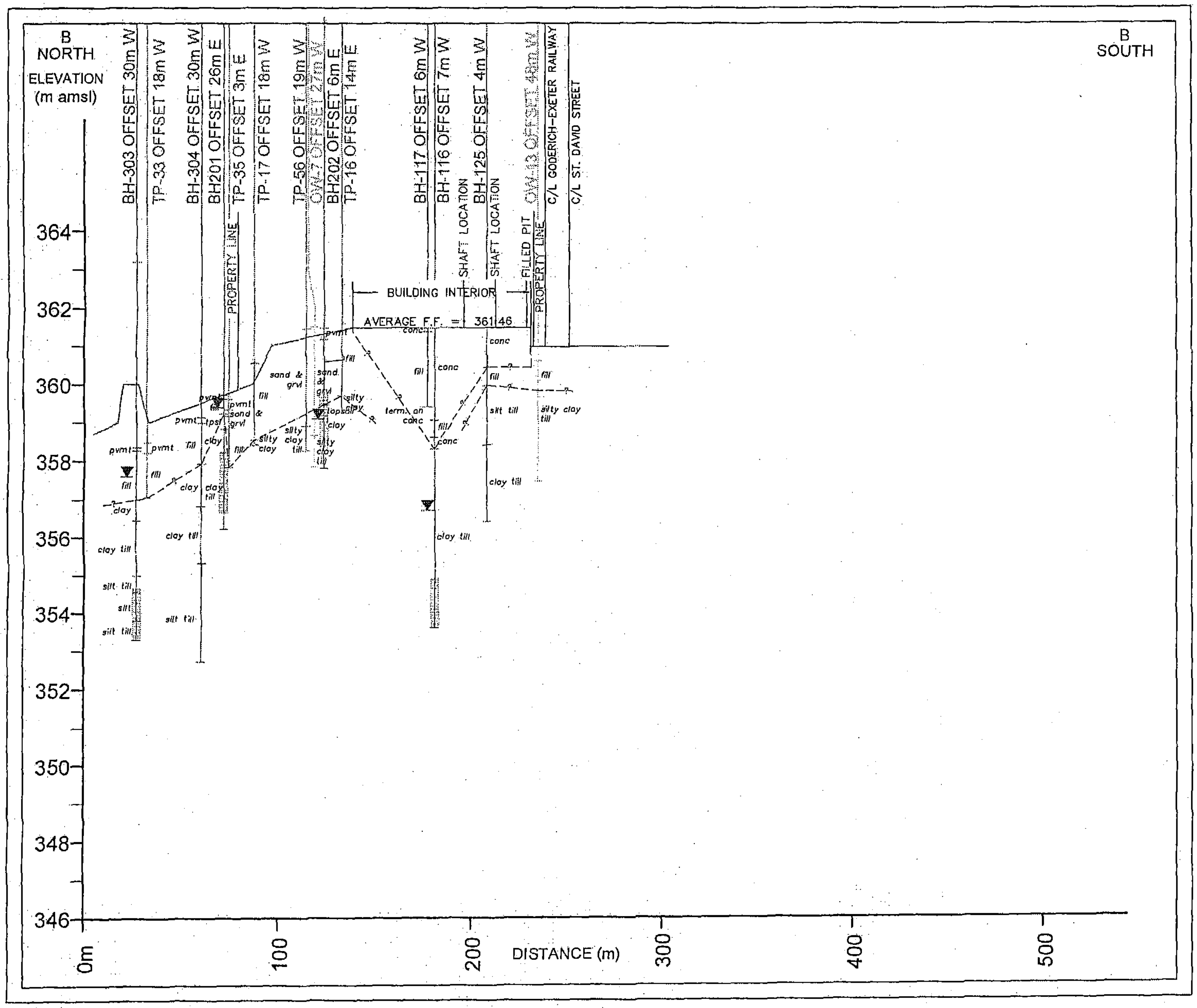


FIGURE 3

CITY OF STRATFORD
COOPER SITE PROPERTY
SITE CONDITIONS - MAY 2009

CROSS SECTION B-B

LEGEND

WELL LOCATION & NUMBER

EXISTING GROUND PROFILE

GEOLOGICAL STRATIGRAPHY

STATIC WATER LEVEL
(Most recent reading available)

WATER FOUND LEVEL
(At time of drilling)

WELL SCREEN

Horizontal Scale 1:2,000
Vertical Scale 1:100
Vertical Exaggeration 20x

May 2009
Project Number: HO047599

Prepared by: C. Sheppard
Verified by: J. Walls

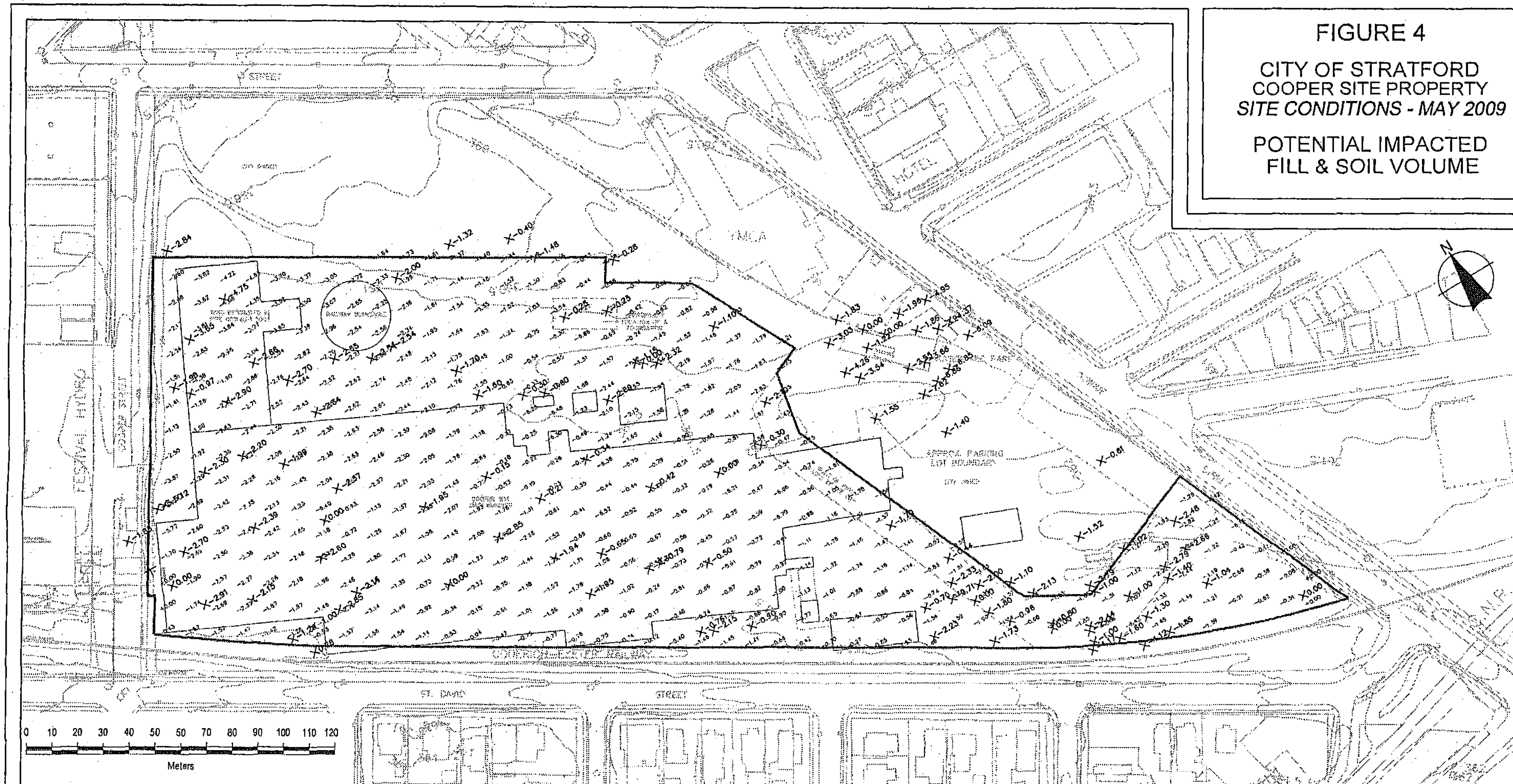
BURNSIDE

HO047599 SITE CONDITIONS MAY 2009 XSB.dwg

FIGURE 4

CITY OF STRATFORD
COOPER SITE PROPERTY
SITE CONDITIONS - MAY 2009

POTENTIAL IMPACTED FILL & SOIL VOLUME



LEGEND

APPROXIMATE COOPER SITE PROPERTY AREA = 4.65 ha (11.5 Acres)

CONTAMINATION THICKNESS IN MONITORING WELLS & TESTPITS (m below ground)

CONTAMINATION THICKNESS GRID (Interpreted by AutoCAD, Land Desktop 2006; m below ground)

POTENTIAL IMPACTED FILL & SOIL VOLUME

VOLUME CALCULATED USING GRID METHOD = 69,029m³

1:1,500
May 2009
Project Number: HO047599

Projection: UTM Zone 17
Datum: NAD83

Prepared by: C. Sheppard

Verified by: J. Walls

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HO047599 SITE CONDITIONS MAY 2009 CV.dwg

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Appendix A
Cost Estimates

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Appendix A-1
Remediation Cost Estimate for
Residential/Parkland/Institutional
Property Use – Generic Standards

Appendix A-1
Remediation Cost Estimate for Residential/Parkland/Institutional Property Use – Generic Standards

Item	Activity	Quantity	Unit	Rate	Budget
1.0	**Environmental Assessment and Site Characterization**				
1.1	***Phase I and II ESA (including):***	1	L.S.	$ 140,000.00	$ 140,000.00
	- Building Conditions Survey				
	- Locates				
	- Geophysics (GPR, EM, etc.)				
	- Test Pitting/Drilling/Soil Sampling				
	- Groundwater Sampling				
	- Surveying				
	- Laboratory Analysis				
	- Reporting				
1.2	*Remedial Options Analysis and Landuse Planning*	1	L.S.	$ 60,000.00	$ 60,000.00
	- Contractor Liaison				
	- Reporting				
				Sub-Total	**$ 200,000.00**
2.0	**On Site Remediation**				
2.1	***Tender/Specification and Tendering***	1	L.S.	$ 40,000.00	$ 40,000.00
2.2	***Above Grade Structures***				
	- Building Demolition	1	L.S.	$ 310,000.00	$ 310,000.00
2.3	***Subgrade Structures***				
	- Excavation and Processing Concrete	36,000	m^3	$ 20.00	$ 720,000.00
	- Crushing and Stockpiling	36,000	m^3	$ 25.00	$ 900,000.00
	- Asbestos Piping Disposal	1	L.S	$ 15,000.00	$ 15,000.00
	- Waste Materials	3,600	m^3	$ 200.00	$ 720,000.00
2.4	***Impacted Fill and Soil***				
	- Excavate/Load/Transport/Disposal	34,500	m^3	$ 200.00	$ 6,900,000.00
2.5	***Wastewater and Groundwater Control***				
	- Pump/Treat/Discharge On Site	5,175	m^3	$ 200.00	$ 1,035,000.00
	- Management of Clean Run-off During Project	1	L.S.	$ 50,000.00	$ 50,000.00
2.6	***Backfilling and Restoration***				
	- Place and Compact Stockpiled Concrete and Inert Materials	36,000	m^3	$ 7.50	$ 270,000.00
	- Acquire/Transport/Place Clean Granular Fill	34,500	m^3	$ 25.00	$ 862,500.00
2.7	***Engineering and Environmental Monitoring***				
	- Engineering and Environmental Oversight	1	L.S.	$ 200,000.00	$ 200,000.00
	- Sampling				
	- Monitoring				
	- Inspection				
2.8	***Regulatory Approvals and Permits***	1	L.S.	$ 20,000.00	$ 20,000.00
2.9	***Miscellaneous***				
	- On Site Management and Operations Activities	1	L.S.	$ 100,000.00	$ 100,000.00
				Sub-Total	**$ 12,142,500.00**
3.0	**Off Site Impacts**				
3.1	***Land Owner Liaison***				
	- Legal	1	L.S.	$ 50,000.00	$ 50,000.00
	- Environmental Assessments and Engineering	1	L.S.	$ 100,000.00	$ 100,000.00
3.2	***Impacted Soil***				
	- Remediation and Restoration	1	L.S.	$ 500,000.00	$ 500,000.00
3.3	***Impacted Groundwater***				
	- Remediation (short term and long term)	1	L.S.	$ 500,000.00	$ 500,000.00
	- Pump and Treat				
	- Bioremediation				
	- Impact Controls				
3.4	***Compensation***				
	- Compensation for Damages and Disruption	1	L.S.	$ 500,000.00	$ 500,000.00
				Sub-Total	**$ 1,650,000.00**
4.0	**Project Finalization**				
4.1	***Documentation***				
4.1.1	*Regulatory Submissions and Documentation and Peer Review*	1	L.S.	$ 40,000.00	$ 40,000.00
4.1.2	*Record of Site Condition and Audit*	1	L.S.	$ 20,000.00	$ 20,000.00
				Sub-Total	**$ 60,000.00**
				Sub-Total	**$ 14,052,500.00**
				10% Contingency	**$ 1,405,250.00**
				Estimated Budget	**$ 15,457,750.00**

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Appendix A-2
Remediation Cost Estimate for Residential/Parkland/Institutional Property Use – Risk Assessment

Appendix A-2
Remediation Cost Estimate for Residential/Parkland/Institutional Property Use – Risk Assessment

Item	Activity	Quantity	Unit	Rate	Budget
1.0	**Environmental Assessment, Site Characterization, and Risk Assessment**				
1.1	***Phase I and II ESA (including):***	1	L.S.	$ 150,000.00	$ 150,000.00
	. *Building Conditions Survey*				
	. *Locates*				
	. *Geophysics (GPR, EM, etc.)*				
	. *Test Pitting/Drilling/Soil Sampling*				
	. *Groundwater Sampling*				
	. *Surveying*				
	. *Laboratory Analysis*				
	. *Reporting*				
1.2	***Risk Assessment***	1	L.S.	$ 300,000.00	$ 300,000.00
	. *Human Health, Ecological, and Toxicological Data Assessment*				
	. *Pre-submission to MOE*				
	. *Risk Assessment*				
1.3	***Remedial Options and Risk Management Strategy***	1	L.S.	$ 100,000.00	$ 100,000.00
				Sub-Total	**$ 550,000.00**
2.0	**On Site Remediation**				
2.1	***Tender/Specification and Tendering***	1	L.S.	$ 40,000.00	$ 40,000.00
2.2	***Above Grade Structures***				
	- *Building Demolition*	1	L.S.	$ 310,000.00	$ 310,000.00
2.3	***Subgrade Structures***				
	- *Excavation and Processing Concrete*	18,000	m^3	$ 20.00	$ 360,000.00
	- *Crushing and Stockpiling*	18,000	m^3	$ 25.00	$ 450,000.00
	- *Asbestos Piping Disposal*	1	L.S.	$ 15,000.00	$ 15,000.00
	- *Waste Materials*	1,800	m^3	$ 200.00	$ 360,000.00
2.4	***Impacted Fill and Soil***				
	- *Excavate/Load/Transport/Disposal*	17,250	m^3	$ 200.00	$ 3,450,000.00
2.5	***Wastewater and Groundwater Control***				
	- *Pump/Treat/Discharge On Site*	2,588	m^3	$ 200.00	$ 517,600.00
	- *Management of Clean Run-off During Project*	1	L.S.	$ 25,000.00	$ 25,000.00
2.6	***Backfilling and Restoration***				
	- *Place and Compact Stockpiled Concrete and Inert Materials*	18,000	m^3	$ 7.50	$ 135,000.00
	- *Acquire/Transport/Place Clean Granular Fill*	17,250	m^3	$ 25.00	$ 431,250.00
2.7	***Engineering and Environmental Monitoring***				
	- *Engineering and Environmental Oversight*	1	L.S.	$ 200,000.00	$ 200,000.00
	- *Sampling*				
	- *Monitoring*				
	- *Inspection*				
2.8	***Regulatory Approvals and Permits***	1	L.S.	$ 20,000.00	$ 20,000.00
2.9	***Miscellaneous***				
	- *On Site Management and Operations Activities*	1	L.S.	$ 50,000.00	$ 50,000.00
				Sub-Total	**$ 6,363,850.00**
3.0	**Off Site Impacts**				
3.1	***Land Owner Liaison***				
	- *Legal*	1	L.S.	$ 50,000.00	$ 50,000.00
	- *Environmental Assessments and Engineering*	1	L.S.	$ 100,000.00	$ 100,000.00
3.2	***Impacted Soil***				
	- *Remediation and Restoration*	1	L.S.	$ 500,000.00	$ 500,000.00
3.3	***Impacted Groundwater***				
	- *Remediation (short term and long term)*	1	L.S.	$ 500,000.00	$ 500,000.00
	- *Pump and Treat*				
	- *Bioremediation*				
	- *Impact Controls*				
3.4	***Compensation***				
	- *Compensation for Damages and Disruption*	1	L.S.	$ 500,000.00	$ 500,000.00
				Sub-Total	**$ 1,650,000.00**
4.0	**Project Finalization**				
4.1	***Documentation***				
	- *Regulatory Submissions and Documentation and Peer Review*	1	L.S.	$ 40,000.00	$ 40,000.00
	- *Record of Site Condition and Audit*	1	L.S.	$ 20,000.00	$ 20,000.00
4.2	***Risk Assessment - Risk Management***	1	L.S.	$ 40,000.00	$ 40,000.00
	- *Certificate of Property Use on Title*				
	- *Risk Management Program*				
				Sub-Total	**$ 100,000.00**
				Sub-Total	**$ 8,663,850.00**
				10% Contingency	**$ 866,385.00**
				Estimated Budget	**$ 9,530,235.00**

Notes:

On site remediation costs to Risk Assessment Derived Standards could vary over a wide range, depending on actual landuse and site development.

Costs presented are based on 50 percent less remediation for Items 2.3, 2.4, 2.5, and 2.6 quantities identified for the remediation to the generic standards outlined in Table A-1.

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Appendix A-3
Remediation Cost Estimate for
Industrial/Commercial/Community
Property Use – Generic Standards

Appendix A-3
Remediation Cost Estimate for Industrial/Commercial/Community Property Use – Generic Standards

Item	Activity	Quantity	Unit	Rate	Budget
1.0	**Environmental Assessment and Site Characterization**				
1.1	*Phase I and II ESA (including):*	1	L.S.	$ 150,000.00	$ 150,000.00
	. *Building Conditions Survey*				
	. *Locates*				
	. *Geophysics (GPR, EM, etc.)*				
	. *Test Pitting/Drilling/Soil Sampling*				
	. *Groundwater Sampling*				
	. *Surveying*				
	. *Laboratory Analysis*				
	. *Reporting*				
1.2	*Remedial Options Analysis and Landuse Planning*	1	L.S.	$ 50,000.00	$ 50,000.00
	. *Contractor Liaison*				
	. *Reporting*				
				Sub-Total	$ 200,000.00
2.0	**On Site Remediation**				
2.1	*Tender/Specification and Tendering*	1	L.S.	$ 40,000.00	$ 40,000.00
2.2	*Above Grade Structures*				
	. *Building Demolition*	1	L.S.	$ 310,000.00	$ 310,000.00
2.3	*Subgrade Structures*				
	. *Excavation and Processing Concrete*	18,000	m^3	$ 20.00	$ 360,000.00
	. *Crushing and Stockpiling*	18,000	m^3	$ 25.00	$ 450,000.00
	. *Asbestos Piping Disposal*	1	L.S.	$ 15,000.00	$ 15,000.00
	. *Waste Materials*	1,800	m^3	$ 200.00	$ 360,000.00
2.4	*Impacted Fill and Soil*				
	. *Excavate/Load/Transport/Disposal*	17,250	m^3	$ 200.00	$ 3,450,000.00
2.5	*Wastewater and Groundwater Control*				
	. *Pump/Treat/Discharge On Site*	2,588	m^3	$ 200.00	$ 517,600.00
	. *Management of Clean Run-off During Project*	1	L.S.	$ 25,000.00	$ 25,000.00
2.6	*Backfilling and Restoration*				
	. *Place and Compact Stockpiled Concrete and Inert Materials*	18,000	m^3	$ 7.50	$ 135,000.00
	. *Acquire/Transport/Place Clean Granular Fill*	17,250	m^3	$ 25.00	$ 431,250.00
2.7	*Engineering and Environmental Monitoring*				
	. *Engineering and Environmental Oversight*	1	L.S.	$ 200,000.00	$ 200,000.00
	. *Sampling*				
	. *Monitoring*				
	. *Inspection*				
2.8	*Regulatory Approvals and Permits*	1	L.S.	$ 20,000.00	$ 20,000.00
2.9	*Miscellaneous*				
	. *On Site Management and Operations Activities*	1	L.S.	$ 50,000.00	$ 50,000.00
				Sub-Total	$ 6,363,850.00
3.0	**Off Site Impacts**				
3.1	*Land Owner Liaison*				
	. *Legal*	1	L.S.	$ 50,000.00	$ 50,000.00
	. *Environmental Assessments and Engineering*	1	L.S.	$ 100,000.00	$ 100,000.00
3.2	*Impacted Soil*				
	. *Remediation and Restoration*	1	L.S.	$ 500,000.00	$ 500,000.00
3.3	*Impacted Groundwater*				
	. *Remediation (short term and long term)*	1	L.S.	$ 500,000.00	$ 500,000.00
	. *Pump and Treat*				
	. *Bioremediation*				
	. *Impact Controls*				
3.4	*Compensation*				
	. *Compensation for Damages and Disruption*	1	L.S.	$ 500,000.00	$ 500,000.00
				Sub-Total	$ 1,650,000.00
4.0	**Project Finalization**				
4.1	*Documentation*				
4.1.1	*Regulatory Submissions and Documentation and Peer Review*	1	L.S.	$ 40,000.00	$ 40,000.00
4.1.2	*Record of Site Condition and Audit*	1	L.S.	$ 20,000.00	$ 20,000.00
				Sub-Total	$ 60,000.00
				Sub-Total	$ 8,273,850.00
				10% Contingency	$ 827,385.00
				Estimated Budget	$ 9,101,235.00

Notes:

On site remediation costs to Risk Assessment Derived Standards could vary over a wide range, depending on actual landuse and site development. Costs presented are based on 50 percent less remediation for Items 2.3, 2.4, 2.5, and 2.6 quantities identified for the remediation to the generic standards outlined in Table A-1.

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Appendix A-4
Remediation Cost Estimate for Industrial/Commercial/Community Property Use – Risk Assessment

Appendix A-4
Remediation Cost Estimate for Industrial/Commercial/Community Property Use – Risk Assessment

Item	Activity	Quantity	Unit	Rate	Budget
1.0	**Environmental Assessment, Site Characterization, and Risk Assessment**				
1.1	*Phase I and II ESA (including):*	1	L.S.	$ 150,000.00	$ 150,000.00
	. *Building Conditions Survey*				
	. *Locates*				
	. *Geophysics (GPR, EM, etc.)*				
	. *Test Pitting/Drilling/Soil Sampling*				
	. *Groundwater Sampling*				
	. *Surveying*				
	. *Laboratory Analysis*				
	. *Reporting*				
1.2	*Risk Assessment*	1	L.S.	$ 300,000.00	$ 300,000.00
	. *Human Health, Ecological, and Toxicological Data Assessment*				
	. *Pre-submission to MOE*				
	. *Risk Assessment*				
1.3	*Remedial Options and Risk Management Strategy*	1	L.S.	$ 100,000.00	$ 100,000.00
				Sub-Total	$ 550,000.00
2.0	**On Site Remediation**				
2.1	*Tender/Specification and Tendering*	1	L.S.	$ 40,000.00	$ 40,000.00
2.2	*Above Grade Structures*				
	. *Building Demolition*	1	L.S.	$ 310,000.00	$ 310,000.00
2.3	*Subgrade Structures*				
	. *Excavation and Processing Concrete*	9,000	m^3	$ 20.00	$ 180,000.00
	. *Crushing and Stockpiling*	9,000	m^3	$ 25.00	$ 225,000.00
	. *Asbestos Piping Disposal*	1	L.S.	$ 15,000.00	$ 15,000.00
	. *Waste Materials*	900	m^3	$ 200.00	$ 180,000.00
2.4	*Impacted Fill and Soil*				
	. *Excavate/Load/Transport/Disposal*	8,625	m^3	$ 200.00	$ 1,725,000.00
2.5	*Wastewater and Groundwater Control*				
	. *Pump/Treat/Discharge On Site*	1,294	m^3	$ 200.00	$ 258,800.00
	. *Management of Clean Run-off During Project*	1	L.S.	$ 12,500.00	$ 12,500.00
2.6	*Backfilling and Restoration*				
	. *Place and Compact Stockpiled Concrete and Inert Materials*	9,000	m^3	$ 7.50	$ 67,500.00
	. *Acquire/Transport/Place Clean Granular Fill*	8,625	m^3	$ 25.00	$ 215,625.00
2.7	*Engineering and Environmental Monitoring*				
	. *Engineering and Environmental Oversight*	1	L.S.	$ 150,000.00	$ 150,000.00
	. *Sampling*				
	. *Monitoring*				
	. *Inspection*				
2.8	*Regulatory Approvals and Permits*	1	L.S.	$ 20,000.00	$ 20,000.00
2.9	*Miscellaneous*				
	. *On Site Management and Operations Activities*	1	L.S.	$ 25,000.00	$ 25,000.00
				Sub-Total	$ 3,424,425.00
3.0	**Off Site Impacts**				
3.1	*Land Owner Liaison*				
	. *Legal*	1	L.S.	$ 50,000.00	$ 50,000.00
	. *Environmental Assessments and Engineering*	1	L.S.	$ 100,000.00	$ 100,000.00
3.2	*Impacted Soil*				
	. *Remediation and Restoration*	1	L.S.	$ 500,000.00	$ 500,000.00
3.3	*Impacted Groundwater*				
	. *Remediation (short term and long term)*	1	L.S.	$ 500,000.00	$ 500,000.00
	. *Pump and Treat*				
	. *Bioremediation*				
	. *Impact Controls*				
3.4	*Compensation*				
	. *Compensation for Damages and Disruption*	1	L.S.	$ 500,000.00	$ 500,000.00
				Sub-Total	$ 1,650,000.00
4.0	**Project Finalization**				
4.1	*Documentation*				
	. *Regulatory Submissions and Documentation and Peer Review*	1	L.S.	$ 40,000.00	$ 40,000.00
	. *Record of Site Condition and Audit*	1	L.S.	$ 20,000.00	$ 20,000.00
4.2	*Risk Assessment - Risk Management*	1	L.S.	$ 40,000.00	$ 40,000.00
	. *Certificate of Property Use on Title*				
	. *Risk Management Program*				
				Sub-Total	$ 100,000.00
				Sub-Total	$ 5,724,425.00
				10% Contingency	$ 572,442.50
				Estimated Budget	$ 6,296,867.50

Notes:

On site remediation costs to Risk Assessment Derived Standards could vary over a wide range, depending on actual landuse and site development. Costs presented are based on 50 percent less remediation for Items 2.3, 2.4, 2.5, and 2.6 quantities identified for the remediation to the generic standards outlined in Table A-1.