

REPORT



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REPORT ON

Landfill Rehabilitation and Cost Estimate Report Winnipeg, Manitoba

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1.0 INTRODUCTION

Golder Associates Ltd. (Golder Associates) was retained by the City of Winnipeg (City), to provide professional consulting services relating to the City's Water and Waste Department closed landfills, as outlined under RFP No. 1199-2014. The study being completed, known as the Landfill Disposition Study, includes 33 landfill sites generally located within the City of Winnipeg, Manitoba (see Figure 1) and will be completed in a phased approach, consisting of the completion of a series of reports considering each site, including:

- Phase 1 – Landfill Status Report;
- Phase 2 – Landfill Environmental Risk Report;
- Phase 3 – Landfill Rehabilitation and Cost Estimate Report;
- Phase 4 – Landfill Land Use Potential Report; and,
- Phase 5 – Legal Risk and Responsibility Report.

The 33 landfills were operated from as early as 1875 to as late as 1998. Investigations undertaken by others in the area of the landfills have identified waste, and in some cases soil, groundwater, surface water, and landfill gas impacts, potentially associated with waste materials.

The potential impact that can occur from waste sites is influenced by factors such as the type and age of material deposited, depth of waste, cover material, and the local geology, hydrogeology and surface water bodies. As a result, investigations of areas where waste is known to have been deposited must assess and/or consider these factors in order to determine the potential for impact. Older waste fill areas containing little putrescible material and pre-dating use of industrial organics may be relatively innocuous, whereas those containing large amounts of organic material or liquid waste can continue to generate landfill gas or seepage even when a significant amount of time (like twenty-five years) has passed since closure of these sites.

This report fulfils Phase 3, the Landfill Rehabilitation and Cost Estimate Report. The Landfill Rehabilitation and Cost Estimate Report presents the estimated capital costs and general operational costs related to proposed changes to the current monitoring programs, data gaps of monitoring that should be considered and recommended improvements to the physical condition (proposed engineered control systems) of each of the 33 sites as presented in the Phase 2 report, Landfill Environmental Risk Report.



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The Landfill Rehabilitation and Cost Estimate Report is organized into the following sections:

- Methodology – outlines the steps utilized to complete this phase of the landfill disposition study;
- Risk Considerations – presents some overarching high level findings and comments that pertain to all of the closed landfill sites evaluated as part of this study. These risk considerations will be further explored in the Phase 5 report, Legal Risk and Responsibility;
- Findings – provides the cost of proposed monitoring program changes, recommended improvements and data gap programs for each site; and,
- Closing – provides concluding statements for the Landfill Rehabilitation and Cost Estimate Report.



2.0 METHODOLOGY

Building on the results of the Environmental Risk Report, the Landfill Rehabilitation and Cost Estimate Report essentially outlines the costs of new investigations, modifications to monitoring and/or new or modified engineered control systems.

In determining these costs the following tasks and considerations were completed:

- A local Winnipeg drilling company, [REDACTED] was contacted to obtain expected drilling advancement rates, unit rate costs and well supply costs;
- A local Winnipeg excavation company was contacted to obtain expected test pit costs;
- Well installation cost estimates are capital costs to install new monitoring wells and/or landfill gas probes;
- Monitoring program cost estimates are changes to the program, i.e., general costs to collect samples from the new monitors, additional monitoring sessions and additional parameters. The costs include the analytical laboratory costs as well as time to collect the samples. These do not include costs of the existing monitoring program. Further these costs may change in the future as the monitoring programs have been set to obtain a certain amount of baseline data but that could be reduced or increased based on findings;
- Competitive rates for consultants were used in the estimates as they pertain to organizing drilling activities and or other intrusive investigations;
- Health and safety provisions during intrusive work were considered and included in the estimates, such as development of a site specific plan and procurement of a gas monitoring device where warranted;
- When calculating travel time, it was considered that the drilling supervision, groundwater or surface water sample collection, and test pit supervision would be completed by someone local to the City of Winnipeg;
- For drilling and field investigation the estimated cost for each site was prepared like it is a unique work activity. If some site investigations are grouped together there could be an opportunity for savings as a result of shared activities, for example surveying, waterra tubing, etc.; and,
- Other repair and upgrade costs were estimated using typical costs for material supply and placement, and estimated lump sum amounts for well repairs.



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4.0 FINDINGS

Table 1 at the end of this report summarizes the recommendations for monitoring and improvement at each site based on the Environmental Risk Report (Golder, 2015). Table 2 at the end of this report summarizes the estimated costs at each of the closed Winnipeg landfill sites related to monitoring and improvements. The costs do not include applicable taxes. The costs provided are for budgeting purposes and detailed cost estimates are recommended prior to proceeding with the recommended work. The following subsections outline the overarching findings from this Landfill Rehabilitation and Cost Estimate Report.

Some of the activities and recommendations from the Environmental Risk Report have not been included in the cost estimates as they are expected to be internal activities that the City can readily achieve. The following activities/recommendations were not included:

- Installation of “no smoking” signs;
- Development of health and safety protocols for road or utility work in affected areas; and,
- Inspection work that would be rolled into the annual monitoring and inspection program currently in place.

4.1 Monitoring Program Changes

The costs and hours estimated for the monitoring program changes include the personnel time associated with the sampling (including travel time of 0.5 hours), the supplies required for the sampling (landfill gas probe rental, groundwater filters, water level probe rental, as applicable) and the analytical costs associated with the sampling program for new programs (not previously completed) and programs where an extra day of effort would be required on top of an existing program. If it was deemed that the new program could be completed within an already existing program with relatively small impact to time then that time and the associated supplies were not included. An assessment of the monitoring results is recommended, however, costs related to the assessment of the results of the monitoring have not been included. An assessment would include not only a comparison to relevant criteria, but an assessment of whether monitoring parameters are appropriate and what the results mean in terms of overall site compliance and risk.

The Environmental Risk Report recommended analysis of groundwater and surface water samples for the comprehensive list from Schedule 5 of the Ontario Ministry of Environment and Climate Change's (MOECC's) report titled, “Landfill Standards: A Guideline on the Regulatory and Approval Requirements for New or Expanding Landfill Sites” (hereafter referred to as the Landfill Standards). It is recommended, for most sites, that the use of the comprehensive list be reassessed after a year of monitoring and potentially reduced to the indicator list. The indicator list would be a shorter list of parameters that are specifically present or relevant at the site. The shorter list would be less costly from an analysis perspective. This would be a reduction in laboratory costs for the monitoring program in future years.

The monitoring program changes range from \$700 at Site 2 (St. Boniface Dump Site) to \$10,500 at Site 18 (Summit Road Landfill Site), with the majority of monitoring program changes around \$2,000 to \$4,000. The total estimated cost for monitoring program changes for all sites is \$98,300.



4.2 Reporting

Costs associated with one year of third party assessment of the monitoring program results and recommendations for monitoring program changes have been provided as reporting costs. The costs for report preparation are scaled based on the number of monitoring locations at a site and the presence of engineered features to be assessed such as landfill gas barriers or leachate collection systems. The reports would be based on a year's worth of monitoring data and does not include compilation of historical data.

4.3 Well Installations

Well installation costs include the following:

- Coordination of the work, including hiring the drilling subcontractor, completing health and safety plans and providing advice to the field crew if problems are encountered. This is typically work completed by a consultant;
- Utility clearance coordination and costs;
- Drilling subcontractor;
- Supervision of the work;
- Monitoring well and gas probe supplies, including dedicated sample tubing and foot valves;
- Monitoring equipment required during drilling (water level probes and gas monitors);
- Surveying of the newly installed monitoring wells or probes; and,
- Production of borehole logs.

The following assumptions were made for estimating the well installation costs:

- Landfill gas probes installed in the granular bedding of utilities are installed at a depth of 5 metres. Note probes installed in these areas with the applicable utility groups in the City;
- Shallow landfill gas probes and monitoring wells have a 10 foot (3 metre) screen to allow the screen to straddle the water table so that the probe can be used to collect both landfill gas and groundwater;
- Monitoring wells completed in the bedrock have a 5 foot (1.5 metre) screen;
- A water truck is only needed for monitoring wells completed in the bedrock and these wells would be completed in the same day so that the water truck costs are not charged on multiple days; and,
- The use of traffic control and flagmen are required for landfill gas probes completed within the granular bedding of utilities and anywhere near active roadways, as appropriate.

As shown in Table 2, the well installation costs vary from \$3,700 at Site 2 (St. Boniface Dump Site) at which only one landfill gas probe is recommended to be installed, to \$28,800 at Sites 26 and 27 (Elmwood and Nairn Avenue Landfill Sites) at which four bedrock/shallow overburden monitoring well nests and eight landfill gas probes have been recommended. In general, the monitoring well installation costs are approximately \$14,000 per site, for a total of \$422,900 for all of the sites.



4.4 Subsurface Investigations

The subsurface investigation includes completing test pits to assist in delineating the extent of the waste footprint at select sites. The costs include a backhoe rental and supervision costs. Service clearance costs are already included in the well installation costs, with the exception of Site 36 (Kilcona Park Landfill Site), for which there are no well installation costs. As shown in Table 2, the subsurface investigation costs are generally between \$1,000 and \$2,000, with the subsurface investigation at Site 36 (Kilcona Park Landfill Site) estimated to be \$4,400. The total estimated cost for the subsurface investigations at the closed landfill sites is \$13,600.

4.5 Survey

The survey costs represent the costs associated with surveying existing landfill gas probes or monitoring wells. The installation of new landfill gas probes or monitoring wells have surveying of those newly installed probes included in the cost of installation. While survey costs have been provided separately in Table 2, surveying of existing probes (where recommended) could be completed in conjunction with the installation of the new well installation, which would save money. As shown in Table 2, the survey costs are estimated to vary from \$500 to \$1,200. The total estimated cost for surveying is \$3,100.

4.6 Other Repairs and Upgrades

The majority of “other repairs and upgrades” costs is the supply and placement of topsoil and seeding. This category also includes grass cutting, fences, grading, cover material supply and placement, and well repairs, for select sites. Details of what are included in this category for the select sites are discussed in Section 4.6 below. As shown in Table 2 the costs vary from \$600 for well repairs at Site 1 (Beliveau Road Dump Site) and Site 32 (Lot 61, St. Mary’s Road Dump Site) to \$174,200 for more extensive earth works at Site 29 (CNR – Dugald Road Landfill Site).

4.7 Select Closed Landfill Site Considerations

Some of the closed landfill sites require additional explanation of the cost estimates. These select closed landfill sites are discussed in the following sections.

4.7.1 Site 7 – Kimberly Landfill Site

The addition of topsoil and seeding to the areas of stressed vegetation at the Kimberly Landfill Site are the areas at the top of the two waste mounds. These areas were measured from aerial photographs and estimated to be approximately 3,400 square metres. It is considered that 0.15 metres of topsoil (or soil capable of sustaining vegetative life) would be adequate as this is the standard in Ontario for landfill topsoil cover thickness. The area would be hydroseeded after the soil is placed.

4.7.2 Site 8 – Cordite Road Landfill Site

In the Environmental Risk Report it was stated that to mitigate failure on the east slope and determine whether further failure on the north slope is imminent, a geotechnical investigation is required. As an initial step, the following activities are recommended to determine the cause of the ongoing slumping of areas (in the east and northeast portions of the site) of the existing landfill cover soil and provide the design of remedial measures to stabilize the slopes:



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- 1) Initial site reconnaissance of the landfill to: 1) confirm areas of previously observed cover soil slumping on the east and northeast side slope areas and check for evidence of recent movement; and, 2) check for slumping areas not previously identified in other portions of the landfill.
- 2) Prepare a Health & Safety Plan appropriate for intrusive investigation within a landfill.
- 3) Field program, to assess the soil cover material and determine the groundwater level within the landfill, i.e., groundwater / leachate mound [noting that the analysis done in the previous assessment in July 2008 assumed full saturation to the top of the cover]:
 - a. Drill three lines of boreholes (two within slumped areas and one within an area that has not visibly slumped) with three holes per line (one near the slope crest, one mid slope, one near toe of slope).
 - b. Continuous soil sampling through the reported 3 m thick silty clay soil cover layer and into the underlying waste (assumed depth of 5 – 6 m).
 - c. Install two monitoring wells per hole, one sealed in the waste below the cover layer, one sealed within the cover soil layer. Provide the monitoring well caps with fittings to allow connection of a gas detection instrument and a manometer to measure gas pressure.
 - d. Excavate a number of test pits within the reported 3 m thick silty clay cover soil layer to: observe the characteristics of the layer (apparent degree of compaction, bonding together of the material, etc.); take soil sample profiles vertically through the cover layer; do in situ density tests using a nuclear density gauge at various levels as each test pit is progressively deepened.
 - e. Survey borehole and test pit location and ground surface, and top of monitoring well riser pipe elevation, as well as survey slope profile along same line as borehole line.
 - f. Geotechnical laboratory index property tests (moisture content profiles, Atterberg limits, grain size distribution, standard Proctor compaction test).
 - g. Measure for the presence, composition and pressure of gas, and for stabilized water levels in the monitoring wells. Repeat at least two times to check/confirm readings.
- 4) Analysis: assess characteristics of soil cover layer material; carry out slope stability analysis; determine, if possible, the reasons for surface slumping in some slope areas versus apparent stability in other areas of the slope; determine remedial measures to stabilize slopes.
- 5) Reporting: preparation of an engineering report containing the factual information, results of assessment and remedial recommendations.

The addition of topsoil and seeding to the areas of stressed vegetation at Cordite Road Landfill Site are the areas on the east side of the landfill mound and the southeast corner of the landfill. These areas were measured from aerial photographs and estimated to be approximately 2,530 square metres. It is considered that 0.15 metres of topsoil (or soil capable of sustaining vegetative life) would be adequate as this is the standard in Ontario for landfill topsoil cover thickness. The area would be hydroseeded after the soil is placed.

Since there were water level measurements from existing wells completed within the landfill footprint the existing monitoring wells likely can be used for sampling purposes. As such, costs for a new monitoring well installed within the waste to characterize the leachate are not included.



4.7.3 Site 10 – McPhillips Street Dump Site (Ash Dump)

The addition of topsoil and seeding to the areas of stressed vegetation at the McPhillips Street Dump Site (Ash Dump) are the areas on the east side of the landfill mound. These areas were measured from aerial photographs and estimated to be approximately 1,600 square metres. It is considered that 0.15 metres of topsoil (or soil capable of sustaining vegetative life) would be adequate as this is the standard in Ontario for landfill topsoil cover thickness. The area would be hydroseeded after the soil is placed.

4.7.4 Site 11 – McPhillips Street Landfill Site

To limit public access onto the Site to reduce minor illegal dumping a barrier is recommended at the McPhillips Street Landfill Site. A 140 metre fence with a secured gate along the western edge of the landfill property is considered to be adequate to reduce the illegal dumping.

4.7.5 Site 14 – Leila Avenue (West) Landfill Site

Recommended improvements in the Environmental Risk Report for the Leila Avenue (West) Landfill Site included placement of topsoil and seeding. It is understood that the City has completed this as part of the installation of a new soccer field. As such, costs associated with the placement of topsoil and seeding have not been included in this report.

The Environmental Risk Report recommended that a subsurface investigation be completed via test pit or borehole/augerhole drilling. Given the land use of the site as a recreation facility and park, borehole drilling has been used for this cost estimate.

4.7.6 Site 18 – Summit Road Landfill Site

Continued improvements to the final grading, topsoil and seeding have not been included in the costs associated with the Summit Road Landfill Site as it is understood these tasks are currently being undertaken.

The Environmental Risk Report states that while the addition of internal leachate sumps will help to reduce the mound within the landfill and decrease the number of landfill leachate seeps, it is not possible at this time to determine if reducing the leachate mound would also reduce the extent of the impact to the groundwater. The potential effect would need to be assessed using a groundwater model. Costs associated with leachate sumps and the groundwater model are not included in the cost estimates for the Summit Road Landfill Site. Based on experience at other landfill sites, internal leachate sumps may cost anywhere from \$20,000 to \$80,000 per sump.

Groundwater and surface water monitoring is currently undertaken at the Summit Road Landfill Site. Changes to the regular parameter list used for monitoring have been recommended (the comprehensive list from Schedule 5 of the Landfill Standards) in addition to petroleum hydrocarbons, polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) (groundwater only). The costs provided in Table 2 represent the difference in analytical costs for the existing samples, the analytical costs for the samples from the new monitoring wells as well as time and disbursements associated with sampling the new monitoring wells.



4.7.7 Site 20 – Charleswood Road Landfill Site

Since a water level was measured in 2014 from existing monitoring well P5L completed within the landfill footprint the monitoring well likely can be used for sampling purposes. As such, costs for a new monitoring well installed within the waste to characterize the leachate is not included.

4.7.8 Site 21 – Charleston Street (Community Row) Dump Site

Access to the Charleston Street (Community Row) Dump Site is difficult. The mobilization of equipment to complete test pits and drilling activities will likely be higher than estimated. Further, drilling activities are only required if waste is found to be present at the site.

A new monitoring well installed within the waste to characterize the leachate is required since none of the landfill gas probes at the Charleston Street (Community Row) Dump Site could be located in 2014.

4.7.9 Site 22 – Charleswood Road (South) Landfill Site

A new monitoring well installed within the waste to characterize the leachate is required since none of the landfill gas probes at the Charleswood Road (South) Landfill Site could be located in 2014.

4.7.10 Site 24 – Cadboro Road (West) Dump Site

Continued inspection of the cover and additional seeding have not been included in the costs associated with the Cadboro Road (West) Dump Site as these tasks are currently being undertaken.

4.7.11 Sites 26 and 27 – Elmwood and Nairn Avenue Landfill Sites

The investigation into the current use of a portion of the Elmwood Landfill Site as a potential dumping area was not included in the costs as it is considered that this work would be completed internally by City staff.

Costs associated with methane monitors/alarms for buildings on the site are not included.

4.7.12 Site 28 – Brooklands Landfill Site

Grass mowing is recommended to improve aesthetics, provide better access to the landfill gas probes and to reduce illegal dumping or illegal activities. It is assumed that mowing of the grass would be undertaken three times per year.

The cost for a gate has been included.

Grading of the area in the centre of the site, where previous dumping of material has occurred was included in the costs. Addition of topsoil and seeding this area was also included.

4.7.13 Site 29 – CNR-Dugald Road Landfill Site

The addition of cover material, topsoil and seeding at the CNR-Dugald Road Landfill Site were limited to the disturbed areas near the central portion of the landfill observed in aerial photos. The areas were measured to be approximately 10,660 square metres. The area should first be graded, then 0.60 metres of clay cover should be placed, followed by 0.15 m of topsoil (or soil capable of sustaining vegetative life) and then seeded.

As noted in the Environmental Risk Report, the CNR-Dugald Road Landfill Site has been owned and operated by a party other than the City of Winnipeg. As such, and pending future reports as part of this landfill disposition study, the recommendations provided at this time for this Site may vary in the future depending on the legal liability this Site poses.



4.7.14 Site 30 – Corydon-Osborne Dump Site

The Environmental Risk Report indicated that a subsurface investigation may be completed via test pit or borehole/augerhole drilling. Given the land use of the site as a recreation area, borehole drilling has been used for this cost estimate.

4.7.15 Site 31 – Red-Assiniboine River Junction Dump Site

As noted in the Environmental Risk Report, the Red-Assiniboine River Junction Dump Site has been owned and operated by a party other than the City of Winnipeg. As such, and pending future reports as part of this landfill disposition study, the recommendations provided at this time for this Site may vary in the future depending on the determination of who has legal liability for this Site.

4.7.16 Site 32 – Lot 61, St. Mary's Road Dump Site

A lump sum amount of \$600 is estimated for repairs to the landfill gas probes within the retirement home. The repairs required are not known at this time, however, typical well repair costs were used and then doubled to account for any difficulties encountered in the repair.

4.7.17 Site 36 – Kilcona Park Landfill Site

Adjustments to the leachate collection system have not been included in the costs for the Kilcona Park Landfill Site as the implementation of this recommendation would be based on on-going monitoring results and is more of a long-term option for the site.



5.0 LIMITATIONS

This report was prepared for the exclusive use of the City of Winnipeg. The report, which specifically includes all tables, figures and attachments, is based on information provided by the City and is based solely on historical information and data obtained by Golder Associates during site visits. The City provided available electronic information for each site. Hard copies of additional historical documents for all of the landfill sites are stored at the City offices. Due to the quantity of these files, the review of these documents was out of the scope of this project, although they have been referenced on a limited basis. It has been assumed that the City has provided the relevant information required to complete this report. Reporting of results from the historical information provided does not allow for evaluation of the adequacy of the work completed.

Although comprehensive in nature, the data contained in this report should not be used in lieu of a more complete Phase II Environmental Site Assessment where such an assessment is required, for example, for a property transaction.

The information provided by the City has not been verified by any physical or intrusive methods other than visual inspection conducted during a visit of the sites. Consequently actual geographic limits of the footprint may extend beyond the boundaries shown on figures and the base of the waste may be different than what is reported.

The costs provided in this report are estimates and are for budgeting purposes. Detailed cost estimates are recommended prior to proceeding with the recommended work.

The services performed, as described in this report, were conducted in a manner consistent with that level of care and skill normally exercised by other members of the engineering and science professions currently practising under similar conditions, subject to the time limits and financial and physical constraints applicable to the services.

Any use which a third party makes of this report, or any reliance on, or decisions to be made based on it, are the responsibilities of such third parties. Golder Associates accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

The findings and conclusions of this report are valid only as of the date of this report. If new information is discovered in future work, including excavations, borings, or other studies, Golder Associates should be requested to re-evaluate the conclusions of this report, and to provide amendments as required.



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6.0 CLOSURE

There are 33 closed landfills generally within the City of Winnipeg for which the monitoring programs, data gaps and engineered control systems were evaluated and changes recommended in the Environmental Risk Report. The findings of the Environmental Risk Report were used to estimate costs associated with these changes. The changes included monitoring program changes, well installations, subsurface investigations, surveys and other repairs or upgrades. The total cost for all of the recommended changes at all of the closed landfills is estimated to be approximately \$824,700 (not including applicable taxes). Consideration of risk ranking will be required to prioritize the sites and the proposed investigations.

We trust this report meets your current needs. If you have any further questions regarding this report, please contact the undersigned.

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7.0 REFERENCES

Golder Associates Ltd. (Golder), 2015. *Landfill Environmental Risk Report for Closed Landfills, Winnipeg, Manitoba*. Prepared for the City of Winnipeg.

Table 1 Summary of Recommendations for Winnipeg Closed Landfills

Site Number	Site Name	Monitoring Program Changes ^{1,2}	Well Installations			Subsurface Investigation	Survey	Other Repairs or Upgrades
			Landfill Gas and/or Shallow Wells	Bedrock Wells	Probes in Utilities			
1	Beliveau Road Dump Site	groundwater samples and landfill gas	4	2	2	--	--	--
2	St. Boniface Dump Site	groundwater samples and landfill gas	1	--	--	--	--	--
3	St. Boniface Landfill Site 1	groundwater samples and landfill gas	4	3	5	--	--	--
4	St. Boniface Landfill Site 2	groundwater samples and landfill gas	3	2	1	--	--	--
5	Redonda Dump Site	groundwater samples and landfill gas	3	2	1	--	--	--
6	Redonda Landfill Site	groundwater samples and landfill gas	8	2	1	--	--	--
7	Kimberly Landfill Site	groundwater samples and landfill gas	8	2	5	--	--	Topsoil and reseeding at tops of hills
8	Cordite Road Landfill Site	groundwater samples and landfill gas	5	2	--	--	--	Geotechnical investigation and topsoil/seeding
9	Bonner Avenue Landfill Site	groundwater samples and landfill gas	3	2	2	--	--	--
10	McPhillips Street Dump Site (Ash dump)	groundwater samples (include PAH) and landfill gas	4	2	--	--	--	Tops soil/seeding
11	McPhillips Street Landfill Site	groundwater samples and landfill gas	5	2	--	--	--	Fence and gate
12	Margaret Park Landfill Site	groundwater samples and landfill gas	7	2	1	--	--	Decommissioning P78E including in well installation costs
13	Leila Avenue Landfill Site	groundwater samples and landfill gas	3	2	3	--	--	--
14	Leila Avenue (West) Landfill Site	groundwater samples and landfill gas	4	2	--	Confirm vertical extent of waste Verify extents of waste footprint at the northern portions	--	--
15	Saskatchewan Avenue Dump Site	groundwater samples (include PAH) and landfill gas	2	3	1	--	--	--
16	Barry Avenue Dump Site	groundwater samples and landfill gas	5	2	1	--	--	--
17	Harcourt Street Landfill Site	groundwater samples, landfill gas and additional residential landfill gas monitoring	--	--	2	Define outer extents of waste	Survey existing monitoring probes/wells	--
18	Summit Road Landfill Site	groundwater samples (include PCB, PAH, PHC F1 to F4)	--	4	--	--	--	--
19	Shaftesbury Blvd. Dump Site	groundwater samples and landfill gas	3	2	--	--	--	--
20	Charleswood Road Landfill Site	groundwater samples and landfill gas	2	2	1	--	Survey existing monitoring probes/wells	--
21	Charleston St. (Community Row) Dump	surface water samples, groundwater samples and landfill gas	3	2	--	Confirm presence of landfill	--	--
22	Charleswood Rd. (South) Landfill Site	groundwater samples and landfill gas	7	2	--	--	--	--
24	Cadboro Rd. (West) Landfill Site	groundwater samples (include PHC F1 to F4), surface water samples and landfill gas	2	2	--	--	Survey existing monitoring probes/wells	--
26827	Elmwood and Nairn Avenue Landfill Sites	groundwater samples and landfill gas	4	4	8	--	--	--
28	Brooklands Landfill Site	groundwater samples and landfill gas	7	2	--	--	--	Mowing of area and gate
29	CNR - Dugald Road Landfill Site	groundwater samples and landfill gas	3	2	--	Confirm vertical extent of waste	--	Grading and cover material
30	Corydon - Osborne Dump Site	groundwater samples and landfill gas	1	--	--	Confirm location of landfill	--	--
31	Red - Assiniboine River Junction Dump	groundwater samples and landfill gas	2	--	--	--	--	--
32	Lot 61, St. Mary's Road Dump Site	groundwater samples, landfill gas and additional residential landfill gas monitoring	4	2	2	--	--	Repairs to probes in retirement home
33	Riel Dump Site	groundwater samples, landfill gas and additional residential landfill gas monitoring	7	2	2	--	--	--
35	River Road Dump Site	groundwater samples, landfill gas and additional residential landfill gas monitoring	4	2	2	--	--	--
36	Kilcona Park Landfill Site	groundwater samples and surface water samples	--	--	--	Define outer extents of waste	Survey existing monitoring probes/wells	--

Notes

- 1 Groundwater samples should be analyzed for the comprehensive list of parameters from Schedule 5 of the Ontario Ministry of Environment and Climate Change's Landfill Standards: A Guideline on the Regulatory and Approval Requirements for New or Expanding Landfill Sites
- 2 Items listed are changes to the monitoring program. Groundwater samples, surface water samples and landfills gas are listed if there are new locations at which that monitoring is taking place
- PAH - polycyclic aromatic hydrocarbons
PHC - petroleum hydrocarbons
PCB - polychlorinated biphenyls

Table 2 Estimated Additional Annual Operating and Capital Costs for Winnipeg Closed Landfills

Site Number	Site Name	Additional Operating Costs					Capital Costs								Total		
		Monitoring Program Changes				Reporting ¹	Well Installations				Subsurface Investigation				Survey	Other Repairs or Upgrades	
		Hours	Analytical Costs and Disbursements ³	Fees	Total		Disbursements ²	Fees for Supervision	Fees for Field Preparation and Coordination	Total	Disbursements	Fees for Supervision	Fees for Field Preparation and Coordination	Total			
1	Beliveau Road Dump Site	5.25	\$ 1,800	\$ 800	\$ 2,600	\$ 6,000	\$ 9,900	\$ 2,100	\$ 2,500	\$ 14,500	\$ -	\$ -	\$ -	\$ -	\$ 600	\$ 23,700	
2	St. Boniface Dump Site	0.5	\$ 500	\$ 200	\$ 700	\$ 2,000	\$ 1,800	\$ 500	\$ 1,300	\$ 3,600	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 6,300	
3	St. Boniface Landfill Site 1	7.75	\$ 3,400	\$ 1,100	\$ 4,500	\$ 7,500	\$ 14,200	\$ 3,400	\$ 3,700	\$ 21,300	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 33,300	
4	St. Boniface Landfill Site 2	4.25	\$ 2,300	\$ 500	\$ 2,800	\$ 5,000	\$ 7,700	\$ 1,800	\$ 2,700	\$ 12,200	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 20,000	
5	Redonda Dump Site	4.25	\$ 1,800	\$ 500	\$ 2,300	\$ 4,500	\$ 7,600	\$ 1,800	\$ 2,700	\$ 12,100	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 18,900	
6	Redonda Landfill Site	5.75	\$ 1,800	\$ 800	\$ 2,600	\$ 7,500	\$ 10,400	\$ 2,000	\$ 2,700	\$ 15,100	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 25,200	
7	Kimberly Landfill Site	5.5	\$ 1,800	\$ 800	\$ 2,600	\$ 10,500	\$ 14,600	\$ 3,300	\$ 3,100	\$ 21,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 19,100	
8	Cordite Road Landfill Site	4.75	\$ 1,800	\$ 700	\$ 2,500	\$ 7,000	\$ 9,300	\$ 2,200	\$ 2,900	\$ 14,400	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 47,100*	
9	Bonner Avenue Landfill Site	4.75	\$ 1,800	\$ 600	\$ 2,400	\$ 5,500	\$ 9,000	\$ 1,900	\$ 2,700	\$ 13,600	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 21,500	
10	McPhillips Street Dump Site (Ash dump)	4	\$ 2,500	\$ 600	\$ 3,100	\$ 5,000	\$ 8,400	\$ 1,900	\$ 3,000	\$ 13,300	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 9,000	
11	McPhillips Street Landfill Site	5	\$ 1,800	\$ 700	\$ 2,500	\$ 5,500	\$ 9,200	\$ 2,100	\$ 2,700	\$ 14,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 25,000	
12	Margaret Park Landfill Site	5.5	\$ 1,800	\$ 800	\$ 2,600	\$ 8,000	\$ 12,700	\$ 2,900	\$ 3,700	\$ 19,300	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 29,900	
13	Leila Avenue Landfill Site	5.25	\$ 1,800	\$ 800	\$ 2,600	\$ 6,000	\$ 9,200	\$ 1,900	\$ 3,000	\$ 14,100	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 22,700	
14	Leila Avenue (West) Landfill Site	4.75	\$ 1,800	\$ 700	\$ 2,500	\$ 5,000	\$ 8,400	\$ 2,100	\$ 2,900	\$ 13,400	\$ 2,200	\$ 1,000	\$ -	\$ -	\$ -	\$ 24,100	
15	Saskatchewan Avenue Dump Site	4.75	\$ 1,800	\$ 600	\$ 2,400	\$ 5,000	\$ 9,000	\$ 2,300	\$ 3,000	\$ 14,300	\$ 1,100	\$ 600	\$ -	\$ -	\$ -	\$ 23,400	
16	Barry Avenue Dump Site	5	\$ 1,800	\$ 700	\$ 2,500	\$ 6,000	\$ 8,000	\$ 1,600	\$ 2,500	\$ 12,100	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 20,600	
17	Harcourt Street Landfill Site	10.25	\$ 4,300	\$ 1,500	\$ 5,800	\$ 3,000	\$ 3,200	\$ 500	\$ 2,100	\$ 5,800	\$ 1,000	\$ 500	\$ -	\$ 1,500	\$ 600	\$ 16,700	
18	Summit Road Landfill Site	4	\$ 11,900	\$ 1,000	\$ 12,900	\$ 11,000	\$ 9,100	\$ 2,700	\$ 2,300	\$ 14,100	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 38,000	
19	Shaftesbury Blvd. Dump Site	4.25	\$ 1,700	\$ 500	\$ 2,200	\$ 4,500	\$ 7,700	\$ 1,800	\$ 2,600	\$ 12,100	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 18,800	
20	Charleswood Road Landfill Site	3.25	\$ 1,700	\$ 400	\$ 2,100	\$ 4,500	\$ 6,900	\$ 1,400	\$ 3,400	\$ 11,700	\$ -	\$ -	\$ -	\$ -	\$ 500	\$ 18,800	
21	Charleston St. (Community Row) Dump	6	\$ 2,700	\$ 1,000	\$ 3,700	\$ 4,500	\$ 6,600	\$ 1,600	\$ 3,200	\$ 11,400	\$ 1,400	\$ 500	\$ -	\$ 1,900	\$ -	\$ 21,500	
22	Charleswood Rd. (South) Landfill Site	4	\$ 1,800	\$ 500	\$ 2,300	\$ 6,500	\$ 9,200	\$ 1,800	\$ 3,200	\$ 14,200	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 23,000	
24	Cadboro Rd. (West) Landfill Site	8	\$ 2,900	\$ 1,100	\$ 4,000	\$ 7,000	\$ 5,700	\$ 1,200	\$ 2,400	\$ 9,300	\$ -	\$ -	\$ -	\$ -	\$ 600	\$ 20,900	
26&27	Elmwood and Nairn Avenue Landfill Sites	8.5	\$ 3,700	\$ 1,100	\$ 4,800	\$ 10,000	\$ 19,800	\$ 4,500	\$ 4,500	\$ 28,800	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 4,300	
28	Brooklands Landfill Site	3.5	\$ 1,700	\$ 500	\$ 2,200	\$ 6,500	\$ 10,000	\$ 2,100	\$ 3,200	\$ 15,300	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 39,800	
29	CNR - Dugald Road Landfill Site	3.75	\$ 1,800	\$ 500	\$ 2,300	\$ 4,500	\$ 7,100	\$ 1,800	\$ 2,600	\$ 11,500	\$ 1,000	\$ 500	\$ -	\$ 1,500	\$ -	\$ 174,200	
30	Corydon - Osborne Dump Site	3.75	\$ 1,800	\$ 500	\$ 2,300	\$ 2,500	\$ 2,100	\$ 300	\$ 2,600	\$ 5,000	\$ 2,300	\$ 600	\$ -	\$ 2,900	\$ -	\$ 12,700	
31	Red - Assiniboine River Junction Dump	1.5	\$ 800	\$ 200	\$ 1,000	\$ 3,000	\$ 2,800	\$ 600	\$ 2,600	\$ 6,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 10,000	
32	Lot 61 St. Mary's Road Dump Site	10	\$ 1,800	\$ 1,400	\$ 3,200	\$ 6,000	\$ 9,600	\$ 2,100	\$ 2,800	\$ 14,500	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 600	
33	Riel Dump Site	16	\$ 1,800	\$ 2,200	\$ 4,000	\$ 7,500	\$ 12,100	\$ 2,500	\$ 3,400	\$ 18,000	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 29,500	
35	River Road Dump Site	12.5	\$ 1,900	\$ 1,800	\$ 3,700	\$ 6,000	\$ 9,900	\$ 2,200	\$ 3,200	\$ 15,300	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 25,000	
36	Kilcona Park Landfill Site	3.75	\$ 2,400	\$ 500	\$ 2,900	\$ 10,500	\$ -	\$ -	\$ -	\$ 1,500	\$ 3,000	\$ -	\$ 4,500	\$ 1,100	\$ -	\$ 19,000	
	Total	180	\$ 75,000	\$ 25,600	\$ 100,600	\$ 193,500	\$ 271,200	\$ 60,900	\$ 89,200	\$ 421,300	\$ 10,500	\$ 6,700	\$ -	\$ 17,200	\$ 2,800	\$ 272,600	\$ 1,008,000

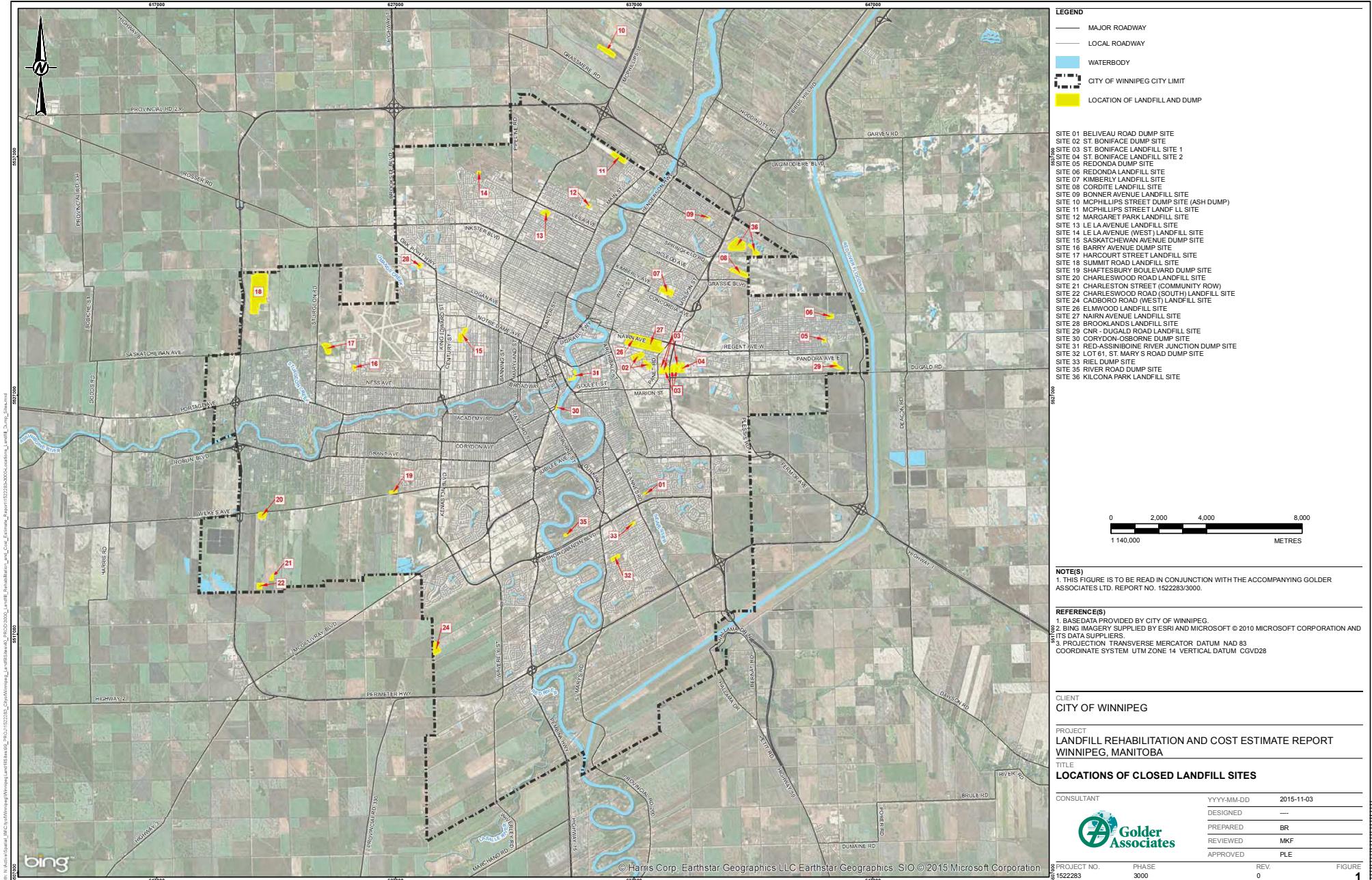
Notes Costs do not include applicable taxes

1 Reporting costs are for one year of monitoring and are estimated based on the number of monitoring wells and engineered features at the site

2 Disbursements include well supply costs, contractor costs, and field equipment (survey equipment, water level tape, gas monitor)

3 Disbursements include laboratory costs and field supplies (filters, water level tape, pH meter, conductivity meters, gas monitors, gloves, etc.)

* Costs include \$32,900 for a geotechnical investigation and \$14,200 for topsoil placement and seeding



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