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Buffer Study Update in Relation to Waste Connections Canada Navan Waste Recycling and Disposal Facility

Proposed Future Development Lands
3252 Navan Road - Ottawa

Prepared For

Claridge Homes

October 13, 2021

Report: PE4588-3

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Table of Contents

PAGE

List of Appendices

1.0 Background Information

A previous Buffer Study report was prepared by Golder Associates (Golder) and issued in December of 2013 for the Spring Valley Trails Development - Phase 3 Lands located immediately west of the subject lands.

The report entitled: “Claridge Homes Spring Valley Trails Development - Phase 3 - Buffer Study in Relation to the BFI Navan Waste Recycling and Disposal Facility - Report Number 07-1121-0232 (2000) was prepared by Golder Associates for Claridge Homes and dated December of 2013". The report was submitted to the City of Ottawa for review and comment and was accepted in 2014. A copy of this report is included in Appendix 3.

The annual environmental monitoring report for the 2019 yearly period prepared by Golder Associates (Golder) and issued in March of 2020 was provided by Waste Connections Canada (WCC) for review of available current information. The previous Buffer Study is being updated to include the additional parcel of land located at 3252 Navan Road. The additional parcel also includes the remnant parcel of the Spring Valley Trails development as part of the application. A survey plan illustrating the boundaries of the subject lands is appended to this report.

In addition, the macro grading plan prepared by IBI Group for Spring Valley Trails Phases 5 and 6 was also reviewed to better understand the final grading in conjunction with the existing grades of the WCC lands further east of the subject site.

2.0 2019 Environmental Monitoring Report

Based on the findings presented in the 2019 environmental monitoring report prepared by Golder for WCC, the following summarizes their highlighted key points:

- No significant change in groundwater flow patterns has been observed.
- Groundwater is monitored at various levels in the subsoil units and within various zones and locations including down-gradient of the landfill.
- From a hydrogeology perspective, the site appears to have a recharge area north of the landfill (north of Navan Road) with a downward groundwater flow component. South of the site, a typical discharge area having a slightly upward groundwater flow component (Mer Bleue bog). Based on the groundwater quality, only minor differences exist in the groundwater quality across the site.

- Golder stated “Leachate quality monitoring results for 2019 indicate that leachate generated at the WCC Navan Facility is not significantly different from previous monitoring events. Leachate at the WCC Navan Facility continues to be relatively weak wastewater when compared to municipal landfill leachate.”

- Exceedances were discussed by phone with the local MECP Ottawa District Office where WCC presented a proposed course of action which was implemented in 2019. The type of exceedances were not provided to Paterson (white out in the report).

- Golder will be presenting to the MECP their results from the spring 2020 monitoring session to confirm the effectiveness of the measures implemented in 2019 and determine the need for a formal contingency plan which will be assessed in collaboration with the MECP.

- The proposed 2020 Environmental Monitoring Program will be the same as the 2019 program with the exception of testing of VOCs which were proposed to be discontinued from the groundwater monitoring program and sediment monitoring.

3.0 Buffer Study Update

3.1 Introduction

The subject land is located at 3252 Navan Road (subject site) which is south of the Navan Road and west of the existing waste disposal facility. The proposed future residential development is located within 500 m of the Waste Connections Canada Navan Waste Recycling and Disposal Facility (WCC Waste Facility) which is a solid waste disposal site. WCC is the current owner, which was previously BFI Canada Inc. Due to the fact that the subject site is within the 500 m buffer area, a buffer study update was completed. This study is to demonstrate that the WCC Waste Facility will not have adverse affects on the proposed development.

Paterson is updating the information previously provided in the report prepared by Golder in 2013, which was considered acceptable for the lands immediately west of the subject site. While the subject site was not included in that prenoted study, several factors from that study can be extrapolated to the subject site.

The buffer study update was performed on behalf of Claridge Homes to satisfy a request from the City of Ottawa that the previous buffer study be updated to address comments from WCC. The initial buffer study was accepted in 2014 by the City of Ottawa for residential development for the Spring Valley Trails development. The purpose of the buffer study update is to review the initial study to ensure that the previous conclusions remain valid for the subject lands.

The accepted buffer study in 2014 addressed the potential for impact from the waste disposal facility possibly due to contamination by leachate, surface water runoff, ground settlement, visual impact, air (dust), odour, noise, soil contamination and landfill gas migration. No potential issues were identified, and the buffer study was deemed acceptable.

3.2 Existing Waste Disposal Facility

The WCC Waste Facility is owned and operated under the Environmental Compliance Approval (ECA) for performing the following:

- Landfilling
- Processing/recycling of solid, non-hazardous industrial, commercial and institutional waste including construction and demolition waste.
- Asbestos waste,
- Dry non-putrescible domestic waste (non-organic)
- Impacted soil

Composting of leaf and yard material was previously performed but has not been accepted since 2009.

The western edge of the WCC Waste Facility is located along the eastern boundary of the subject land. A 100 m separation exists between the western toe of the landfill footprint and the WCC Waste Facility western property boundary. The subject site is separated from the limit of waste placement and the western property boundary of the WCC Waste Facility by approximately 100 m. In 2009, the waste facility obtained approval for the expansion design for an estimated 10 years beyond 2012. According to WCC, it's our understanding that the remaining life of the WCC waste facility is based on the remaining permitted air space represented by the final waste grades and contours. Since the underlying silty clay deposit is being consolidated by the weight of the landfill, on-going settlement may allow for fill to be placed in the western portion related to this settlement. Therefore, the remaining life of the landfill may be extended to 2026-2027 or longer.

3.3 Local Geology

Local geology in the area of the subject site and the WCC Waste Facility consists of a thick silty clay deposit overlain by silty sands of varying thickness. An escarpment which runs east-west through the subject site and the WCC Waste Facility was once covered by such silty sand deposits, which were mostly eroded below the escarpment. Above the escarpment, silty sand deposits are found to be 0.6 to 2 m thick. A thick (20 to 35 m) marine silty clay deposit underlies the entire area. Bedrock in the area consists of shale from the Billings Formation.

3.4 Surface Runoff

Surface runoff from the east side of the WCC Waste Facility site drains to Bearbrook drainage basin, which is part of the South Nation River watershed. The west side of the WCC Waste Facility and the subject site drain into the Mud Creek drainage basin, which in turn drains into Green's Creek, part of the Ottawa River and Rideau River watershed. The Mer Bleue bog, a unique and recognized ecological feature, is located south of both sites.

Studies performed during the approval process for the expansion of the WCC Waste Facility found that surface water runoff is not having adverse effects on surface water receptors downstream of the landfill. The existing approved surface water management system at the WCC Waste Facility comprises a network of drainage ditches and roadside swales to intercept runoff generated on-site and direct it to either the east or west stormwater management pond. As the WCC Waste Facility is an engineered landfill, potential contamination from the leachate releases would be apparent in groundwater prior to surface water. Furthermore, surface water monitoring is performed to assess surface water flow and quality of the WCC Waste Facility. Therefore, surface water on the subject site will not be impacted by the WCC Waste Facility.

3.5 Local Groundwater Flow

The local groundwater flow in the area is from north to south, from the escarpment towards the edge of the Mer Bleue bog. The thick clay deposit acts as an aquitard or hydraulic barrier to groundwater movement, such that lateral flow occurs only through the surficial silty sand deposit and the upper weathered desiccated silty clay crust zone, which have a total thickness of only a few metres. The water table is between 1 to 2 m below ground surface north of the escarpment and near ground surface south of the escarpment. There is also the possibility of a perched groundwater condition in water trapped in the silty sand deposit overlying the impervious silty clay deposit.

3.6 Hydrogeological Review

The infiltration of rainwater into the landfill and decomposing waste creates a liquid called leachate which, if not managed properly, has the potential to impact groundwater in the vicinity of a landfill. In assessing the potential for groundwater contamination by leachate, the local geology and hydrology, approved engineering controls, and continued groundwater monitoring programs were considered.

The natural hydrogeological aquitard imposed by the thick silty clay deposit, that underlies the area, impedes the flow of groundwater, which flows from north to south, hydraulically cross-gradient to the subject site.

3.7 Engineering Controls

Engineered controls include a leachate collection system below the northeast and central area of the waste footprint, and a perimeter collection trench along the west and south edges of the waste footprint. The leachate collection system is designed such that the groundwater elevation within the landfill is maintained at a lower level than the groundwater elevation in the surrounding area, creating a hydraulic trap, which causes groundwater to flow towards the landfill, rather than away from it. In addition, the 100 m wide west buffer between the landfill footprint and the WCC Waste Facility property boundary is occupied by a berm of compacted silty clay which adds a further level of redundancy in mitigating the potential westward migration of leachate.

Collected leachate is pumped to the City's sewer system via a forcemain and can also be pumped to tanker trucks as a contingency measure. An additional leachate management system was constructed to accommodate the approved horizontal expansion area of the landfill to the east.

Groundwater monitoring is currently performed on an 18-month basis (next monitoring event will be in the fall of 2020), such that potentially impacted groundwater would be detected prior to any migration off-site. In summary, there

is no mechanism by which landfill leachate can affect groundwater quality beneath the subject site.

3.8 Ground Settlement

Settlement of the existing ground surface across the subject site is not expected to occur as a result of the adjacent landfilling activities. Groundwater table drawdown as a result of the excavations during the landfill construction and the hydraulic trap design of the leachate collection system is limited in lateral extent due to the low permeability of the thick silty clay deposit. Therefore, settlement of the silty clay deposit below the subject site will not be negatively impacted by operations of the WCC Waste Facility. It should be further noted that on-going monitoring of the groundwater levels within 10 m of the western property boundary of the WCC Waste Facility site. Mitigation measures to minimize any water table drawdown on the site itself, as a result of the site development, will be implemented as part of the development design.

3.9 Visual Impact

Potential visual impact from the WCC Waste Facility expansion was assessed during the expansion approval process. Though additional mitigation of visual impact was not deemed necessary along the west side of the WCC Waste Facility (which is closest to the subject site), existing mitigation measures provide an adequate visual barrier from viewpoints west of the WCC Waste Facility. Continued growth of vegetation will further decrease the landfill visibility with time. Furthermore, a 20m treed buffer will be created along the eastern side of the Claridge lands, immediately adjacent to the landfill, as part of the site development.

3.10 Air Quality, Dust, Odour and Noise

Based on the aforementioned letter, as well as available site plan, Paterson completed a stationary noise analysis for the aforementioned residential development. Twenty-six (26) reception points at 1.5 m and 4.5 m elevations were selected within the 400 m proximity radius for this analysis.

A request to the WCC Waste Facility to document the existing equipment at the landfill and to measure true noise levels was rejected at the time of writing this report. Therefore, noise sources were modelled as the worst case indicator based on historical aerial photographs. The equipment utilized in the analysis is representative of the equipment that is used for solid waste disposal. The noise analysis was modelled to include: two excavators, three loaders, a vibratory compactor, three trucks, and three truck routes into and out of the existing Navan landfill. The locations of equipment at the Navan Landfill, as well as the break down of the frequency's and sound levels of equipment are noted in the full report of this stationary noise study: Paterson Report PG5224-2 dated June 1, 2021, located in Appendix 2.

The predictive modelling of potential off-site impacts related to air quality, dust and odour were carried out as part of the approvals processes for the WCC Waste Facility expansion which included potential receptor locations adjacent to the subject site. The modelling prediction results indicated that the site operations were expected to meet Provincial requirements and not cause adverse effects off-site. There are a number of design and operation mitigation measures to control and minimize the potential for off-site atmospheric impacts. Ongoing monitoring programs demonstrate that the WCC Waste Facility is performing acceptably as expected based on predictions. Considering that operations on the landfill are progressively moving eastward, away from the subject site, it's expected that the subject site will not experience unacceptable atmospheric effects from the WCC Waste Facility site.

3.11 Contaminated Soil and Groundwater

Contamination of soil and groundwater at the subject site are not expected to occur as a result of the WCC Waste Facility. Recent testing carried out at the subject site confirmed that the soil and groundwater has not been impacted by the WCC Waste Facility. Furthermore, hazardous waste is not accepted at the WCC Waste Facility in Navan.

3.12 Landfill Gas

In studies performed during the approval process for the WCC Waste Facility expansion, it was determined that the migration of landfill gas generated by the WCC Waste Facility landfill is impeded by the naturally occurring geology and engineered controls for the landfill site. Landfill gas migrates through the path of least resistance, as such, the thick silty clay layer, which underlies the area, does not favour methane migration and gas would preferentially migrate towards the atmosphere through the waste and sand unit. Methane generated by the landfill is expected to be intercepted by the leachate collection perimeter trench or blocked by the perimeter clay berms before it would travel off-site. Using a generally accepted approximation that significant methane migration may extend for a distance equal to ten times the depth of the landfill between the ground surface and the water table, the maximum distance of significant methane migration would be expected to be 20 m from the toe of the waste footprint, approximately one fifth the distance between the western waste limit of the WCC Waste Facility and the eastern property boundary of the subject site. A proposed landfill gas collection system was approved as part of the expansion of the WCC Waste Facility and the interim landfill gas management system which is currently in place. It's expected that the proposed landfill gas collection has been installed since then.

Landfill gas monitoring is performed at a large number of locations on the WCC Waste Facility site and indicates that off-site lateral migration of landfill gas has not occurred. Landfill gas monitoring carried out on the Claridge lands substantiates the WCC landfill gas monitoring results. Based on the above, the combination of the natural geological setting and engineered features mitigate the potential migration of landfill gas in the subsurface from the WCC Waste Facility.

4.0 Geotechnical Information and Long-Term Dewatering

4.1 Long Term Dewatering

Based on the information provided by WCC for the WCC Waste Facility in Navan, the western limit of the landfill is approximately 120 m from the toe of the landfill slope. The 20 m strip along the eastern boundary of the subject site for Spring Valley Trails (Blocks 36 and 38 in the survey plan), will be used to include the existing ditch which would remain the same along with a slight re-alignment of the ditch along the southern portion.

The invert of the leachate collection system along the western boundary of the WCC Waste Facility ranges from elevation 68.7 m (southern portion) to approximately 70 m (northern portion).

A clay cut-off trench along the western limit of the WCC Waste Facility is used as a hydraulic barrier to prevent horizontal migration of any below grade leachate from migrating within the silty sand layer overlying the silty clay deposit.

The development of Phases 5 and 6 of the Spring Valley Trails (SVT) will require the re-grading of the subject site including site servicing. The macro-grading information provided by IBI Group, indicates that for the most part, the site grading will either match or below slightly below the existing grade. Site servicing will be approximately 3 to 4.5 m below the finished grade. For the SVT site, long term groundwater levels range from elevation 66 m in the southern portion to elevation 80 m for the northern portion along the eastern boundary adjacent to the western boundary of the WCC Waste Facility. Therefore, based on the proposed site servicing depths, it's expected that no short or long-term dewatering will occur at the SVT site that would impact the existing groundwater table at the WCC Waste Facility. Furthermore, the site servicing in the silty clay deposit will have typical clay dykes to prevent the servicing trench from becoming a hydraulic pathway which prevents any dewatering at the subject site and the adjacent WCC Waste Facility.

The 20 m buffer strip along the eastern boundary of the SVT site will include the existing drainage ditch that will be slightly realigned at the south end. The 20 m buffer strip will essentially remain similar to existing conditions which maintains no adverse effects to the WCC Waste Facility.

4.2 Slope Stability

It was noted that a berm is located around the perimeter of the WCC Waste Facility. This berm is approximately 17 m high at the south end and approximately 12 m high at the north end, relative to the existing grade of the subject site. A slope stability was completed for this berm to access any potential risks. It was also noted that there was a stormwater management pond located at the top on the berm, on the northern portion of the berm.

Paterson has completed a slope stability analysis for a slope profile, identified as Section G, extending approximately 30 m east of the property line into the proposed residential development, and 250 m west of the property line into the existing Ottawa Landfill stockpiled material berm. Refer to Paterson Drawing PG5224-1 - Test Hole Location Plan, attached to the current memorandum.

As noted in the aforementioned Letter to City of Ottawa, details of the berm's construction are not available. Therefore, conservative soil parameters were assigned to the stockpiled silty clay fill material. Figure 1 presents the slope stability results of the existing slope profile. Based on our analysis, the minimum global factor of safety of 1.96 and 1.50 for static and seismic conditions, respectively, are considered satisfactory. Therefore, the existing slope profile of the stockpiled material berm is considered acceptable from a geotechnical perspective.

The slope stability analysis was conducted considering saturated conditions with the groundwater level present at the surface, representing the worst-case scenario. Based on the colour, consistency and moisture levels of the soil samples recovered from the boreholes within Phase 5 of the aforementioned development, the long-term groundwater level is expected between 3 to 4 m depth below the existing ground surface.

For the most part, since the final grades will remain relatively close to the existing grades, there is no cut operation along with long term dewatering that would affect the slope stability of the landfill side slopes. Also, since the toe of the landfill slope has a lateral separation of 120 m or more from the proposed development area, there will be no significant changes to the subsoil conditions at the SVT development that would affect the current stability of the landfill side slopes.

5.0 Conclusion

In conclusion, it is our opinion that the WCC Waste Facility will not have any adverse effects on the proposed development and will not pose any risks to human health and safety.

Furthermore, the completion of Phases 5 and 6 of the Spring Valley Trails development will have no adverse effects to the neighbouring WCC waste facility including the leachate collection system, the clay cut-off barrier located along the western limits of the waste facility and the slope stability of the existing landfill side slopes.

It's recommended that the zone of influence of the WCC Waste Facility be reduced such that it excludes the future development of the subject site.

6.0 Statement of Limitations

The recommendations provided in this report are in accordance with our present understanding of the project.

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than Claridge Homes or their agents is not authorized without review by Paterson for the applicability of our recommendations to the alternative use of the report.

Paterson Group Inc.

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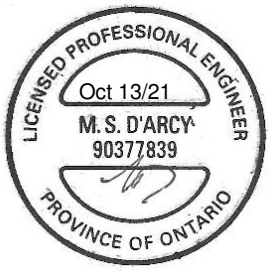
Mark S. D'Arcy, P.Eng., QP$_{ESA}$



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APPENDIX 1

Soil Profile and Test Data Sheets

Symbols and Terms

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
3252 Navan Road
Ottawa, Ontario

DATUM

REMARKS

BORINGS BY CME 55 Power Auger **DATE** 2019 May 16

FILE NO. PE4588

HOLE NO. BH 1

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	
FILL: Brown silty sand with crushed stone and gravel 0.51		AU	1				
FILL: Brown silty clay, trace gravel 1.37		SS	2	33	14	1	
FILL: Brown silty sand 2.59		SS	3	75	6	2	
		SS	4	100	6		
Brown **SILTY CLAY**		SS	5	100	4	3	
- grey by 3.8m depth		SS	6	100	4	4	
		SS	7	100	1	5	
6.10		SS	8	100	W	6	
End of Borehole							

Photo Ionization Detector
● Volatile Organic Rdg. (ppm)

○ **Lower Explosive Limit %**

20 40 60 80

Monitoring Well Construction

100 200 300 400 500

RKI Eagle Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

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FILE NO. PE4588

HOLE NO. BH 2

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	
FILL: Brown silty sand, some gravel, trace clay		AU	1				
		SS	2	21	15	1	
		SS	3	79	13	2	
2.29							
		SS	4	46	7		
Brown **SILTY CLAY**		SS	5	100	5	3	
- grey by 3.8m depth		SS	6	100	4	4	
		SS	7	100	W	5	
		SS	8	100	W		
6.10						6	
End of Borehole							

Photo Ionization Detector

● Volatile Organic Rdg. (ppm)

○ **Lower Explosive Limit %**

20 40 60 80

Monitoring Well Construction

100 200 300 400 500

RKI Eagle Rdg. (ppm)

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FILE NO. PE4588

HOLE NO. BH 3

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	
FILL: Brown silty sand with gravel		AU	1				
		SS	2	71	18	1	
1.52							
Brown **SILTY CLAY**		SS	3	83	7	2	
		SS	4	100	3		
- grey by 2.3m depth		SS	5	100	3	3	
		SS	6	100	1	4	
4.57							
End of Borehole							

Photo Ionization Detector

● Volatile Organic Rdg. (ppm)

○ **Lower Explosive Limit %**

20 40 60 80

100 200 300 400 500

RKI Eagle Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

Monitoring Well Construction

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REMARKS

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FILE NO. PE4588

HOLE NO. BH 4

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	
FILL: Brown silty sand with gravel		AU	1				
0.60							
FILL: Brow nsilty sand with clay, gravel and sandstone, trace organics		SS	2	33	27	1	
1.37							
		SS	3	58	9	2	
		SS	4	88	7		
		SS	5	100	7	3	
Brown **SILTY CLAY**		SS	6	100	9	4	
		SS	7	100	7	5	
		SS	8	100	4		
- grey by 6.1m depth		SS	9	100	2	6	
		SS	10	100	2	7	
		SS	11	100			
8.38						8	
End of Borehole							

Photo Ionization Detector
● Volatile Organic Rdg. (ppm)

○ **Lower Explosive Limit %**

20 40 60 80

Monitoring Well Construction

100 200 300 400 500

RKI Eagle Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

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REMARKS

BORINGS BY CME 55 Power Auger **DATE** 2019 May 17

FILE NO. PE4588

HOLE NO. BH 5

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	
		AU	1				
		SS	2	33	8	1	
		SS	3	54	9	2	
FILL: Brown silty sand, some gravel and brick		SS	4	29	14	3	
		SS	5	58	5		
		SS	6	42	15	4	
		SS	7	38	6	5	
		SS	8	12	5		
6.10						6	
		SS	9	79	21		
		SS	10	100	15	7	
Brown **SILTY CLAY**		SS	11	100	8	8	
- grey by 8.4m depth		SS	12	88	4	9	
		SS	13	100	2		
		SS	14	100	1	10	
10.67							
End of Borehole							

Photo Ionization Detector
● Volatile Organic Rdg. (ppm)

○ **Lower Explosive Limit %**

20 40 60 80

113.8

Monitoring Well Construction

100 200 300 400 500

RKI Eagle Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

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FILE NO. PE4588

HOLE NO. BH 6

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	
		AU	1				
		SS	2	58	16	1	
		SS	3	33	7		
		SS	4	71	7	2	
FILL: Brown silty sand with gravel, some clay, trace brick and topsoil		SS	5	62	8	3	
		SS	6	75	22		
		SS	7	71	8	4	
		SS	8	67	20		
		SS	9	46	8	5	
6.86							
		SS	10	88	15	6	
Brown **SILTY CLAY**		SS	11	100	7		
- grey by 8.4m depth		SS	12	100	5	7	
		SS	13	100	2		
		SS	14	100	W	8	
10.67							
End of Borehole						9	
						10	

Photo Ionization Detector
● Volatile Organic Rdg. (ppm)

○ **Lower Explosive Limit %**

20 40 60 80

Monitoring Well Construction

100 200 300 400 500

RKI Eagle Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

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SOIL PROFILE AND TEST DATA

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Ottawa, Ontario

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REMARKS

BORINGS BY Portable Drill **DATE** 2019 May 22

FILE NO. PE4588

HOLE NO. BH 7

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							
TOPSOIL 0.30		SS	1	100		0	
Brown **SILTY CLAY** 0.71		SS	2	100		1	
Brown **SILTY CLAY**		SS	3	100		2	
- grey by 1.8m depth		SS	4	100		3	
3.05		SS	5	100			
End of Borehole							

Photo Ionization Detector
● Volatile Organic Rdg. (ppm)

○ **Lower Explosive Limit %**

20 40 60 80

100 200 300 400 500

RKI Eagle Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

Monitoring Well Construction

patersongroup Consulting Engineers

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SOIL PROFILE AND TEST DATA

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DATUM

REMARKS

BORINGS BY Portable Drill **DATE** 2019 May 22

FILE NO. PE4588

HOLE NO. BH 8

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							
TOPSOIL 0.28		SS	1	12		0	
Grey **SILTY SAND** 0.91		SS	2	58		1	
Brown **SILTY CLAY**		SS	3	100			
1.83							
- grey by 1.5m depth							
End of Borehole							

Photo Ionization Detector
● Volatile Organic Rdg. (ppm)
○ **Lower Explosive Limit %**

20 40 60 80

100 200 300 400 500

RKI Eagle Rdg. (ppm)
▲ Full Gas Resp. △ Methane Elim.

Monitoring Well Construction

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
3252 Navan Road
Ottawa, Ontario

DATUM

REMARKS

BORINGS BY Portable Drill **DATE** 2019 May 22

FILE NO. PE4588

HOLE NO. BH 9

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							
TOPSOIL 0.15		SS	1	62		0	
		SS	2	71		1	
Brown **SILTY CLAY**		SS	3	100		2	
		SS	4	100			
3.05		SS	5	100		3	
End of Borehole							

Photo Ionization Detector
● Volatile Organic Rdg. (ppm)

○ **Lower Explosive Limit %**

20 40 60 80

Monitoring Well Construction

100 200 300 400 500

RKI Eagle Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
3252 Navan Road
Ottawa, Ontario

DATUM

REMARKS

BORINGS BY CME 55 Power Auger **DATE** 2019 September 5

FILE NO. PE4588

HOLE NO. BH10

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	
FILL: Brown silty clay, trace sand and gravel							
0.81							
		SS	1	75	10	1	
Compact to loose, brown **SILTY SAND**		SS	2	88	24	2	
2.82		SS	3	88	9		
Brown **SILTY CLAY**		SS	4	100	2	3	
- grey by 3.3m depth		SS	5	100	W	4	
5.18		SS	6	100	W	5	
End of Borehole							
(GWL @ 1.92m - Sept. 9, 2019)							

Photo Ionization Detector

● Volatile Organic Rdg. (ppm)

○ **Lower Explosive Limit %**

20 40 60 80

100 200 300 400 500

RKI Eagle Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

Monitoring Well Construction

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
3252 Navan Road
Ottawa, Ontario

DATUM

REMARKS

BORINGS BY CME 55 Power Auger **DATE** 2019 September 5

FILE NO. PE4588

HOLE NO. BH11

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	
						1	
						2	
OVERBURDEN						3	
						4	
						5	
6.10						6	
		SS	1	100	1		
		SS	2	100		7	
		SS	3	100		8	
		SS	4	100			
Grey **SILTY CLAY**		SS	5	100		9	
		SS	6	100		10	
11.28		SS	7	100		11	
End of Borehole							
(GWL @ 2.84m - Sept. 9, 2019)							

Photo Ionization Detector

● Volatile Organic Rdg. (ppm)

○ **Lower Explosive Limit %**

20 40 60 80

100 200 300 400 500

RKI Eagle Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

Monitoring Well Construction

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
3252 Navan Road
Ottawa, Ontario

DATUM

REMARKS

BORINGS BY CME 55 Power Auger **DATE** 2019 September 5

FILE NO. PE4588

HOLE NO. BH12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	
FILL: Brown silty sand with gravel		SS	1	79	30	1	
1.27							
Compact, grey **SILTY SAND**		SS	2	75	12	2	
2.11							
		SS	3	100	1	3	
		SS	4	100	W		
Brown to grey **SILTY CLAY**		SS	5	100	W	4	
		SS	6	100	W	5	
5.18							
End of Borehole							
(GWL @ 3.66m - Sept. 9, 2019)							

Photo Ionization Detector

● Volatile Organic Rdg. (ppm)

○ **Lower Explosive Limit %**

20 40 60 80

100 200 300 400 500

RKI Eagle Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

Monitoring Well Construction

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
3252 Navan Road
Ottawa, Ontario

DATUM

REMARKS

BORINGS BY CME 55 Power Auger **DATE** 2019 September 5

FILE NO. PE4588

HOLE NO. BH13

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	
FILL: Brown silty sand with gravel, trace cobbles and boulders		SS	1	58	24	1	
1.52							
		SS	2	58	18	2	
Compact, brown **SILTY SAND**		SS	3	17	42		
3.05						3	
Brown **SILTY SAND**		SS	4	100	4		
		SS	5	100	3	4	
- grey by 3.8m depth							
		SS	6	100	W	5	
5.18							
End of Borehole							
(GWL @ 2.28m - Sept. 9, 2019)							

Photo Ionization Detector
● Volatile Organic Rdg. (ppm)

○ **Lower Explosive Limit %**

20 40 60 80

100 200 300 400 500

RKI Eagle Rdg. (ppm)

▲ Full Gas Resp. △ Methane Elim.

Monitoring Well Construction

SYMBOLS AND TERMS

SOIL DESCRIPTION

Behavioural properties, such as structure and strength, take precedence over particle gradation in describing soils. Terminology describing soil structure are as follows:

Desiccated	-	having visible signs of weathering by oxidation of clay minerals, shrinkage cracks, etc.
Fissured	-	having cracks, and hence a blocky structure.
Varved	-	composed of regular alternating layers of silt and clay.
Stratified	-	composed of alternating layers of different soil types, e.g. silt and sand or silt and clay.
Well-Graded	-	Having wide range in grain sizes and substantial amounts of all intermediate particle sizes (see Grain Size Distribution).
Uniformly-Graded	-	Predominantly of one grain size (see Grain Size Distribution).

The standard terminology to describe the relative strength of cohesionless soils is the compactness condition, usually inferred from the results of the Standard Penetration Test (SPT) 'N' value. The SPT N value is the number of blows of a 63.5 kg hammer, falling 760 mm, required to drive a 51 mm O.D. split spoon sampler 300 mm into the soil after an initial penetration of 150 mm. An SPT N value of "P" denotes that the split-spoon sampler was pushed 300 mm into the soil without the use of a falling hammer.

Compactness Condition	'N' Value	Relative Density %
Very Loose	<4	<15
Loose	4-10	15-35
Compact	10-30	35-65
Dense	30-50	65-85
Very Dense	>50	>85

The standard terminology to describe the strength of cohesive soils is the consistency, which is based on the undisturbed undrained shear strength as measured by the in situ or laboratory shear vane tests, unconfined compression tests, or occasionally by the Standard Penetration Test (SPT). Note that the typical correlations of undrained shear strength to SPT N value (tabulated below) tend to underestimate the consistency for sensitive silty clays, so Paterson reviews the applicable split spoon samples in the laboratory to provide a more representative consistency value based on tactile examination.

Consistency	Undrained Shear Strength (kPa)	'N' Value
Very Soft	<12	<2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very Stiff	100-200	15-30
Hard	>200	>30

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

Cohesive soils can also be classified according to their "sensitivity". The sensitivity, S_t, is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil. The classes of sensitivity may be defined as follows:

Low Sensitivity:	$S_t < 2$
Medium Sensitivity:	$2 < S_t < 4$
Sensitive:	$4 < S_t < 8$
Extra Sensitive:	$8 < S_t < 16$
Quick Clay:	$S_t > 16$

ROCK DESCRIPTION

The structural description of the bedrock mass is based on the Rock Quality Designation (RQD).

The RQD classification is based on a modified core recovery percentage in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be a result of closely-spaced discontinuities (resulting from shearing, jointing, faulting, or weathering) in the rock mass and are not counted. RQD is ideally determined from NQ or larger size core. However, it can be used on smaller core sizes, such as BQ, if the bulk of the fractures caused by drilling stresses (called "mechanical breaks") are easily distinguishable from the normal in situ fractures.

RQD %	**ROCK QUALITY**
90-100	Excellent, intact, very sound
75-90	Good, massive, moderately jointed or sound
50-75	Fair, blocky and seamy, fractured
25-50	Poor, shattered and very seamy or blocky, severely fractured
0-25	Very poor, crushed, very severely fractured

SAMPLE TYPES

SS	-	Split spoon sample (obtained in conjunction with the performing of the Standard Penetration Test (SPT))
TW	-	Thin wall tube or Shelby tube, generally recovered using a piston sampler
G	-	"Grab" sample from test pit or surface materials
AU	-	Auger sample or bulk sample
WS	-	Wash sample
RC	-	Rock core sample (Core bit size BQ, NQ, HQ, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

PLASTICITY LIMITS AND GRAIN SIZE DISTRIBUTION

WC%	-	Natural water content or water content of sample, %
LL	-	Liquid Limit, % (water content above which soil behaves as a liquid)
PL	-	Plastic Limit, % (water content above which soil behaves plastically)
PI	-	Plasticity Index, % (difference between LL and PL)
Dxx	-	Grain size at which xx% of the soil, by weight, is of finer grain sizes These grain size descriptions are not used below 0.075 mm grain size
D10	-	Grain size at which 10% of the soil is finer (effective grain size)
D60	-	Grain size at which 60% of the soil is finer
Cc	-	Concavity coefficient = $(D30)^2$ / (D10 x D60)
Cu	-	Uniformity coefficient = D60 / D10

Cc and Cu are used to assess the grading of sands and gravels:
Well-graded gravels have: $1 < Cc < 3$ and $Cu > 4$
Well-graded sands have: $1 < Cc < 3$ and $Cu > 6$
Sands and gravels not meeting the above requirements are poorly-graded or uniformly-graded.
Cc and Cu are not applicable for the description of soils with more than 10% silt and clay
(more than 10% finer than 0.075 mm or the #200 sieve)

CONSOLIDATION TEST

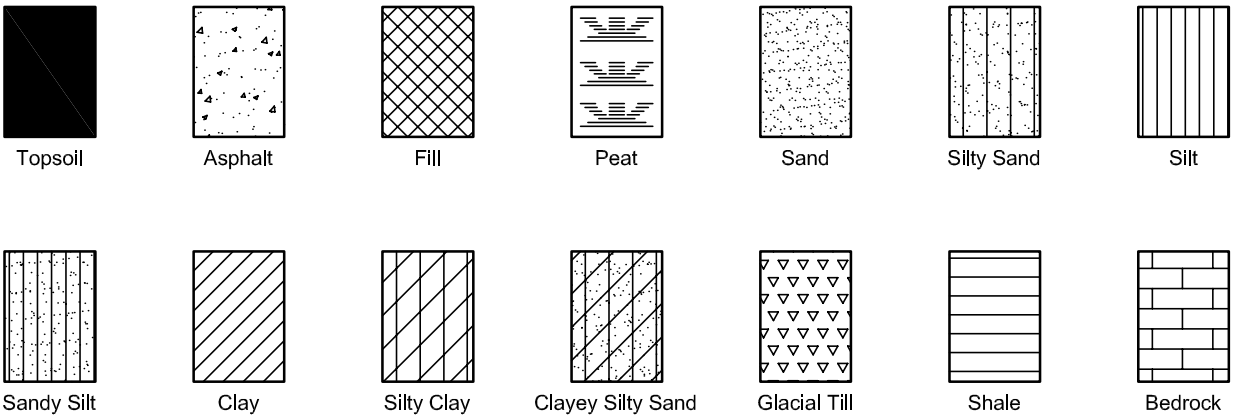
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void Ratio		Initial sample void ratio = volume of voids / volume of solids
Wo	-	Initial water content (at start of consolidation test)

PERMEABILITY TEST

k	-	Coefficient of permeability or hydraulic conductivity is a measure of the ability of water to flow through the sample. The value of k is measured at a specified unit weight for (remoulded) cohesionless soil samples, because its value will vary with the unit weight or density of the sample during the test.

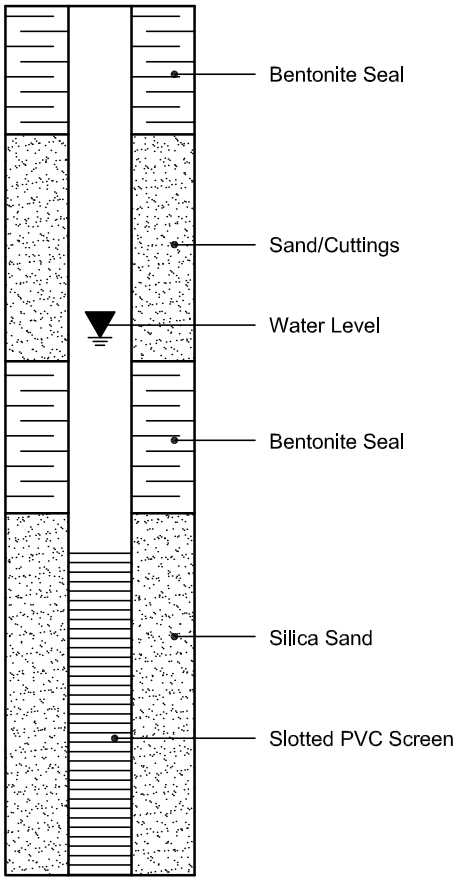
SYMBOLS AND TERMS (continued)

STRATA PLOT

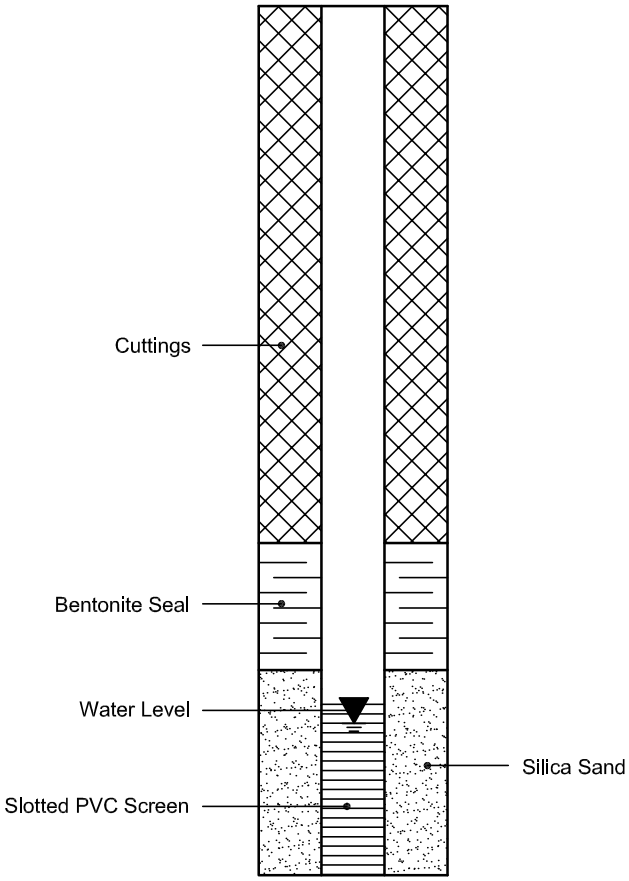


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



APPENDIX 2

Drawing PE4588-3 – Test Hole Location Plan

Figures 1A to 1B – Slope Stability Cross Sections

Paterson Noise Study PG5224-2 dated June 1, 2021

VACANT

RESIDENTIAL

WASTE CONNECTIONS CANADA
NAVAN ROAD LANDFILL

RESIDENTIAL

NAVAN ROAD

EXISTING ABOVEGROUND STORAGE TANKS

BH 10 BH 11 BH 1 BH 12 BH 3 BH 5 BH 7 BH 8 BH 9 BH 13 BH 2 BH 4 BH 6

STORAGE

DWELLING

LANDSCAPING MATERIALS

FILL PILES

FORMER ABOVEGROUND STORAGE TANK

LANDSCAPING MATERIALS

VACANT / TREED

PRESCOTT - RUSSELL TRAIL LINE

MER BLEUE BOG

RESIDENTIAL

LEGEND:

BOREHOLE WITH MONITORING WELL LOCATION

patersongroup
consulting engineers

154 Colonnade Road South
Ottawa, Ontario K2E 7J5
Tel: (613) 226-7381 Fax: (613) 226-6344

NO.	REVISIONS	DATE	INITIAL

CLARIDGE HOMES (GLADSTONE) INC.

PHASE II - ENVIRONMENTAL SITE ASSESSMENT
3252 NAVAN ROAD

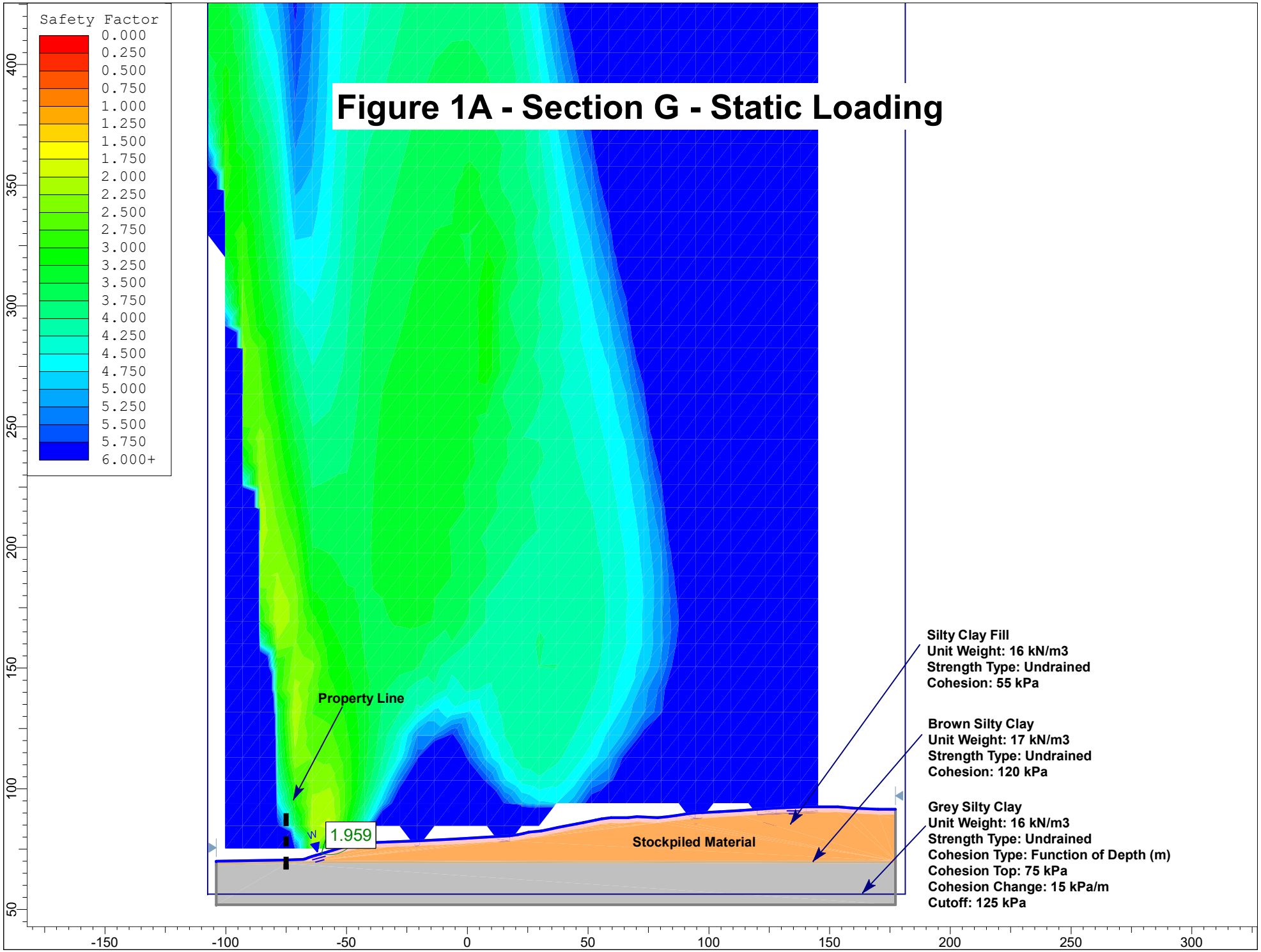
OTTAWA, ONTARIO

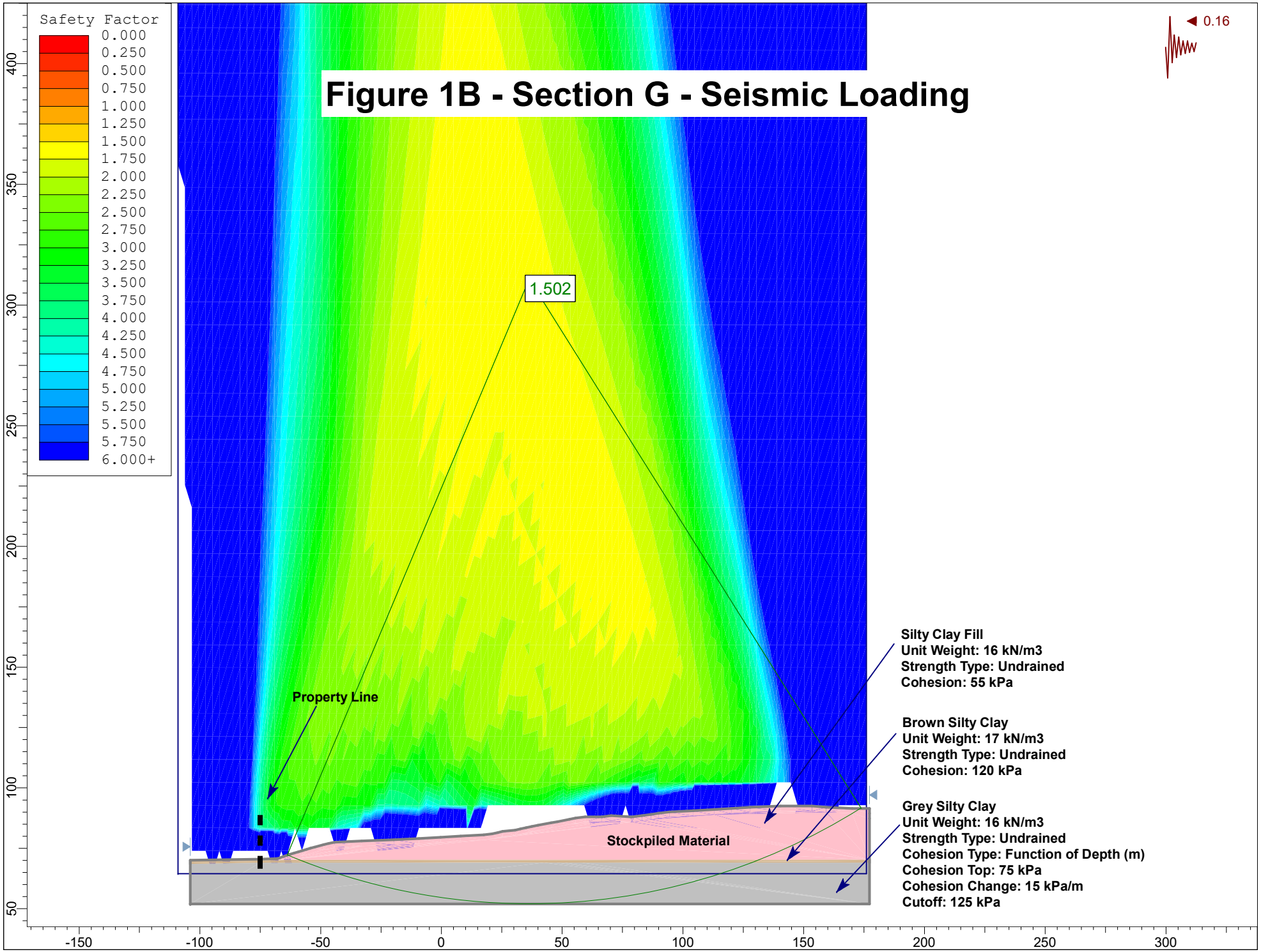
Title:

TEST HOLE LOCATION PLAN

Scale: 1:2500	Date: 09/2019
Drawn by: MPG	Report No.: PE4588-2
Checked by: MB	PE4588-4
Approved by: MSD	Revision No.:

p:\autocad drawings\environmental\pe45xx\pe4588\pe4588-4 thlp.dwg


Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
Figure 1A - Section G - Static Loading
Property Line
1.959
Stockpiled Material
Silty Clay Fill
Unit Weight: 16 kN/m3
Strength Type: Undrained
Cohesion: 55 kPa
Brown Silty Clay
Unit Weight: 17 kN/m3
Strength Type: Undrained
Cohesion: 120 kPa
Grey Silty Clay
Unit Weight: 16 kN/m3
Strength Type: Undrained
Cohesion Type: Function of Depth (m)
Cohesion Top: 75 kPa
Cohesion Change: 15 kPa/m
Cutoff: 125 kPa
400
350
300
250
200
150
100
50
-150
-100
-50
0
50
100
150
200
250
300


Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
0.16
Figure 1B - Section G - Seismic Loading
1.502
Property Line
Stockpiled Material
Silty Clay Fill
Unit Weight: 16 kN/m3
Strength Type: Undrained
Cohesion: 55 kPa
Brown Silty Clay
Unit Weight: 17 kN/m3
Strength Type: Undrained
Cohesion: 120 kPa
Grey Silty Clay
Unit Weight: 16 kN/m3
Strength Type: Undrained
Cohesion Type: Function of Depth (m)
Cohesion Top: 75 kPa
Cohesion Change: 15 kPa/m
Cutoff: 125 kPa
400
350
300
250
200
150
100
50
-150
-100
-50
0
50
100
150
200
250
300

Geotechnical Engineering

Environmental Engineering

Hydrogeology

Geological Engineering

Materials Testing

Building Science

Archaeological Services

patersongroup

Environmental Noise Control Study - Stationary Noise Component

Proposed Residential Development
Spring Valley Trails
3252 Navan Road - Ottawa

Prepared For

Claridge Homes (Gladstone)

June 1, 2021

Report: PG5224-2

Paterson Group Inc.
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www.patersongroup.ca

Table of Contents Page

Appendices

1.0 Introduction

Paterson Group (Paterson) was commissioned by Claridge Homes (Gladstone) to conduct a Stationary Noise Review for the proposed Spring Valley Trails Phase 5 and 6 residential development to be located at 3252 Navan Road, in the City of Ottawa. It should be noted that Paterson's report was solely prepared to review the stationary noise source, which is identified as the adjacent property (Waste recycling and disposal operation at BFI Navan Facility).

The following report has been prepared specifically and solely for the aforementioned project which is described herein. It contains our findings and includes acoustical recommendations pertaining to the design and construction of the subject development as they are understood at the time of writing this report.

This study has been conducted according to City of Ottawa document - Engineering Noise Control Guidelines (ENCG), dated January 2016, and the Ontario Ministry of the Environment Guideline NPC-300.

2.0 Background

It is understood that the proposed development will consist of single houses and townhouses. The single houses and townhouses will have outdoor living areas. Local roadways, residential driveways and landscaped areas are anticipated for the proposed development.

3.0 Methodology and Noise Assessment Criteria

Stationary Noise

Stationary noise sources include sources or facilities that are fixed or mobile and can cause a combination of sound and vibration levels emitted beyond the property line. These sources may include commercial air conditioner units, generators and fans. Facilities that may contribute to stationary noise may include car washes, snow disposal sites, transit stations and manufacturing facilities. In this situation, the stationary noise source consists of an existing solid waste disposal facility.

The impact of stationary noise sources are directly related to the location of the subject site within the urban environment. The proposed development can be classified as Class 2 by provincial guidelines and outlined in the ENGC, meaning "a suburban areas of the City outside of the busy core where the urban hum is evident but within the urban boundary."

Table 1 - Guidelines for Stationary Noise - Class 2

Time of Day	Outdoor Point of Reception	Pane of Window
7:00-19:00	50	50
19:00-23:00	45	50
23:00-7:00	-	45

1. Standards taken from Table 3.2a; Guidelines for Stationary Noise - Steady and Varying Sound

If the sound level limits are exceeded the following Warning Clause may be referenced:

Table 2 - Warning Clauses for Sound Level Exceedances

Warning Clause	Description
Warning Clause Type E	"Purchasers/tenants are advised that due to the proximity of the adjacent industry (facility) (utility), noise from the industry (facility) (utility) may at times be audible."

2. Clauses taken from section C8 Warning Clauses; Environmental Noise Guidelines - NPC-300

4.0 Analysis

The stationary noise source consisting of the BFI Navan Facility was identified within the 500 m radius from the proposed development. It is understood that the western edge of the BFI Navan Facility property is located approximately 120 metres from the eastern edge of the proposed residential development, and an additional 100 metres wide area is occupied by a compacted earth berm between the western toe of the landfill footprint and the BFI Navan Facility western property boundary, such that the proposed residential development is separated from the limit of waste placement by approximately 220 metres. It is also understood that the earth berm has a height that rises from about 17 metres at its south end to 12 metres towards its north end relative to the ground surface elevation on the adjacent subject property. It is further understood that the BFI Navan Facility will have an estimated 10 years of operational period beyond 2012 based on the currently approved capacity. Based on an agreement made during the Environmental Assessment process, the solid waste disposal facility will close upon reaching the currently approved capacity. Therefore, this stationary noise source is considered temporary and all analysis and recommendations made with respect to this stationary noise source can be removed from all deeds of sale once the solid waste disposal facility is closed.

The noise sources were modeled as the worst case indicator. The equipment utilized in the analysis is representative of the equipment that is used for solid waste disposal. The equipment consists of two excavators, three loaders, a vibratory compactor, three trucks, and three truck routes into and out of the existing BFI Navan Facility. A break down of the frequency's and sound levels of this equipment is included in Appendix 1.

The existing solid waste disposal facility is the only stationary noise source located within the 500 m proximity of the proposed development. The analysis was completed with specialized noise software: Predictor-Lima Version 2021.1. Twenty-six (26) reception points were selected within the 400 m proximity radius for our analysis. The reception points were selected at 1.5 m and 4.5 m elevations, so that both pane of glass at the first level and the second level of the proposed houses and outdoor living areas could be interpolated. The results of these reception points are included in Appendix 1.

5.0 Discussion

Results of the analysis can be found in Appendix 1. Reception points were analyzed at 1.5 m and 4.5 m elevations.

Proposed Residential Development

An analysis was completed for the proposed residential development, taking into consideration the lot layouts and approximate dwelling alignment. An initial analysis was performed utilizing the existing berm at the landfill with no sound mitigation measures. This analysis resulted in a maximum value of 52.0 dBA, which slightly exceeds the 50 dBA limit.

As per the Environmental Noise Guidelines prepared by the City of Ottawa, the following chart outlines the procedures to follow for exceedances to the stationary noise levels.

Table 3 - Noise Control Measures for New Development in Proximity to Stationary Noise Sources

Primary Mitigation Measure in order of Preference	Proposed Mitigation Measure
Insertion of noise insensitive land uses between the source and sensitive receptor	A 120 metres noise insensitive land is inserted between proposed development and the BFI Navan Facility
Orientation of buildings to provide quiet zones in rear yards, interior spaces and amenity areas	Side walls and rear yards are exposed to the stationary noise source.
construction techniques, enhanced construction quality	Exceedances for outdoor living areas - standard construction techniques are considered acceptable for the proposed dwellings.
earth berms	An earth berm has been constructed surrounding the western edge of BFI Navan Facility
acoustic barriers	Acoustic barriers are not required for noise mitigation

An analysis was completed utilizing an acoustic (noise) barrier at the rear property line of the dwellings closest to the landfill. The resultant noise levels were similar to those previously analyzed.

The anticipated noise levels, while slightly exceeding the 50 dBA limit, are considered acceptable with a Warning Clause provided.

6.0 Conclusion

The anticipated noise level at proposed residential development is considered acceptable while the BFI Navan Facility is in operation. Therefore, additional noise mitigation measures will not be required. However, Block 33, 34, 35 should have a provision to include the use of a central air conditioner, to ensure that windows will not need to be opened.

Due to the proximity of the BFI Navan Facility, a Warning Clause should be on the deed of sale of the units within the proposed residential development. Suggested wording is as follows:

> Purchasers/land owners are advised that there is a licensed solid waste disposal facility less than 500 metres away and that, from time to time, they may experience noise, dust and/or vibration as a result of the ongoing operations.

7.0 Statement of Limitations

The recommendations made in this report are in accordance with our present understanding of the project. Our recommendations should be reviewed when the project drawings and specifications are complete.

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than the Claridge Homes (Gladstone) or their agent(s) is not authorized without review by this firm for the applicability of our recommendations to the altered use of the report.

Paterson Group Inc.

Stephanie A. Boisvenue, P.Eng. David J. Gilbert, P.Eng.

Report Distribution:

- ❑ Claridge Homes (e-mail copy)
- ❑ Paterson Group (1 copy)

APPENDIX 1

FIGURE 1 - MODEL OF PROPOSED RESIDENTIAL DEVELOPMENT

FIGURE 1 - MODEL OF PROPOSED RESIDENTIAL DEVELOPMENT - WITH BARRIER

FIGURE 2 - INITIAL ANALYSIS (TABLE OF RESULT)

FIGURE 2 - INITIAL ANALYSIS (TABLE OF RESULT) - WITH BARRIER

FIGURE 3 - INITIAL ANALYSIS (CONTOUR RESULT)

FIGURE 3 - INITIAL ANALYSIS (CONTOUR RESULT) - WITH BARRIER

ITEM PROPERTIES

Figure 1 - Model of Proposed Residential Development

Paterson Group Inc. , Canada

Industrial noise - LimA - ISO 9613.1/2, [version of Area - Model - Spring Valley Trails] , Predictor V2021.1 Licensed to Paterson Group Inc. , Canada

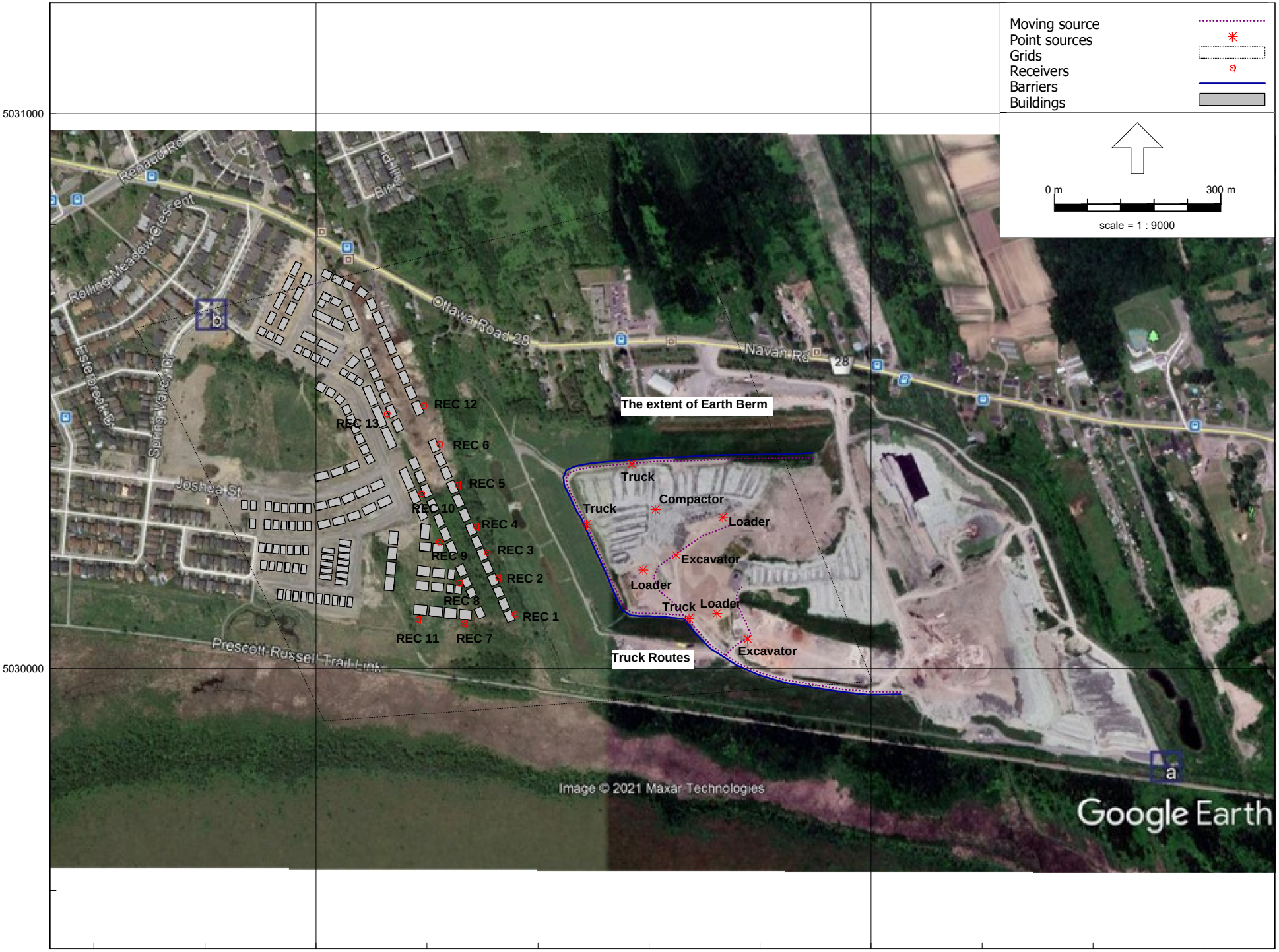


Figure 1 - Model of Proposed Residential Development

Paterson Group Inc. , Canada

Industrial noise - LimA - ISO 9613.1/2, [version of Area - Model - Spring Valley Trails] , Predictor V2021.1 Licensed to Paterson Group Inc. , Canada

Report: Table of Results
Model: Model - Spring Valley Trails
LAeq: total results for receivers
Group: (main group)
Group Reduction: No

Name Receiver	Description	X	Y	Height	Day	Evening	Night
Rec 1_A	REC 1	18460357.79	5030097.83	1.50	51.8	--	--
Rec 1_B	REC 1	18460357.79	5030097.83	4.50	52.0	--	--
Rec 10_A	REC 10	18460189.85	5030315.01	1.50	33.1	--	--
Rec 10_B	REC 10	18460189.85	5030315.01	4.50	38.4	--	--
Rec 11_A	REC 11	18460184.10	5030088.37	1.50	37.4	--	--
Rec 11_B	REC 11	18460184.10	5030088.37	4.50	41.0	--	--
Rec 12_A	REC 12	18460193.70	5030473.38	1.50	47.2	--	--
Rec 12_B	REC 12	18460193.70	5030473.38	4.50	47.3	--	--
Rec 2_A	REC 2	18460328.57	5030163.39	1.50	51.1	--	--
Rec 2_B	REC 2	18460328.57	5030163.39	4.50	51.5	--	--
Rec 3_A	REC 3	18460307.88	5030208.74	1.50	50.8	--	--
Rec 3_B	REC 3	18460307.88	5030208.74	4.50	51.2	--	--
Rec 4_A	REC 4	18460288.69	5030255.61	1.50	50.9	--	--
Rec 4_B	REC 4	18460288.69	5030255.61	4.50	51.3	--	--
Rec 5_A	REC 5	18460255.44	5030330.91	1.50	49.4	--	--
Rec 5_B	REC 5	18460255.44	5030330.91	4.50	49.7	--	--
Rec 6_A	REC 6	18460222.28	5030403.75	1.50	48.9	--	--
Rec 6_B	REC 6	18460222.28	5030403.75	4.50	49.0	--	--
Rec 7_A	REC 7	18460266.73	5030080.76	1.50	39.8	--	--
Rec 7_B	REC 7	18460266.73	5030080.76	4.50	43.2	--	--
Rec 8_A	REC 8	18460257.98	5030154.36	1.50	35.2	--	--
Rec 8_B	REC 8	18460257.98	5030154.36	4.50	41.1	--	--
Rec 9_A	REC 9	18460221.42	5030228.09	1.50	39.0	--	--
Rec 9_B	REC 9	18460221.42	5030228.09	4.50	44.7	--	--
rec13_A	REC 13	18460127.57	5030458.77	1.50	31.9	--	--
rec13_B	REC 13	18460127.57	5030458.77	4.50	37.7	--	--

All shown dB values are A-weighted

Report: Table of Results
Model: Model - Spring Valley Trails
LAeq: total results for receivers
Group: (main group)
Group Reduction: No

Name Receiver	Description	X	Y	Height	Day	Evening	Night
Rec 1_A	REC 1	18460357.79	5030097.83	1.50	51.8	--	--
Rec 1_B	REC 1	18460357.79	5030097.83	4.50	52.0	--	--
Rec 10_A	REC 10	18460189.85	5030315.01	1.50	33.1	--	--
Rec 10_B	REC 10	18460189.85	5030315.01	4.50	38.4	--	--
Rec 11_A	REC 11	18460184.10	5030088.37	1.50	37.4	--	--
Rec 11_B	REC 11	18460184.10	5030088.37	4.50	41.0	--	--
Rec 12_A	REC 12	18460193.70	5030473.38	1.50	47.2	--	--
Rec 12_B	REC 12	18460193.70	5030473.38	4.50	47.3	--	--
Rec 2_A	REC 2	18460328.57	5030163.39	1.50	51.1	--	--
Rec 2_B	REC 2	18460328.57	5030163.39	4.50	51.5	--	--
Rec 3_A	REC 3	18460307.88	5030208.74	1.50	50.8	--	--
Rec 3_B	REC 3	18460307.88	5030208.74	4.50	51.2	--	--
Rec 4_A	REC 4	18460288.69	5030255.61	1.50	50.9	--	--
Rec 4_B	REC 4	18460288.69	5030255.61	4.50	51.3	--	--
Rec 5_A	REC 5	18460255.44	5030330.91	1.50	49.4	--	--
Rec 5_B	REC 5	18460255.44	5030330.91	4.50	49.7	--	--
Rec 6_A	REC 6	18460222.28	5030403.75	1.50	48.9	--	--
Rec 6_B	REC 6	18460222.28	5030403.75	4.50	49.0	--	--
Rec 7_A	REC 7	18460266.73	5030080.76	1.50	39.8	--	--
Rec 7_B	REC 7	18460266.73	5030080.76	4.50	43.2	--	--
Rec 8_A	REC 8	18460257.98	5030154.36	1.50	35.2	--	--
Rec 8_B	REC 8	18460257.98	5030154.36	4.50	41.1	--	--
Rec 9_A	REC 9	18460221.42	5030228.09	1.50	39.0	--	--
Rec 9_B	REC 9	18460221.42	5030228.09	4.50	44.7	--	--
rec13_A	REC 13	18460127.57	5030458.77	1.50	31.9	--	--
rec13_B	REC 13	18460127.57	5030458.77	4.50	37.7	--	--

All shown dB values are A-weighted

Figure 3 - Initial Analysis (Contour Results)

Industrial noise - LimA - ISO 9613.1/2, [version of Area - Model - Spring Valley Trails] , Predictor V2021.1 Licensed to Paterson Group Inc. , Canada

Paterson Group Inc. , Canada

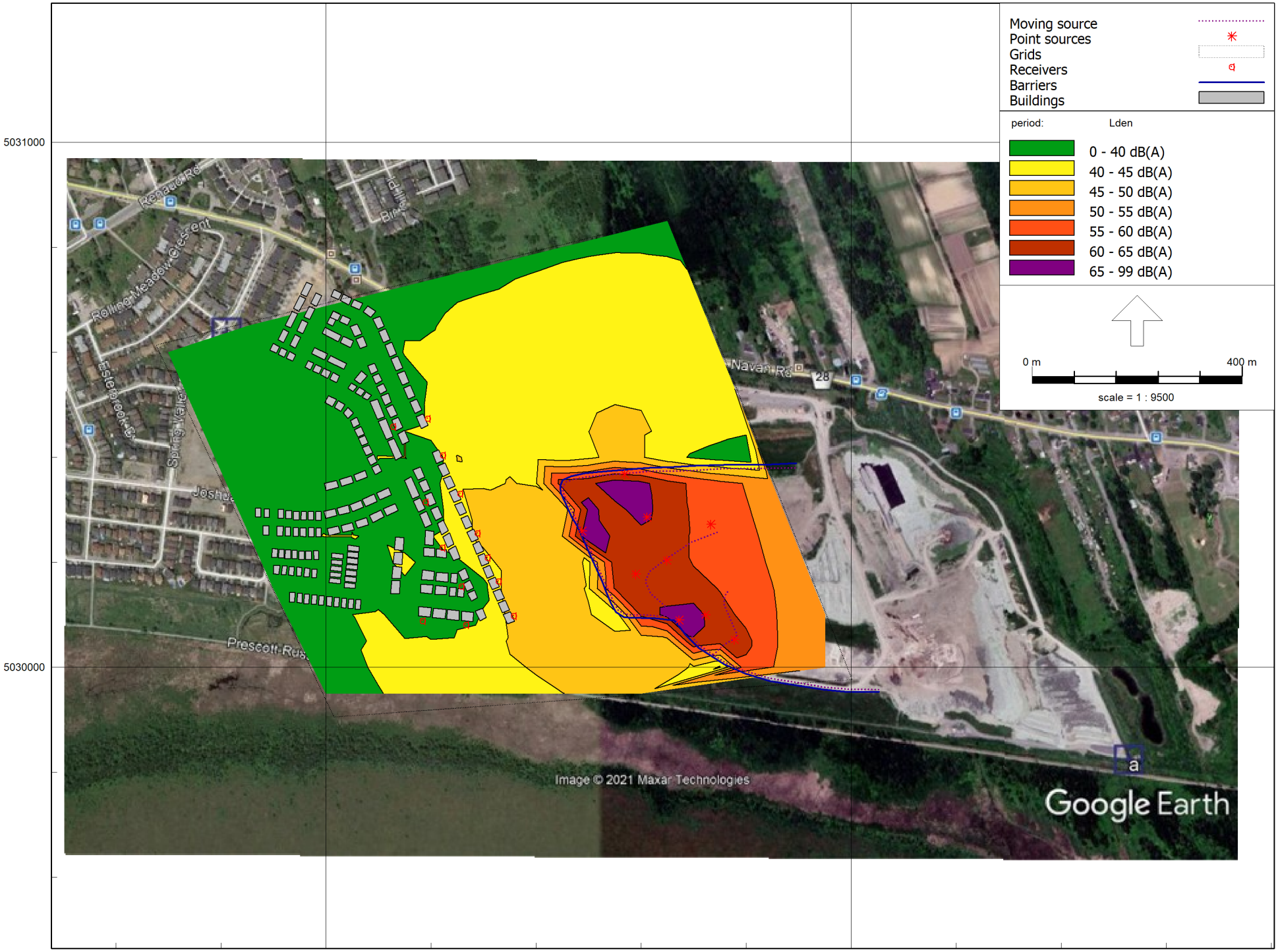


Figure 3 - Initial Analysis (Contour Results)

Industrial noise - LimA - ISO 9613.1/2, [version of Area - Model - Spring Valley Trails] , Predictor V2021.1 Licensed to Paterson Group Inc. , Canada

Paterson Group Inc. , Canada

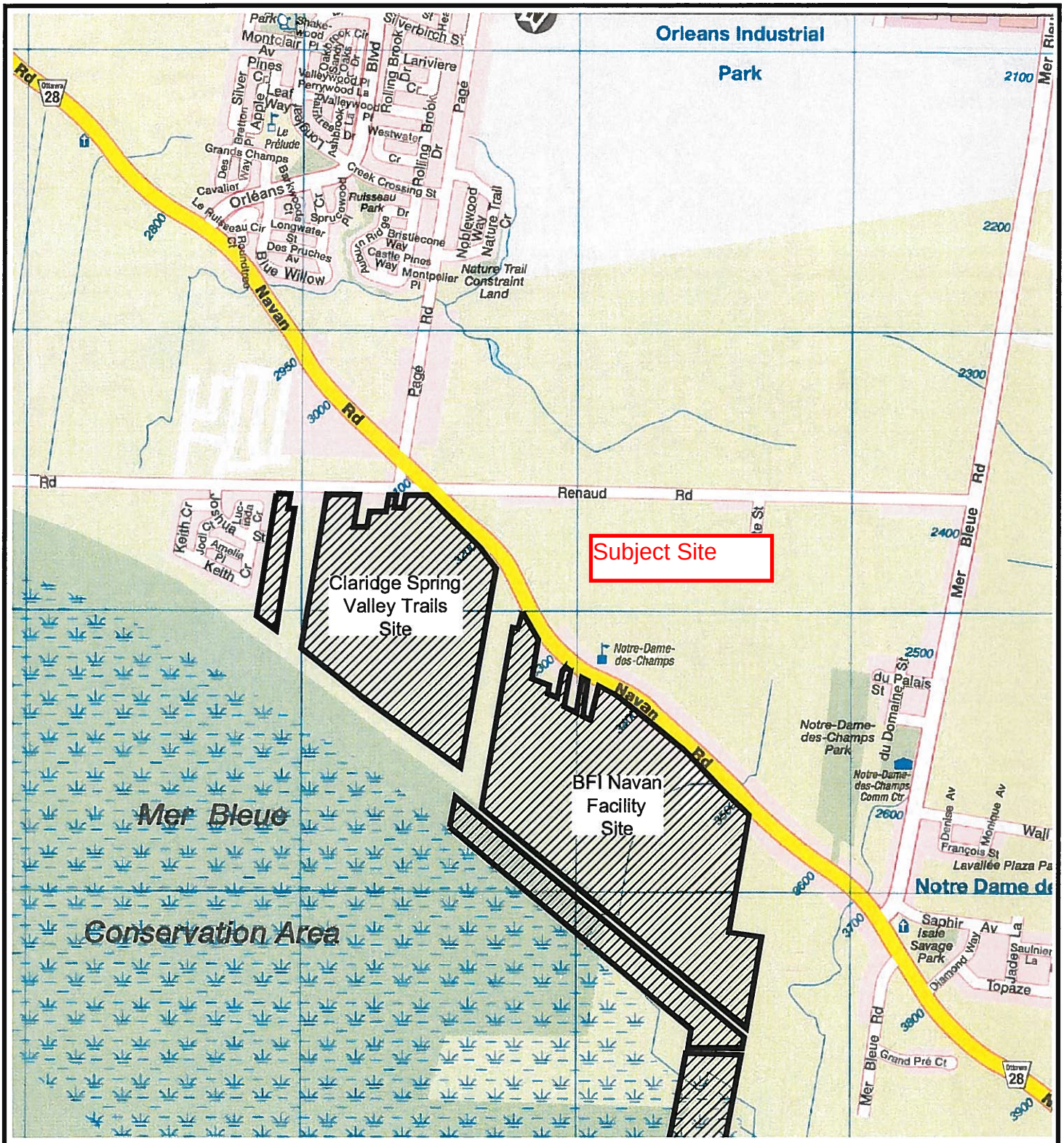
Model: Model - Spring Valley Trails
version of Area - Area
Group: (main group)
Listing of: Point sources, for method Industrial noise - LimA - ISO 9613.1/2

Desc.	No building	No ind.site	Lw 63	Lw 125	Lw 250	Lw 500	Lw 1k	Lw 2k	Lw 4k	Lw 8k
Loader	No	No	75.80	77.90	83.40	88.80	91.00	89.20	88.00	76.90
Compactor	No	No	82.80	87.90	91.40	97.80	100.00	101.20	97.00	89.90
Truck	No	No	95.80	87.90	96.40	99.80	104.00	102.20	97.00	89.90
Truck	No	No	95.80	87.90	96.40	99.80	104.00	102.20	97.00	89.90
Truck	No	No	95.80	87.90	96.40	99.80	104.00	102.20	97.00	89.90
Excavator	No	No	74.80	84.90	88.40	94.80	95.00	93.20	87.00	77.90
Loader	No	No	75.80	77.90	83.40	88.80	91.00	89.20	88.00	76.90
Excavator	No	No	74.80	84.90	88.40	94.80	95.00	93.20	87.00	77.90
Loader	No	No	75.80	77.90	83.40	88.80	91.00	89.20	88.00	76.90

APPENDIX 3

Applicable Figures by Others

Golder Report 07-1121-0232 (2000)



NOTE

THIS FIGURE IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GOLDER ASSOCIATES LTD. REPORT No. 07-1121-0232-2000

Golder Associates
Ottawa, Ontario, Canada

SCALE	1:20,000
DATE	2013-12-20
DESIGN	
CAD	JM/BR
CHECK	ALC
REVIEW	PAS

TITLE

KEY PLAN

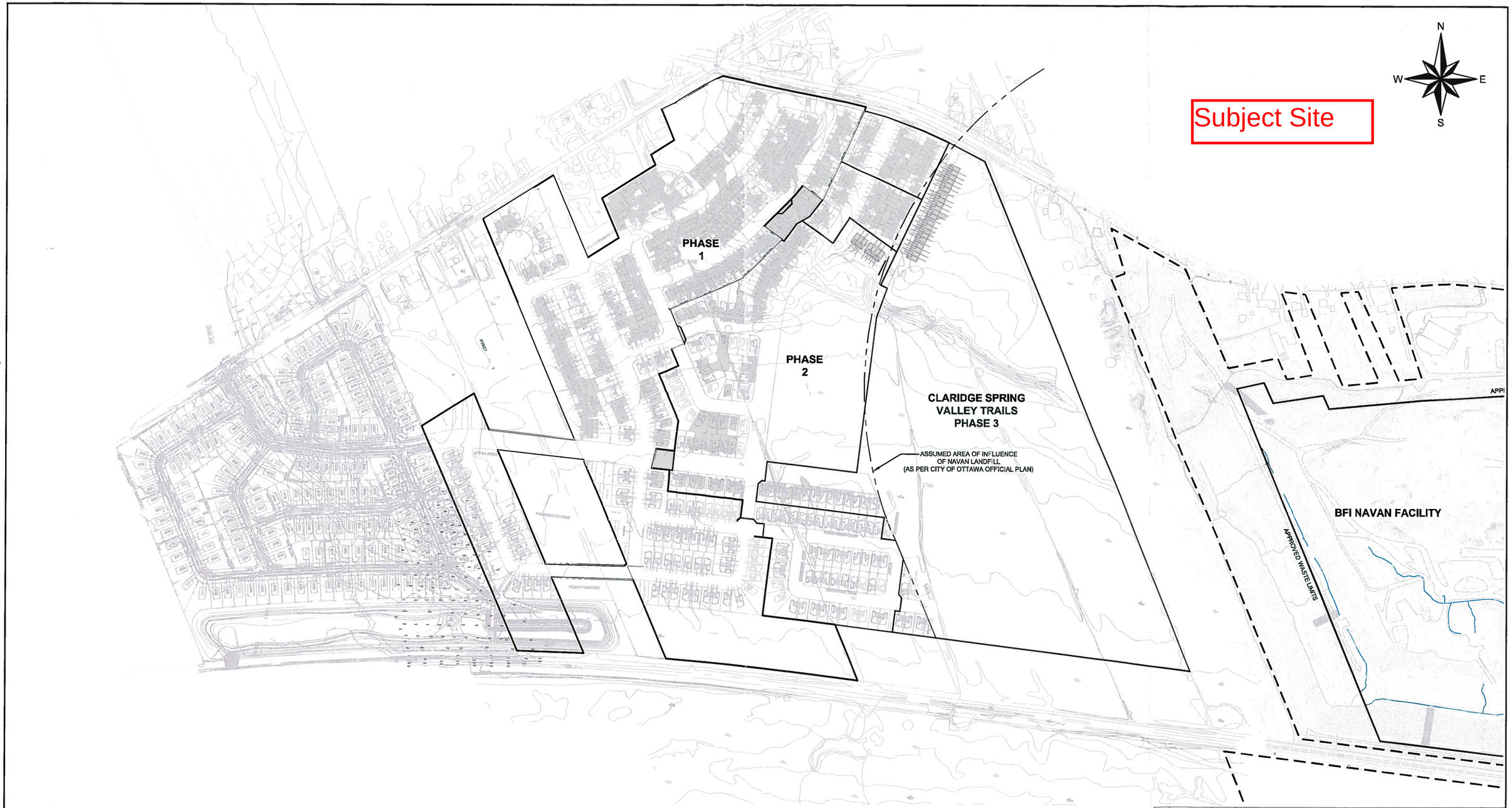
FILE No. 0711210232-2000-01.dwg

PROJECT No. 07-1121-0232 REV.

BUFFER STUDY
PHASE 3 - SPRING VALLEY TRAILS

FIGURE 1

PLOT DATE: December 20, 2013
FILENAME: N:\Active\2007\1121 - Geotechnical\07-1121-0232 Claridge Spring Valley Ottawa\ACAD\Phase 2000\0711210232-2000-01.dwg



LEGEND

- CLARIDGE PROPERTY BOUNDARY
- EXISTING BUILDING
- ROAD
- BFI PROPERTY BOUNDARY
- FENCE LINE
- CLARIDGE SITE CONTOURS (SEP. 2006)
- BFI SITE CONTOURS (JULY 2010)

REFERENCE

1. BASE PLAN SUPPLIED IN ELECTRONIC FORMAT BY IBI GROUP AND THE BASE MAPPING CO. LTD.

NOTE

1. THIS FIGURE IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GOLDER ASSOCIATES LTD. REPORT No. 07-1121-0232-2000

100 0 100 200
SCALE 1:5000 METRES

REV	DATE	DES	REVISION DESCRIPTION	CAD	CHK	RVW

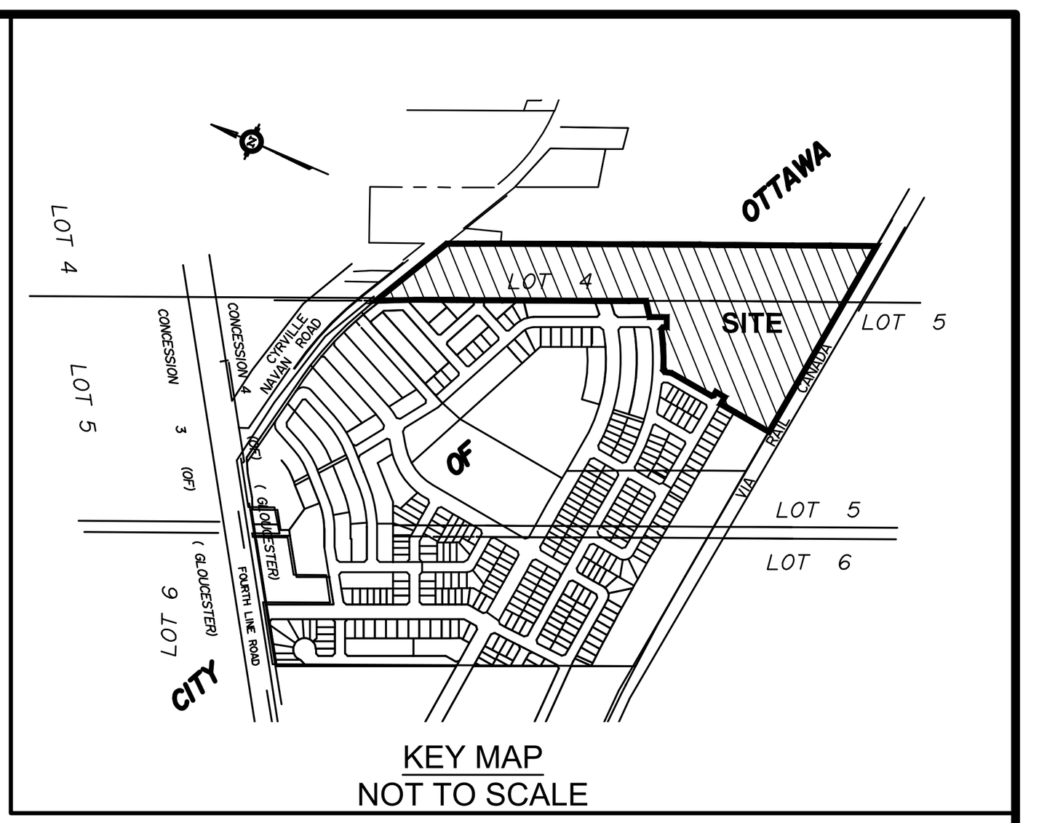
PROJECT
BUFFER STUDY
PHASE 3 - SPRING VALLEY TRAILS
OTTAWA, ONTARIO

TITLE
CLARIDGE HOMES
SPRING VALLEY TRAILS
SITE PLAN

Golder Associates
Ottawa, Ontario, Canada

PROJECT No.	07-1121-0232		FILE No.	0711210232-2000-02.dwg	
DESIGN			SCALE	1:5,000	REV.
CAD	JM/BR	2013-12-20	FIGURE No.		
CHECK	ALC	2013-12-20		2	
REVIEW	PAS	2013-12-20			

PLOT DATE: December 20, 2013
FILENAME: N:\Active\2007\1121 - Geotechnical\07-1121-0232 Claridge Spring Valley Ottawa\ACAD\Phase 2000\0711210232-2000-02.dwg



SKETCH TO ILLUSTRATE

PROPOSED UNIT LAYOUT ON PHASE 5
SPRING VALLEY TRAILS DEVELOPMENT
CITY OF OTTAWA

Prepared by Annis , O'Sullivan , Vollebekk Ltd.

Scale 1 : 1000

Metric

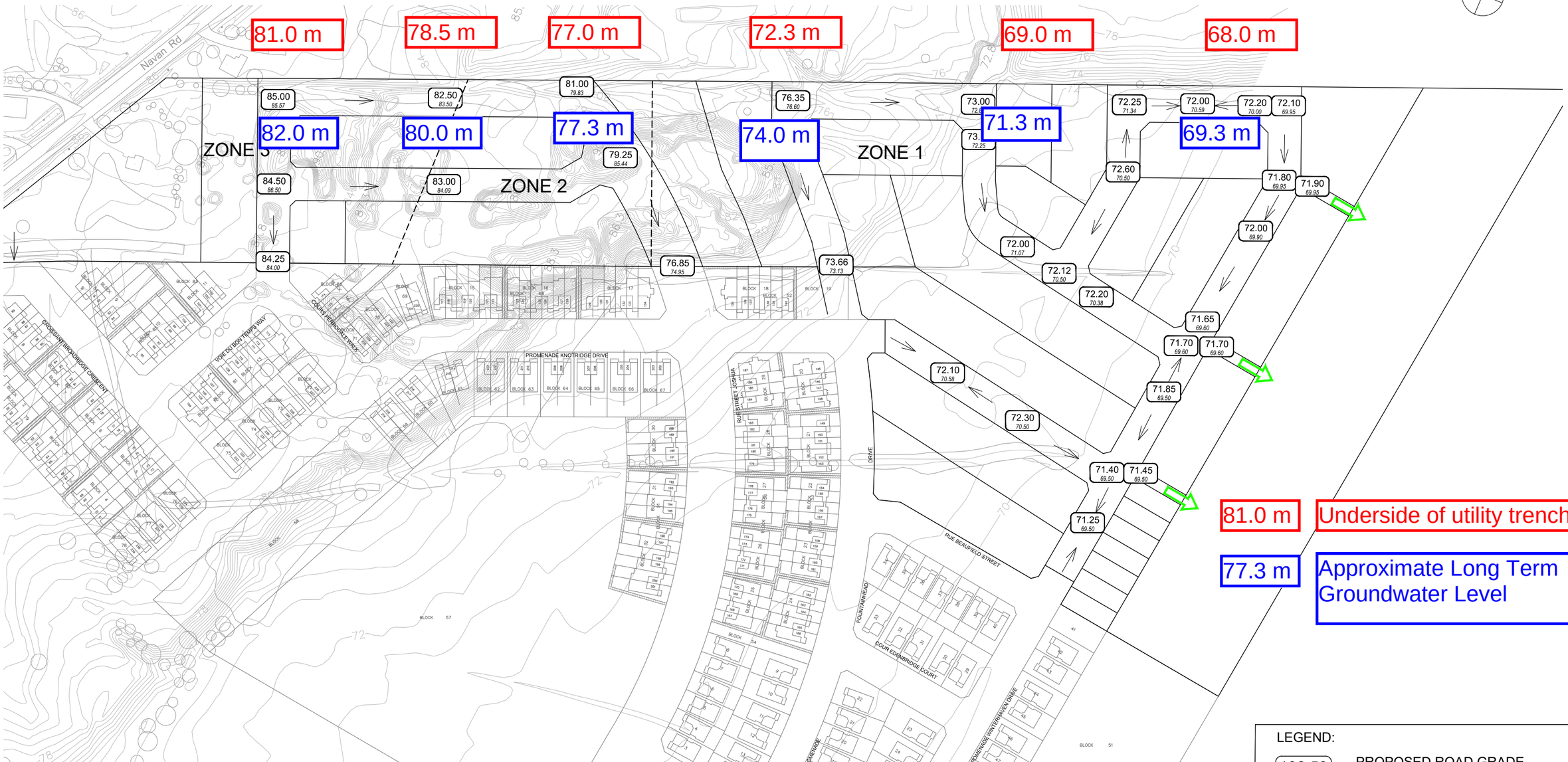
DISTANCES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

REVISION SCHEDULE

NO.	REVISION	DATE	BY
3	REVISED LAYOUT	JUNE 9, 2020	N
2	TOWNHOUSE UNITS ADDED	MAR. 18, 2020	N
1	PLAN PREPARED FOR DISCUSSION	FEB 25, 2020	N

ANNIS, O'SULLIVAN, VOLLEBEKK LTD.
14 Concourse Gate, Suite 500
Nepean, Ont. K2E 7S6
Phone: (613) 727-0850 / Fax: (613) 727-1079
Email: Nepean@aovltd.com
Ontario Land Surveyors

Job No. 20313-19 Claridge Pt Lts 4 5 C4 OF GL DPS D3 | N



PERMISSIBLE GRADE RAISE	
ZONE	m
1	2.5m
2	1.0m
3	0.5m

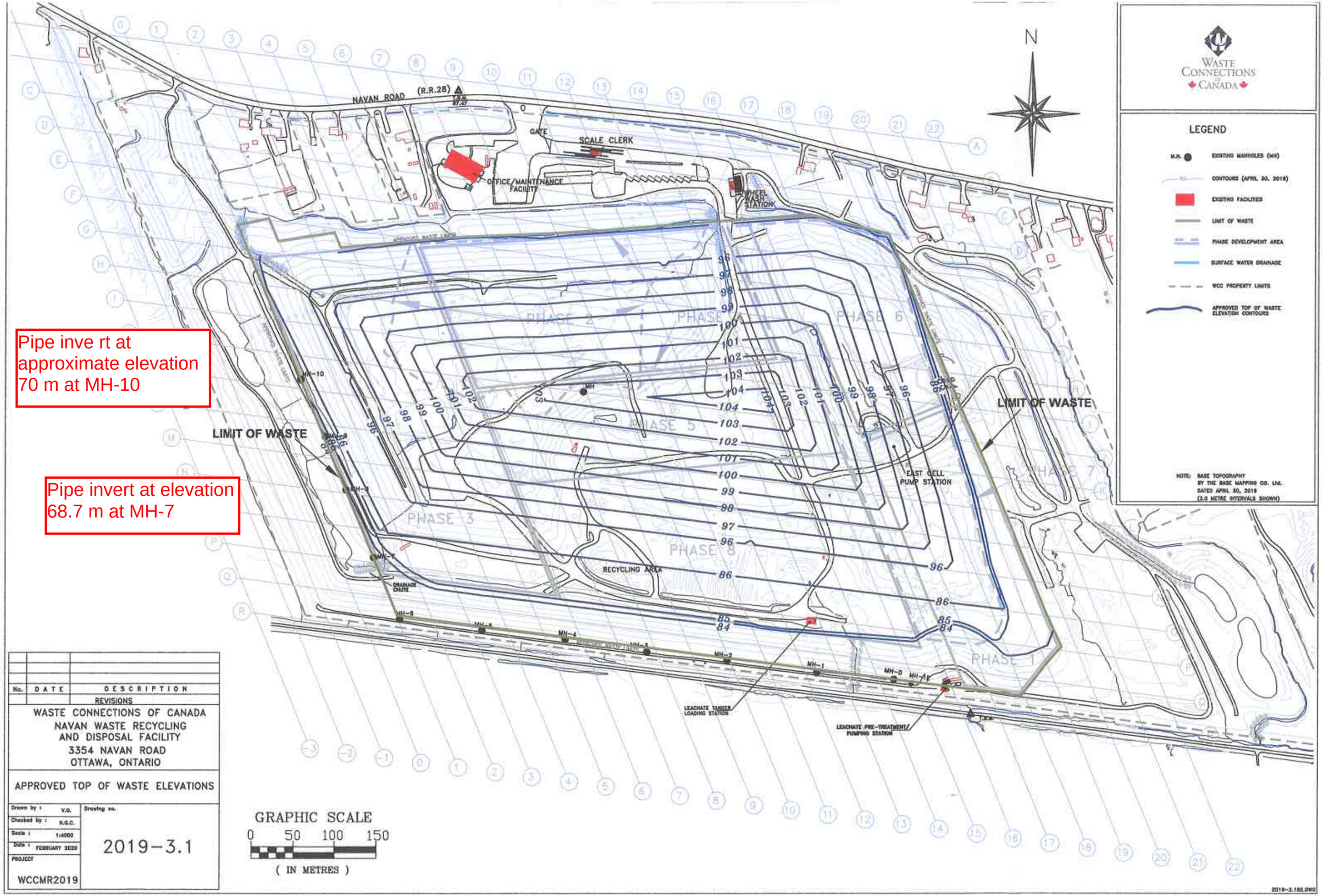
LEGEND:

- 102.50 / 101.55 — PROPOSED ROAD GRADE / EXISTING GRADE
- ⇨ — DIRECTION OF MAJOR FLOW
- * — DENOTES UNITS MAY REQUIRE SPECIAL DESIGN

Scale	Project Title	Drawing Title	Sheet No.
N.T.S.	SPRING VALLEY TRAILS PHASE 5 & 6	MACRO GRADING	FIGURE 6.1

Pipe inve rt at approximate elevation 70 m at MH-10

Pipe invert at elevation 68.7 m at MH-7



No.	DATE	DESCRIPTION
		REVISIONS

WASTE CONNECTIONS OF CANADA
NAVAN WASTE RECYCLING AND DISPOSAL FACILITY
3354 NAVAN ROAD
OTTAWA, ONTARIO

APPROVED TOP OF WASTE ELEVATIONS

Drawn by :	V.G.
Checked by :	N.G.C.
Scale :	1:4000
Date :	FEBRUARY 2020
PROJECT	WCCMR2019
Drawing no.	2019-3.1

GRAPHIC SCALE
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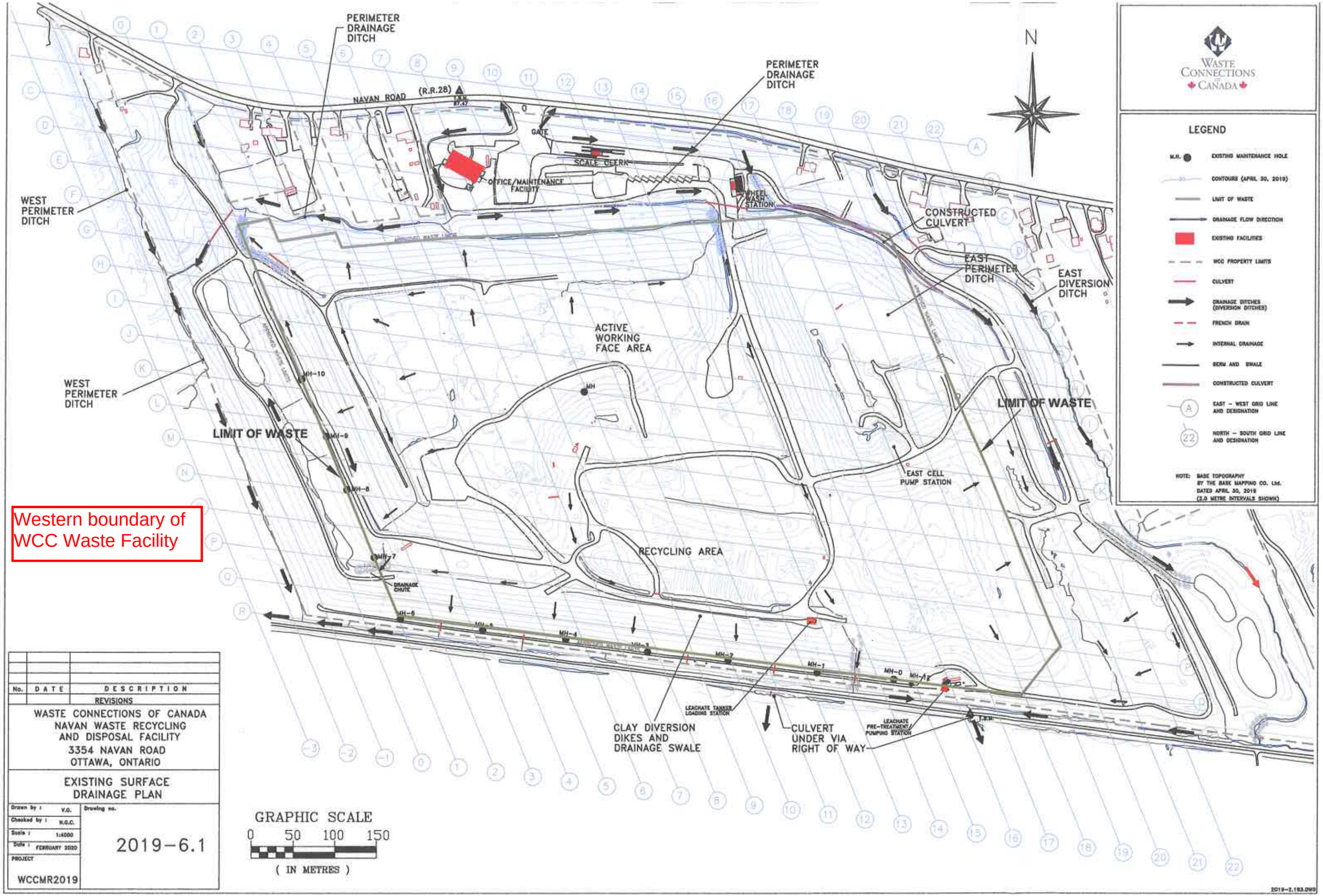
(IN METRES)

2019-3.1R2.DWG



Western boundary of WCC Waste Facility

No.	DATE	DESCRIPTION
		REVISIONS

WASTE CONNECTIONS OF CANADA
NAVAN WASTE RECYCLING AND DISPOSAL FACILITY
3354 NAVAN ROAD
OTTAWA, ONTARIO

EXISTING SURFACE DRAINAGE PLAN

Drawn by : V.G.	Drawing no.
Checked by : N.G.C.	
Scale : 1:4000	2019-6.1
Date : FEBRUARY 2020	
PROJECT WCCMR2019	

GRAPHIC SCALE
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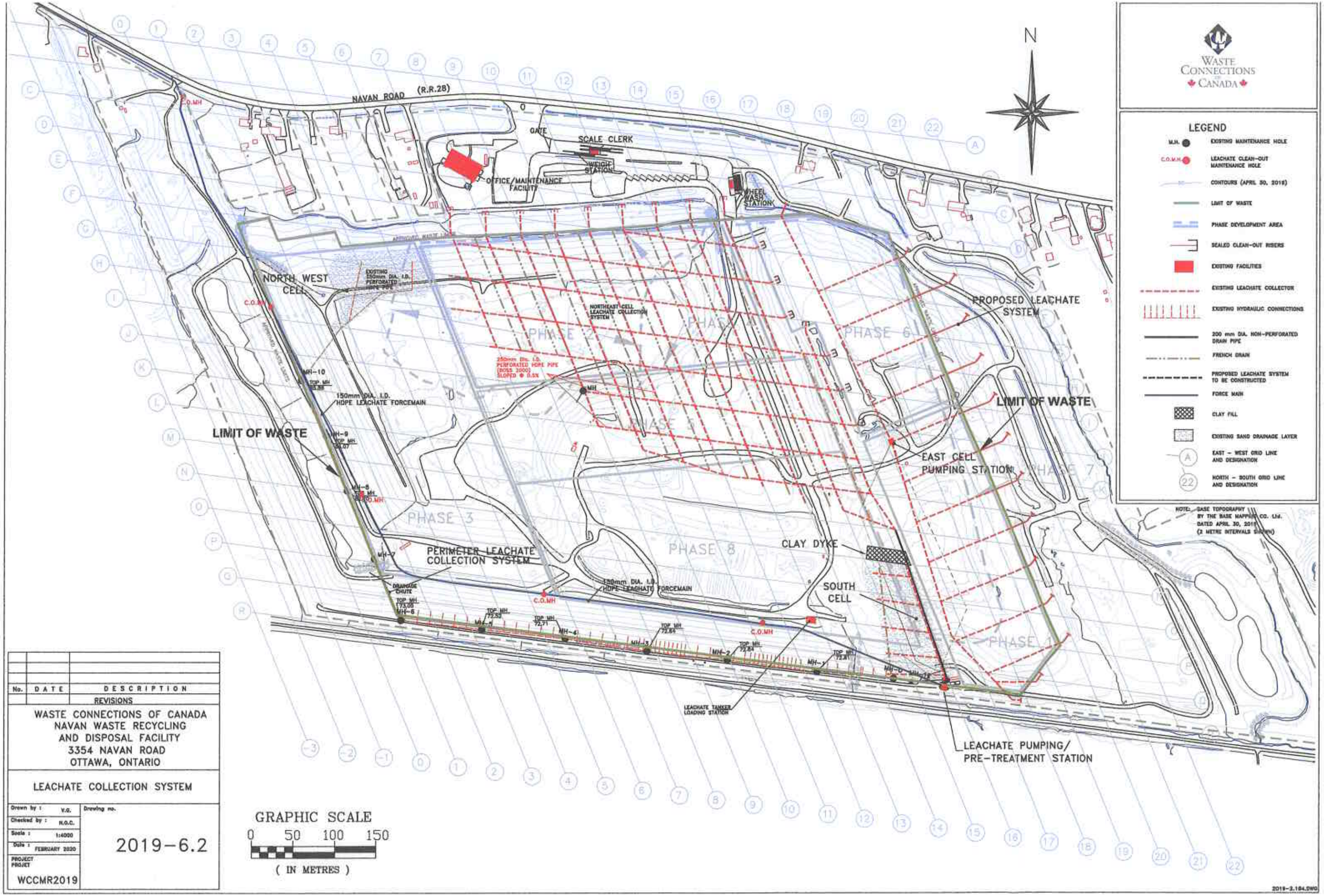
(IN METRES)

2019-2.193.DWG



No.	DATE	DESCRIPTION
		REVISIONS

WASTE CONNECTIONS OF CANADA
NAVAN WASTE RECYCLING AND DISPOSAL FACILITY
3354 NAVAN ROAD
OTTAWA, ONTARIO

LEACHATE COLLECTION SYSTEM

Drawn by : V.G.	Drawing no.
Checked by : N.G.C.	
Scale : 1:4000	2019-6.2
Date : FEBRUARY 2020	
PROJECT PROJECT	
WCCMR2019	

GRAPHIC SCALE
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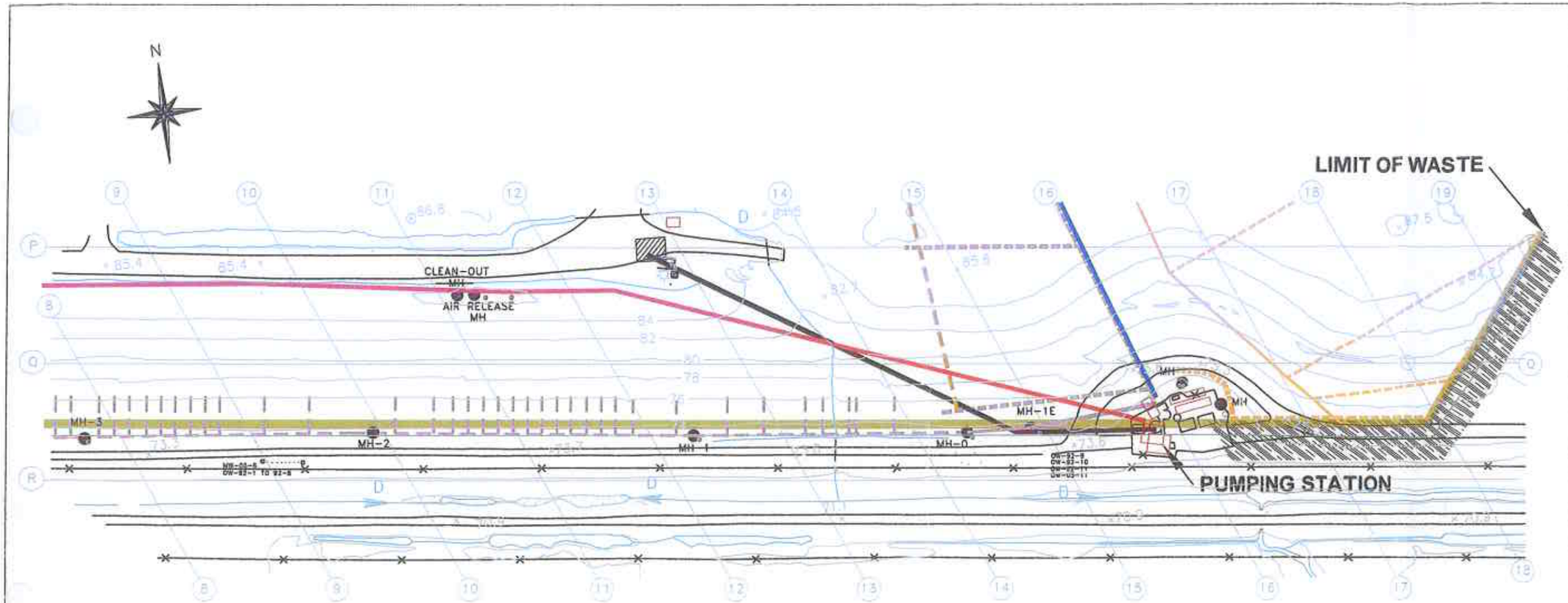
(IN METRES)

2019-2.184.DWG



GRAPHIC SCALE

0 25 50 75

(IN METRES)

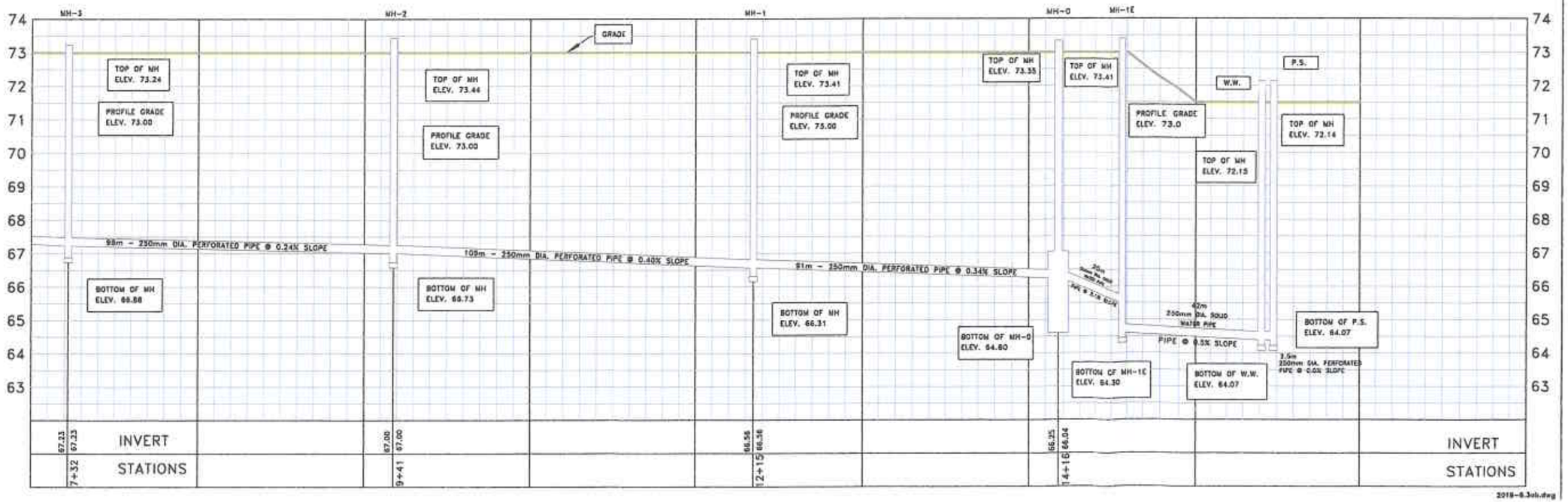
SCALE 1:400

WASTE CONNECTIONS OF CANADA

LEGEND

- MH — EXISTING MANHOLES (MH)
- CONTOURS (MAY 1, 2018)
- WASTE LIMIT
- 200 mm DIA. DR17 HDPE PERFORATED PIPE
- 200 mm DIA. DR17 HDPE SOLID PIPE
- 200 mm BOSS 2000 PERFORATED LEACHATE COLLECTION PIPE AND EXISTING HYDRAULIC CONNECTIONS
- 250 mm DIA. (SDR-18) C-900 PVC WATER PIPE (BLUE BRUTE)
- 150 mm DIA. FORCEMAIN TO TANKER LOADING STATION (CONTINGENCY)
- FRENCH DRAIN
- 200mm HDPE SOLID DRAINAGE PIPE
- 150 mm HDPE FORCEMAIN TO CITY OF OTTAWA SANITARY SEWER
- GW — GROUNDWATER MONITORING WELLS
- A — EAST - WEST GRID LINE AND DESIGNATION
- 22 — NORTH - SOUTH GRID LINE AND DESIGNATION

NOTE: BASE TOPOGRAPHY BY THE BASE MAPPING CO. Ltd. DATED MAY 1, 2018 (2 METRE INTERVALS SHOWN)



No.	DATE	DESCRIPTION
		REVISIONS

WASTE CONNECTIONS OF CANADA
NAVAN WASTE RECYCLING AND DISPOSAL FACILITY
3354 NAVAN ROAD
OTTAWA, ONTARIO

LEACHATE COLLECTION SYSTEM
PLAN AND PROFILE
LINE 8 TO 18

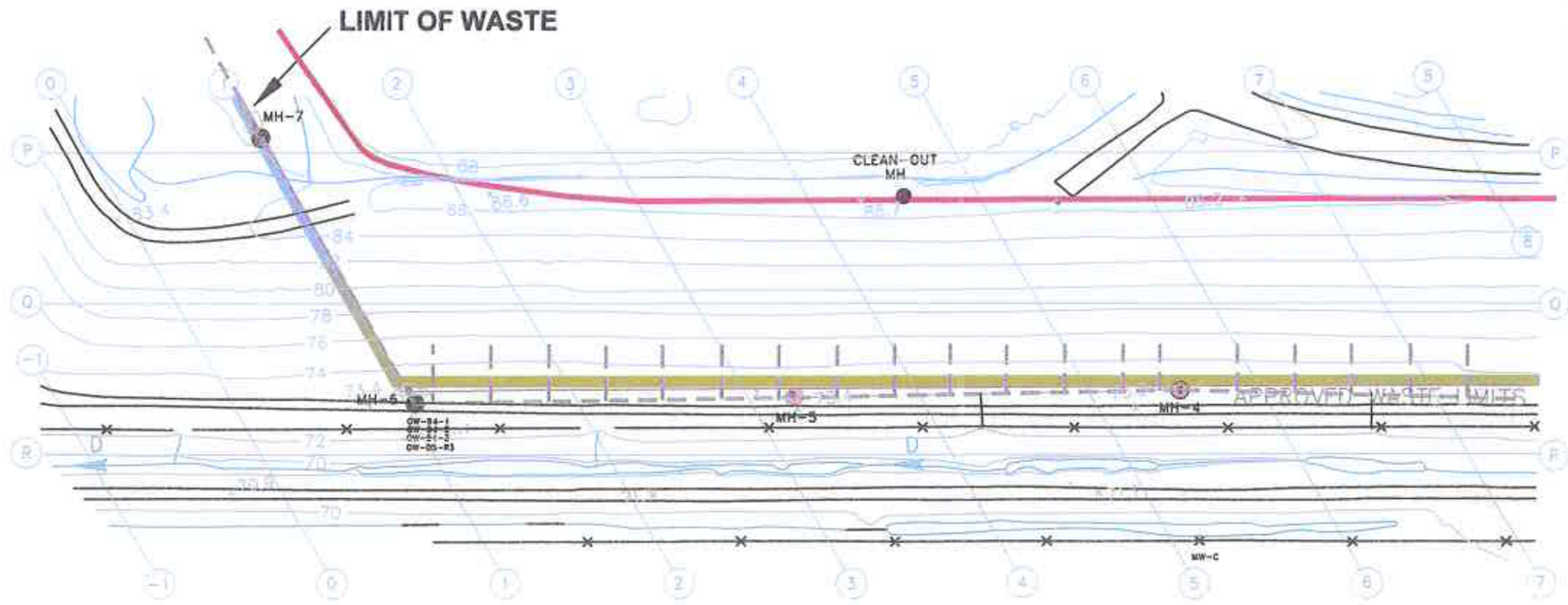
Drawn by : V.G.
Checked by : K.G.C.
Scale : 1:1500
Date : JANUARY 2019
PROJECT WCCMR2018

DRAWING NUMBER

2018-6.3A

2018-6.3sh.dwg

N



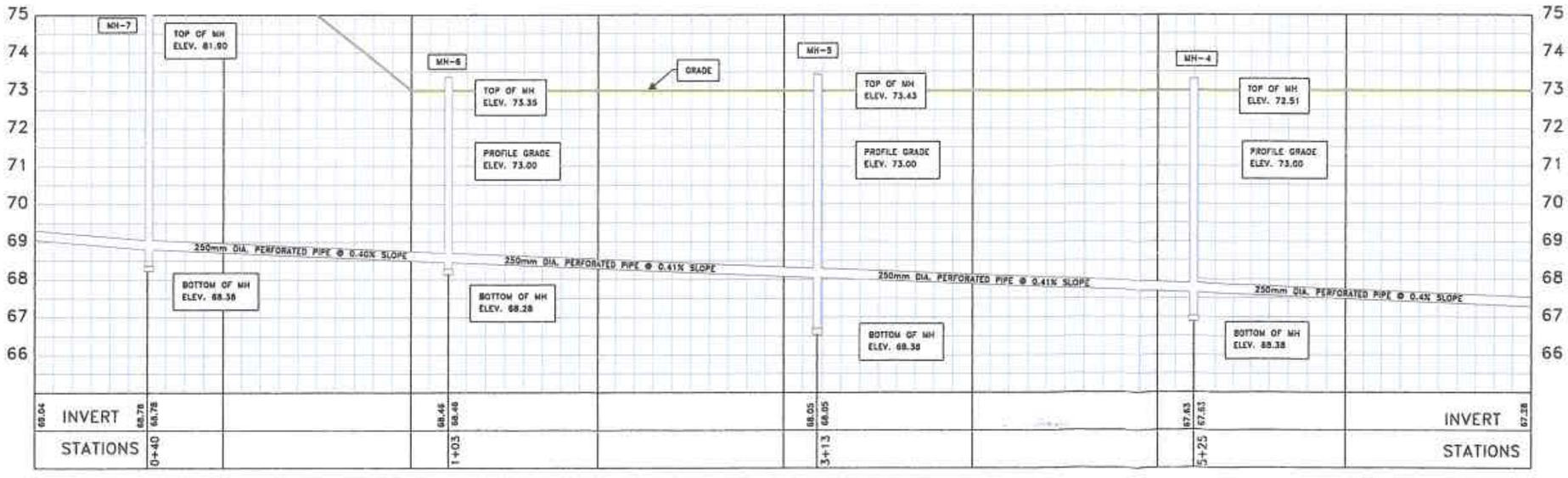
Invert of perforated pipe at elevation 68.7 m at MH-7

GRAPHIC SCALE

0 25 50 75

(IN METRES)

SCALE 1:400



No.	DATE	DESCRIPTION
		REVISIONS

WASTE CONNECTIONS OF CANADA
NAVAN WASTE RECYCLING
AND DISPOSAL FACILITY
3354 NAVAN ROAD
OTTAWA, ONTARIO

LEACHATE COLLECTION SYSTEM
PLAN AND PROFILE
LINE 1 TO 7

Drawn by : V.G.	DRAWING NUMBER
Checked by : H.G.C.	
Scale : 1:1000	2018-6.3B
Date : JANUARY 2019	
PROJECT WCCMR2018	

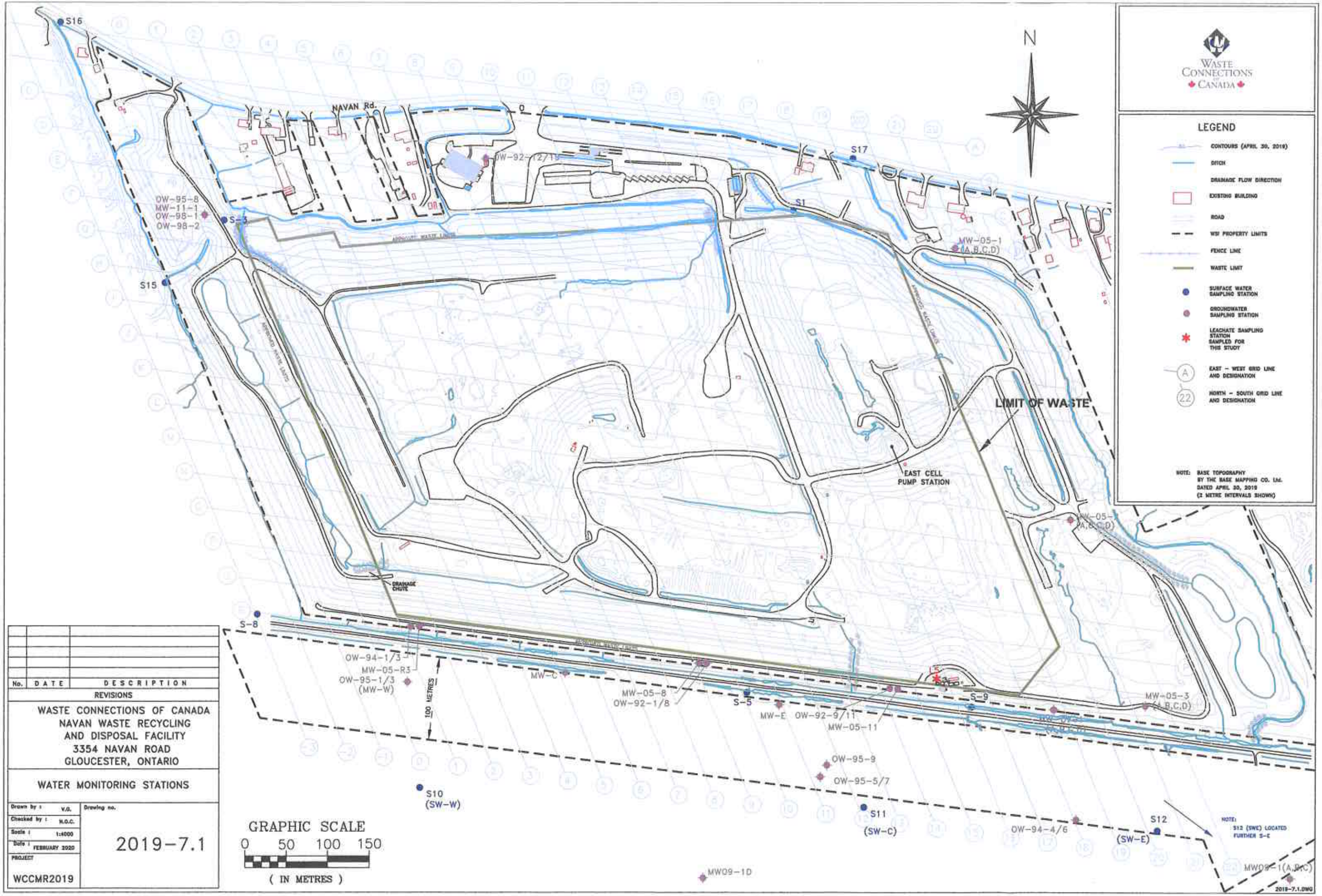
WASTE CONNECTIONS of CANADA

LEGEND

- MH — EXISTING MANHOLES (MH)
- CONTOURS (MAY 1, 2018)
- WASTE LIMIT
- 250 mm BOSS 3000 PERFORATED LEACHATE COLLECTION PIPE
- EXISTING HYDRAULIC CONNECTIONS
- FORCEMAIN TO CITY OF OTTAWA SANITARY SEWER
- OW — GROUNDWATER MONITORING WELLS
- A — EAST - WEST GRID LINE AND DESIGNATION
- 22 — NORTH - SOUTH GRID LINE AND DESIGNATION

NOTE: BASE TOPOGRAPHY BY THE BASE MAPPING CO. Ltd. DATED MAY 1, 2018 (2 METRE INTERVALS SHOWN)

2018-6.3db.dwg



WASTE CONNECTIONS OF CANADA

LEGEND

- CONTOURS (APRIL 30, 2019)
- DITCH
- DRAINAGE FLOW DIRECTION
- EXISTING BUILDING
- ROAD
- WSI PROPERTY LIMITS
- FENCE LINE
- WASTE LIMIT
- SURFACE WATER SAMPLING STATION
- GROUNDWATER SAMPLING STATION
- LEACHATE SAMPLING STATION SAMPLED FOR THIS STUDY
- EAST – WEST GRID LINE AND DESIGNATION (A)
- NORTH – SOUTH GRID LINE AND DESIGNATION (22)

NOTE: BASE TOPOGRAPHY BY THE BASE MAPPING CO. Ltd. DATED APRIL 30, 2019 (2 METRE INTERVALS SHOWN)

NOTE: S12 (SWE) LOCATED FURTHER S-E

No.	DATE	DESCRIPTION
		REVISIONS

WASTE CONNECTIONS OF CANADA
NAVAN WASTE RECYCLING
AND DISPOSAL FACILITY
3354 NAVAN ROAD
GLOUCESTER, ONTARIO

WATER MONITORING STATIONS

Drawn by : V.G.	Drawing no.
Checked by : H.O.C.	2019-7.1
Scale : 1:4000	
Date : FEBRUARY 2020	
PROJECT: WCCMR2019	

2019-7.1.DWG

December 2013

REPORT ON

Claridge Homes Spring Valley Trails Development – Phase 3 Buffer Study in Relation to the BFI Navan Waste Recycling and Disposal Facility

Submitted to:
Claridge Homes
210 Gladstone Avenue, Suite 2001
Ottawa, Ontario
K2P 0Y6

Attn: Jim Burghout

REPORT

Report Number: 07-1121-0232 (2000)

Distribution:

5 copies, 1 CD - City of Ottawa
2 copies, 1 CD - Claridge Homes
1 copy, 1 CD - Paterson Group Inc.
2 copies - Golder Associates Ltd.

Golder Associates

EXECUTIVE SUMMARY

The Claridge Homes (Claridge) Spring Valley Trails development is located on lands to the south of the intersection of Navan Road and Renaud Road in Ottawa, Ontario. The property is being developed in 3 Phases. Presently, Phases 1 and 2 have been approved. Phase 3 of the Claridge development is located within 500 metres of the BFI Canada Inc. (BFI) Navan Waste Recycling and Disposal Facility (BFI Navan Facility), a solid waste disposal site. According to Section 3.8 of the City of Ottawa (City) Official Plan, land within 500 metres of an operating or non-operating solid waste disposal site is considered to be within the influence area of the solid waste disposal site. This buffer study was performed on behalf of Claridge in consultation with BFI Canada Inc. to satisfy the requirements of Section 3.8.6 as it relates to Phase 3 of the Spring Valley Trails development area, which requires that a study be performed to assess the potential for the solid waste disposal site to have unacceptable or adverse effects on the proposed development or pose risks to human health and safety. Based on this site-specific assessment, a determination is to be made of the required buffer (or separation) between the waste disposal site and the proposed development.

As required under Section 3.8.7 of the City of Ottawa's Official Plan, this buffer study addresses the potential for impact to the Claridge site from the BFI Navan Facility due to contamination by leachate, surface water runoff, ground settlement, visual impact, air (dust), odour, and noise, soil contamination, and landfill gas migration.

The BFI Navan Facility is owned and operated by BFI under Environmental Compliance Approval (ECA) No. A460702. The BFI Navan Facility performs landfilling and/or processing/recycling of solid, non-hazardous industrial, commercial and institutional (IC&I) waste (including construction and demolition (C&D) waste), asbestos waste, dry non-putrescible domestic waste (non-organic) and impacted soil. Composting of leaf and yard materials was previously performed, but material has not been accepted for composting since 2009. The western edge of the BFI Navan Facility property is located approximately 100 metres from the eastern edge of the Claridge Spring Valley Trails development; an additional separation of 100 metres exists between the western toe of the landfill footprint and the BFI Navan Facility western property boundary, such that Phase 3 of the Claridge site is separated from the limit of waste placement by approximately 200 metres. In April 2009, BFI received *Environmental Protection Act* (EPA) Approval for the expansion of the BFI Navan Facility. The approved expansion design provided additional disposal capacity for an estimated 10 years of operation beyond 2012. As per an agreement made during the Environmental Assessment (EA) process, the site will close on reaching the currently approved capacity and there will not be an application made for future expansion.

Local geology in the area of the Claridge site and the BFI Navan Facility consists of a thick clay deposit overlain by sands of varying thickness. An escarpment which runs east-west through the Claridge site and the BFI Navan Facility was once covered by such sand deposits, which have been mostly eroded below the escarpment. Above the escarpment, sands are found to be 0.6 to 2.0 metres thick. A thick (20 to 35 metre) marine clay deposit underlies the entire area. Bedrock in the area is composed of shale of the Billings Formation.

Surface runoff from the east side of the BFI Navan Facility site drains to the Bear Brook drainage basin, which is part of the South Nation River watershed. The west side (and the Claridge site) drain into the Mud Creek drainage basin, which in turn drains into Green's Creek, part of the Rideau River watershed. The Mer Bleue bog, a unique and internationally recognized ecological feature, is located to the south of both sites.

Local groundwater flow in the area is from north to south, from the escarpment toward the edge of the Mer Bleue. The thick clay deposit acts as an aquitard or barrier to groundwater movement, such that lateral flow

occurs only through the surficial sand unit and upper weathered clay zone, which have a total thickness of a few metres. The water table is between 1 and 2 metres below ground surface north of the escarpment and near the ground surface south of the escarpment. Regional groundwater flow in the deep bedrock aquifer is eastward.

Infiltration of rain water into a landfill and decomposing waste creates a liquid called leachate which, if not managed properly, has the potential to impact groundwater in the vicinity of a landfill. In assessing the potential for groundwater contamination by leachate, the local geology and hydrogeology, approved engineered controls, and continued groundwater monitoring program were considered. The natural hydrogeological aquitard imposed by the thick clay deposit that underlies the area impedes the flow of groundwater, which flows from north to south, hydraulically cross-gradient to the Claridge site. Engineered controls include a leachate collection system below the northeast and central area of the waste footprint, and a perimeter collection trench along the west and south edges of the waste footprint. The leachate collection system is designed such that the groundwater elevation within the landfill is maintained at a level lower than the groundwater elevation in the surrounding area, creating a "hydraulic trap", which causes groundwater to flow toward the landfill, rather than away from it. In addition, the 100 metre wide west buffer between the landfill footprint and the BFI Navan Facility property boundary is occupied by a berm of compacted silty clay soil, which adds an additional level of redundancy in mitigating the potential westward migration of leachate. Collected leachate is pumped to the City's sewer system via force main, but can also be pumped to tanker trucks as a contingency measure. A proposed addition to the leachate management system will be constructed during the approved horizontal expansion area of the landfill to the east. Groundwater monitoring is performed semi-annually, such that potentially impacted groundwater would be detected prior to any migration off-site. In summary, there is no mechanism by which landfill leachate can affect groundwater quality beneath the Claridge Phase 3 lands.

Studies performed during the approval process for the expansion of the BFI Navan Facility found that surface water runoff is not having an adverse effect on surface water receivers downstream of the landfill. The existing approved surface water management system at the BFI Navan Facility comprises a network of drainage ditches and roadside swales to intercept runoff generated on-site and direct it to either the east or west stormwater management pond. As the BFI Navan Facility landfill is an engineered landfill, potential contamination from a leachate release would be apparent in groundwater prior to surface water. Additionally, surface water monitoring is performed to assess surface water flow and quality at the BFI Navan Facility. As such, surface water on the Claridge site will not be impacted by the BFI Navan Facility.

Ground settlement on the Claridge lands is not expected to occur as a result of landfilling activities. Significant drawdown of the water table can cause ground settlement in clay soils. Water table drawdown as a result of excavations during landfill construction and the hydraulic trap design of the leachate collection system is limited in lateral extent due to the low permeability of the thick silty clay deposit. As a result, ground settlement on the Claridge site will not be caused by operations at the BFI Navan Facility, as confirmed by ongoing monitoring of groundwater levels within 10 metres of the landfill on the BFI site.

Potential visual impact from the BFI Navan Facility expansion was assessed during the expansion approval process. Though additional mitigation of visual impact was not deemed necessary along the west side of the BFI Navan Facility (which is closest to the Claridge property), existing mitigation measures provide an adequate visual barrier from viewpoints west of the BFI Navan Facility. Continued growth of vegetation will further decrease the landfill visibility with time. Additionally, in the longer term the waste mound will be landscaped with plantings so as to blend into the escarpment, which will occur early on in the lifespan of the landfill due to

phasing of the vertical expansion beginning on the west side of the BFI Navan Facility site and moving eastward away from the Claridge lands.

The predictive modelling of potential off-site impacts related to air quality, dust, odour and noise carried out as part of the approvals processes for the BFI Navan Facility landfill expansion included potential receptor locations within the Claridge Phase 3 lands. The modelling prediction results indicated that the site operations were expected to meet provincial requirements and not cause adverse effects off-site. There are a number of design and operational mitigation measures to control and minimize the potential for off-site atmospheric impacts. Ongoing monitoring programs demonstrate that the BFI Navan Facility is performing acceptably as expected based on predictions. Considering that operations on the landfill are progressively moving eastwards, away from the Claridge Phase 3 lands, it is expected that the Claridge Phase 3 lands will not experience unacceptable atmospheric effects from the BFI Navan Facility site.

Contamination of soil at the Claridge site is not expected to occur as a result of the BFI Navan Facility.

Hazardous waste is not accepted at the BFI Navan Facility.

As discussed in studies performed during the approval process for the BFI Navan Facility expansion, the migration of landfill gas generated by the BFI Navan Facility landfill is impeded by the naturally occurring geology and engineered controls for the landfill site. Landfill gas migrates through the path of least resistance; as such, the thick clay layer which underlies the area does not favor methane migration and gas would preferentially migrate toward the atmosphere through the waste or sand unit. Methane generated by the landfill is expected to be intercepted by the leachate collection perimeter trench or blocked by the perimeter clay berms before it would travel off site. Using a generally accepted approximation that significant methane migration may extend for a distance equal to ten times the depth of landfill between the ground surface and the water table, the maximum distance of significant methane migration would be expected to be 20 metres from the toe of the waste footprint, about one tenth the distance between the western waste limit of the BFI Navan Facility landfill and the eastern property boundary of the Claridge site. A proposed landfill gas collection system was approved as part of the expansion of the BFI Navan Facility and an interim landfill gas management system is currently in place. Furthermore, landfill gas monitoring is performed at a large number of locations on the BFI Navan Facility site, and indicates that off-site lateral migration of landfill gas has not occurred. For all of the reasons described above, the combination of the natural geological setting and engineered features mitigate the potential migration of landfill gas in the subsurface from the BFI Navan Facility.

The City has retained consultants in the past to review studies about potential impacts from the BFI Navan Facility on the surrounding properties. Outstanding concerns raised during previous reviews of the BFI Navan Facility expansion and its potential off-site impacts have been addressed throughout this study.

In conclusion, the BFI Navan Facility will not have unacceptable or adverse effects on the proposed development and will not pose any risks to human health and safety. It is recommended that the zone of influence of the BFI Navan Facility be reduced such that it excludes the Claridge Spring Valley Trails development lands.

Table of Contents

FIGURES

APPENDICES

1.0 INTRODUCTION

Claridge Homes (Claridge) is constructing a residential development called Spring Valley Trails to the south of the intersection of Navan Road and Renaud Road in the east end of Ottawa, Ontario as shown in the Key Plan (Figure 1). The development has been proposed in 3 Phases; presently, Phases 1 and 2 have been approved. Phase 3 of the Claridge development is located within 500 metres of the BFI Canada Inc. (BFI) Navan Waste Recycling and Disposal Facility (BFI Navan Facility), a solid waste disposal site. According to Section 3.8 of the City of Ottawa (City) Official Plan, land within 500 metres of an operating or non-operating solid waste disposal site is considered to be within the influence area of the solid waste disposal site, as shown on Figure 2. As a result, the City requires that a buffer study be conducted, in consultation with the owner/operator of the waste disposal site, to assess the potential for the solid waste disposal site to have unacceptable or adverse effects on the proposed development or pose risks to human health and safety. Based on this site-specific assessment, a determination is to be made of the required buffer (or separation) between the waste disposal site and the proposed development.

The purpose of this buffer study is to satisfy the requirements of Section 3.8 of the City's Official Plan, as it relates to Phase 3 of the Spring Valley Trails development area. The study also addresses previous concerns expressed by the City with regard to development within 500 metres of the BFI Navan Facility. As required by Section 3.8.7 of the Official Plan, the buffer study addresses the following areas of potential concern: contamination by leachate, surface water runoff, ground settlement, visual impact, air (dust), odour, and noise, soil contamination, and landfill gas (LFG) migration. This study has been completed by Golder Associates Ltd. (Golder) on behalf of Claridge and in consultation with BFI.

2.0 SITE DESCRIPTION

2.1 Claridge Homes Spring Valley Trails Development

The Claridge Homes Spring Valley Trails Development (Claridge Development) is located on lands south of Navan Road and Renaud Road. The property measures approximately 800 metres by 800 metres in plan dimension (though is irregular in shape). It is bound to the south by a former CN Rail line and the Mer Bleue Conservation area (Mer Bleue), to the west by a residential development, to the north by Navan Road and Renaud Road, and to the east by a 100 metre wide commercial property followed by the BFI Navan Facility site further to the east. Figure 1 indicates the site location on a Key Plan. The development has been proposed in three Phases. Phases 1 and 2, located at the western portion of the Claridge Development, have been approved and are constructed or are under construction. The proposed Phase 3 comprises the eastern end of the property, and falls within 500 metres of the BFI Navan Facility landfill property. Phase 3 of the Claridge Development, to which this buffer study applies, will be hereafter referred to as the Claridge site. Figure 2 shows the extent of Phase 3, and its location in relation to the BFI Navan Facility landfill.

2.2 BFI Navan Facility

The BFI Navan Facility (formerly known as the Waste Services (CA) Inc. Navan Landfill) is located at 3354 Navan Road in the east end of Ottawa, Ontario, and is owned and operated by BFI under Environmental Compliance Approval (ECA) (formerly referred to as a Certificate of Approval) No. A460702. The BFI Navan Facility began operating in 1960, and performs landfilling and processing/recycling of wastes mostly generated within the City. The BFI Navan Facility accepts solid, non-hazardous industrial, commercial and institutional (IC&I) waste (including construction and demolition (C&D) waste), asbestos waste, dry non-putrescible domestic waste (non-organic) and impacted soil. Composting of leaf and yard materials was previously performed at the BFI Navan Facility, but material has not been accepted for composting since 2009. The north, west, south and east sides of the landfill footprint are surrounded by buffer zones of 30 to 70 metres, 100 metres, 10 metres and 140 metres, respectively. Note that on the south side of the landfill a 10-metre buffer zone exists between the south limits of the waste mound and the VIA Rail right-of-way (ROW) and an additional buffer strip with a width of 100 metres exists to the south of the VIA Rail ROW. Figure 3 shows the BFI Navan Facility site layout and its location in relation to the neighbouring Claridge Development to the west. Considering the total 100 metre width of buffer on the west side of the BFI Navan Facility and the adjacent 100 metre wide commercial property, the total separation distance between the limit of waste placement and the east limit of the Claridge property is 200 metres.

In April 2009, BFI received *Environmental Protection Act* (EPA) Approval for the expansion of the BFI Navan Facility. This approval was achieved following the approval under the *Environmental Assessment Act* of an Environmental Assessment Study Report (EASR) (Golder 2007b) in August 2007, and through the submission of the following applications:

- Amendment to ECA No. A460702 under Section 27 of the EPA;
- ECA (Air and Noise) under Section 9 of the EPA; and,
- ECA (Sewage Works) under Section 53 of the *Ontario Water Resources Act* (OWRA).

The EASR considered several options for the expansion of the landfill, and identified the preferred option from which the final landfill expansion details were developed. The EASR was accompanied by technical support documents detailing the air and odour assessment, noise assessment and the conceptual design for each of the expansion options. As part of the public consultation process, the EASR was peer reviewed on behalf of the City in full by Conestoga-Rovers & Associates (CRA) in 2007. Following the environmental assessment, the aforementioned ECA applications under Sections 9 and 27 of the EPA and under Section 53 of the OWRA were submitted. A Design and Operations (D&O) Report (Golder 2008b) was submitted providing the required technical support for the three applications. Additional supporting documents included a Hydrogeology, Hydrology and Geotechnical Study (Golder 2008a) and Financial Assurance documents. The application to amend ECA No. A460702 was approved, and ECA (Air and Noise) No. 6733-7BYS9A and ECA (Sewage Works) No. 4816-7C7M6C were issued for the expanded BFI Navan Facility. The approved expansion design provided additional disposal capacity for an estimated 10 years operation beyond 2012; it is currently expected that the landfill capacity will be reached in about 2025.

3.0 PHYSICAL SITE SETTING

Due to the physical proximity of the Claridge site and the BFI Navan Facility, the geology, hydrogeology, and hydrology for the two sites have been described concurrently.

3.1 Geology

The Claridge site and the BFI Navan Facility are situated in the region of the Ottawa Valley clay plain at the western edge of the Prescott and Russell sand plains. The lowland region is composed of unconsolidated glacial till deposits, varved clays and marine beds of clay and sand from the post-glacial Champlain Sea. The Claridge and BFI sites are located on the banks of a former channel of the Ottawa River. The post-glacial Ottawa River Channels (located east of Ottawa) are from 3 kilometres to 10 kilometres wide and up to 18 metres deep, and are floored with clay and silt and bordered by sand deltas. The escarpment which runs east-west through the Claridge site and the BFI Navan Facility was once covered by sand deposits which have been mostly eroded below the escarpment. Above the escarpment, surficial sands are found to be 0.6 to 2.0 metres thick in the landfill area. A thick (20 to 35 metre) marine clay deposit underlies the entire area. Bedrock in the area is composed of shale of the Billings Formation. Figure 4 provides a schematic cross-section through the landfill in the north-south direction, which shows the geology through the escarpment. Figure 5 contains a cross-section in the east-west direction through the eastern portion of the Claridge site and the western portion of the BFI Navan Facility, which shows the consistency in geology across the sites. The landfill geometry and certain features are also shown on the cross sections.

3.2 Hydrogeology and Hydrology

The BFI Navan Facility is located on a watershed divide between two major drainage watersheds - the Rideau River watershed to the west and the South Nation River watershed to the east. Surface runoff drains to both the east and west of the BFI Navan Facility site. The east side of the BFI Navan Facility site drains to the Bear Brook drainage basin, which is part of the South Nation River watershed. The west side, and the Claridge site, drain into the Mud Creek drainage basin, which in turn drains into Green's Creek, part of the Rideau River watershed. The Mer Bleue bog, a unique and internationally recognized ecological feature, is located to the south of both sites.

Studies have shown that the regional groundwater flow in the deep bedrock aquifer is eastward. Local groundwater flow in the area is from north to south as shown on Figure 6, i.e., from the escarpment towards the edge of the Mer Bleue. The thick clay deposit acts as an aquitard or barrier to groundwater movement, such that lateral flow occurs only through the surficial sand unit and upper weathered clay zone, which have a total thickness of a few metres. As indicated in the Hydrogeology, Hydrology and Geotechnical Study Report for the BFI Navan Facility (Golder, 2008a), the water table is between 1 and 2 metres below ground surface north of the escarpment, and very near the ground surface south of the escarpment. Historical groundwater level data from the BFI Navan Facility site indicate that a groundwater recharge zone exists north of the escarpment (where a downward hydraulic gradient exists), and that a discharge zone exists south of the escarpment (where an upward hydraulic gradient exists).

4.0 ASSESSMENT OF POTENTIAL LANDFILL IMPACTS

4.1 Groundwater Contamination by Leachate

Infiltration of rain water into a landfill and decomposing waste creates a liquid called leachate. If not managed properly, leachate has the potential to impact groundwater in the vicinity of a landfill. The following sections describe the generation of leachate at the BFI Navan Facility, the systems in place to manage the leachate (the natural geological and hydrogeological barriers and the leachate management system) and the approach used to detect if leachate has entered and is migrating in the groundwater flow system (the groundwater monitoring program).

4.1.1 Leachate Generation Rate and Quality

As discussed in the Hydrogeology, Hydrology and Geotechnical Study (Golder 2008a), leachate contaminants suggested in Ontario Regulation (O.Reg.) 232/98 (MOE 1998) to represent municipal solid waste are not all applicable to the BFI Navan Facility due to the type of waste accepted at the landfill site, which consists of IC&I waste and non-organic domestic waste. Following consultation with the MOE and the Ministry of Natural Resources (MNR) during the EA process for the landfill expansion, boron, dichloromethane, potassium, magnesium, ammonia and phenols were chosen as appropriate parameters for modelling the potential groundwater impacts due to leachate from the landfill.

4.1.2 Geological and Hydrogeological Barriers

The potential for leachate generated by the BFI Navan Facility landfill to impact the Claridge site has been assessed based on the direction of groundwater flow, the physical separation between the Claridge site and the landfill footprint, the leachate collection system (LCS) and the results of the contaminant transport modelling.

Shallow groundwater flow in the area is from north to south consistent with the relief of the property which changes in elevation by approximately 15 metres to 18 metres between the up-gradient and down-gradient boundaries of the landfill. The groundwater flow is shown in Figure 6, which has been generated using water elevation data from May 2013. Groundwater elevations within the landfill footprint are not available as monitoring wells are not constructed within the waste footprint; groundwater levels within the footprint are locally controlled by the leachate collection system beneath the base of the waste. As shown on Figure 6 the groundwater elevation north of the landfill (on top of the escarpment) is approximately 14 metres higher than the groundwater elevation south of the landfill (below the escarpment), indicating a strong horizontal hydraulic gradient from north to south. The Claridge site is located west and hydraulically cross-gradient of the BFI Navan Facility. The thick clay deposit in the area is of low permeability and acts as an aquitard (or barrier to groundwater movement). Shallow groundwater flow is thus controlled by the surficial sand layer and upper weathered clay zone above the clay aquitard. The slight upward gradient at the down-gradient boundary of the landfill would suggest there is upward vertical flow of shallow groundwater at this location, which would retard the potential for leachate migration into the deeper groundwater system. Groundwater flow in the deep bedrock aquifer is eastward and hydraulically downgradient (away) from the Claridge site, noting that the landfill area does not provide a source of infiltrating water to the deep aquifer due to the natural aquitard provided by the thick clay deposit.

In addition to being hydraulically cross-gradient and upgradient from the BFI Navan Facility, the Claridge site is physically separated from the landfill footprint by a 100 metre buffer zone (within the BFI Navan Facility property limits) and a 100 metre wide commercial property, reducing even further the potential for landfill leachate impacted groundwater from reaching the Claridge site.

Potentially impacted groundwater is cut off from the shallow groundwater flow system by the perimeter LCS located around the south and southwest sides of the landfill. The groundwater elevations in the area around the landfill footprint are higher than the base of the landfill and LCS, therefore creating a "hydraulic trap", i.e., a groundwater flow direction into the landfill as opposed to out of the landfill. Maintaining the LCS in a drained condition, which is the way the LCS is operated, results in a lowering of the water table at the southeast corner of the landfill by more than 3 metres below the original ground at the southeast corner of the landfill, and by about 2 metres at the southwest corner. This water table lowering influences the hydraulic gradients within the waste pile near the landfill's south boundary. A clay cut-off wall on the down-gradient (south) side of the LCS was constructed as a back up to the LCS to further limit the potential migration of leachate out of the landfill towards the south. The hydraulic trap, and presence and operation of a LCS decrease the potential risk of leachate impacting the surrounding groundwater.

Finally, contaminant transport modelling was completed during the landfill expansion approvals process as documented in the Hydrogeology, Hydrology and Geotechnical Study (Golder 2008a). The modelling found that movement of contaminants, both laterally at shallow depth south toward Mer Bleue and downward toward the bedrock aquifer is controlled by diffusion. It was concluded, based on the modelling, that any diffusion of contaminants laterally and downward at the landfill site itself will be negligible. Lateral diffusion of contaminants was modelled for movement southward as this is the direction of groundwater flow, and would thus also be the direction potentially most impacted by the diffusion of contaminants. As such, impacts from the diffusion of contaminants in all other directions (for example, westward in the direction of the Claridge site) would be less than those in the direction of groundwater flow. As such, long term diffusion of contaminants is not expected to impact groundwater beneath the Claridge site.

4.1.3 Leachate Management System

A plan view of the existing and approved eastern expansion of the leachate management system is presented in Figure 7. The existing leachate management system includes an underdrain system in the northwest corner of the waste footprint. This is connected via HDPE pipe to a perimeter leachate collection trench which runs along the west and south sides of the waste mound, and extends approximately 150 metres along the east side of the waste mound, starting at the southeast corner. The perimeter leachate collection trench consists of a granular-filled trench and perforated drainage pipe and access to the perimeter leachate collection trench is provided via a series of manholes. A LCS also exists beneath the northeast and central area of the waste footprint. All leachate collected is drained to a wet well and pump station located at the southeast corner of the pre-expansion waste footprint. Leachate is pretreated and pumped via forcemain to the City sewer system for final treatment at the City's municipal sewage treatment plant. As a contingency, leachate may also be transported by tanker truck to the municipal sewage treatment plant. A vertical manhole connected to the LCS in the northeast quadrant ("the central manhole") provides an alternative point of access to evacuate leachate if positive drainage to the wet well and pump station is not maintained. The need for an artificial constructed liner system is negated by the natural low-permeability clay soils at the base of the landfill, which act as a natural barrier to the transport of contaminants out of the landfill.

The proposed extension of the LCS in the disposal area to the east of the existing waste mound has been designed to meet or exceed the requirements in Schedule 1 of the Landfill Standards (MOE 1998) for a 100-year service life. The proposed LCS in this area includes an underdrain system consisting of perforated leachate collection pipes and a granular drainage blanket composed of clear stone, separated from the clay subgrade by a separator geotextile, and from the waste by a filter geotextile covered above by a sand layer to prevent fines from entering the drainage blanket. The leachate collection pipes will drain to a perforated header pipe which will drain to a sump. Leachate will be pumped from the sump to the existing wet well and leachate pump station. Leachate collection pipes will be sloped toward the header pipe, and the header pipe sloped toward the sump to achieve positive drainage. The sump will be located in the interior of the eastern area where settlement is expected to be highest, such that positive drainage will be maintained as settlement occurs. The subgrade will be prepared in a saw-tooth fashion to provide gradients toward the collection pipes. A perimeter collection trench will be constructed along the south limits of the eastern area as a secondary/contingency containment measure, and will be connected to the wet well/pump station by a gate valve.

BFI has constructed low permeability clay cut-off walls and clay berms at the perimeter of the waste footprint. At the edge of the fill area, native sand and other pervious materials have been removed and replaced with lower permeability compacted clay. These clay barriers are designed to contain leachate. Presently, the constructed clay barriers exist along the north perimeter, and the west and south perimeters of the fill area. As development of the landfill progresses into the eastern area, clay barriers will be constructed along the south and southeast perimeters.

In addition, the 100 metre wide west buffer of the BFI site is occupied by a large berm of compacted silty clay soil between the disposal area and the BFI property boundary (illustrated in Figure 5). This berm, together with the west side perimeter leachate collection pipe, provides protection against potential leachate migration in the westward direction.

4.1.4 Contingency Plan

The existing perimeter LCS and the perimeter LCS to be constructed at the down-gradient side of the expanded footprint area to the east will function as a contingency measure should the collection system beneath the waste fail. If these perimeter systems (and repaired or replacement perimeter systems) do not function as intended, and in the event of premature failure of the LCS such that a leachate mound is formed within the landfill, an additional contingency exists that involves the installation of purge wells through the cover of the landfill and into the granular blanket of the LCS. Details of the purge well installation would be determined based on the level of leachate mound control required. Leachate collected from the purge wells would be sent off-site for treatment. MOE approval to implement the contingency measures, if ever required, will be obtained through an amendment to the D&O Report for the expanded BFI Navan Facility landfill.

In addition, a compacted clay berm/cut-off trench will be built along the southern limits of the expanded footprint area to the east, extending some distance up the east side of the waste footprint. This clay berm would be keyed into the underlying native unweathered clay soils to provide a redundant level of containment in the unlikely event that leachate were to mound at the downgradient end of this eastern area.

In the event that positive drainage is not maintained within the LCS in the northeast quadrant, leachate can be removed through the central manhole.

4.1.5 Groundwater Monitoring

Groundwater monitoring has been performed at the BFI Navan Facility since 1981, and has occurred semi-annually since 1991. Groundwater monitoring is performed and reported as outlined in Condition 109 of ECA No. A460702. Groundwater monitoring is performed in the four stratigraphic units identified as a shallow surface sand layer, an upper weathered clay zone, an intact (unweathered) deposit of clay and a glacial till/upper bedrock zone. Monitoring wells are present in each of these units up-gradient, at the down-gradient edge of the waste pile and further down-gradient of the landfill. Monitoring well locations are shown on Figure 6.

Traditional methods of site compliance assessment involve comparing downgradient concentrations of site specific compliance evaluation parameters (parameters defined as site specific leachate indicator parameters) in groundwater to Reasonable Use Performance Objective (RUPO) concentrations, as defined by MOE Guideline B-7 (MOE 1994). RUPO concentrations for compliance evaluation parameters are calculated using the upper background concentration value at the site. Traditionally, a trigger concentration of a compliance evaluation parameter exceeds the RUPO for that parameter. Trigger concentrations may change over time as background concentrations from future monitoring programs are added to the data base.

Due to the poor natural (background) water quality at the BFI Navan Facility site, traditional methods of site compliance assessment provide very limited understanding of potential leachate impact. A comparison of water quality between the up-gradient station and the south property boundary station on the east side of the property, where there are no potential impacts from landfill activities, shows that there is a difference between the up-gradient and down-gradient water quality in the area of the landfill site. Several naturally occurring parameters, including boron, copper, iron, sodium, alkalinity, arsenic, bicarbonate, lead, TDS, COD and chloride are elevated at the southeast property boundary station. These naturally elevated parameters could potentially mask the presence of leachate impacts associated with the landfill. The RUPO for groundwater at the BFI Navan Facility would consider iron, manganese, and boron. Based on the natural water quality data, boron and iron are not good leachate indicator parameters, which would leave only manganese to evaluate compliance. Therefore, the MOE has agreed that RUPO is not an appropriate method of determining site compliance in the hydrogeologic setting of the BFI Navan Facility.

A site-specific trigger mechanism outlined in the Groundwater and Surface Water Trigger Mechanism report (Golder 2007a) was proposed in 2007, and approved during the expansion approval process. The leachate indicator parameter list for the BFI Navan Facility site includes alkalinity, ammonia, boron, chloride, hardness, magnesium, manganese and potassium. The list was derived based on both typical landfill and site specific leachate indicator parameters, taking into consideration historical concentrations of typical parameters observed in the leachate compared to those observed concentrations in groundwater. Concentrations of parameters that exceed background range are treated as potential exceedances which warrant further consideration. Trigger locations within the sand deposit, weathered clay zone, intact clay deposit, and glacial till/upper bedrock zone are located at the down-gradient (south) limit of the landfill footprint. .

In conclusion, groundwater is monitored on a regular basis and there are systems in place to detect if landfill leachate is beginning to impact the groundwater surrounding the landfill footprint (trigger mechanism). Steps would then be taken to determine how the leachate is reaching the groundwater and the situation would be rectified. This monitoring program and trigger mechanism further reduce the potential for landfill leachate to impact groundwater on the Claridge site.

The results of the groundwater monitoring to date show that leachate has not adversely affected groundwater quality in the surficial sand layer or upper weathered clay zone at a distance 10 metre south of the landfill (directly downgradient in terms of the groundwater flow direction).

4.1.6 Summary

Groundwater quality beneath the Claridge Phase 3 Spring Valley Trails land is protected from potential leachate impacts from the BFI Navan Facility by:

- The natural geologic setting, consisting of an extensive and thick deposit of low permeability silty clay soil;
- A groundwater flow direction from north to south (escarpment towards the edge of the Mer Bleue), not westward towards the Claridge site;
- A physical separation distance of 200 metres between the disposal area and the east property limit of the Phase 3 lands;
- An engineered perimeter leachate collector around the west and south side of the landfill, and a leachate collection system beneath the northeast and central portions of the disposal area and beneath the approved expanded footprint area further to the east; and,
- The design and operation of the leachate collection system, which creates a "hydraulic trap" and induces shallow groundwater flow towards the landfill, not away from it.

Ongoing groundwater monitoring shows that leachate has not affected groundwater quality at a distance of 10 metres beyond the downgradient (south) limit of the disposal area.

In conclusion, there is no apparent mechanism by which landfill leachate can affect groundwater quality beneath the Claridge Phase 3 lands.

4.2 Surface Water Runoff

The following sections describe the study undertaken to assess potential impact to surface water from the BFI Navan Facility landfill, the surface water management system in place and the surface water monitoring program.

4.2.1 Environmental Assessment Study Report

An assessment of the surface water environment was previously performed during the preparation of the EASR (Golder 2007b) for the BFI Navan Facility expansion. Both surface water quantity and surface water quality were assessed based on the conceptual model of surface flows for the BFI Navan Facility. The assessment found that the landfill is not having an adverse effect on downstream surface water receivers or the Mer Bleue.

4.2.2 Surface Water Management

The surface water management system at the BFI Navan Facility comprises a network of drainage ditches and roadside swales to intercept runoff generated at the BFI Navan Facility and direct it to either the east or west stormwater management pond. The east stormwater pond is located in the southeast corner of the BFI Navan Facility property, north of the Via Rail ROW and the discharge follows the same path south of the Via Rail ROW as the original pond servicing the east half of the site. Upstream flows originating to the northeast of the landfill

site are directed and conveyed to the Mer Bleue via the East By-Pass Ditch. The west stormwater pond is located in the northwest part of the BFI Navan Facility property approximately 275 m from the north property limit and discharges to the existing ditch which crosses the west property limit. Upstream flows originating to the north and northwest of the BFI Navan Facility site are diverted around the landfill by ditches that exist along the perimeters of the on-site buffer zone. The surface water management plan is shown in Figure 8.

Additionally, interim clay cover is placed over inactive portions of the existing waste mound to minimize runoff from the waste mound. Finished slopes are covered with clay soil, graded and seeded. Soil stockpiles are also covered with topsoil and/or compost and seeded for surface water and erosion control. To protect the perimeter clay slopes against erosion, clay diversion dikes and drainage swales have been constructed to collect surface run-off above the slope.

4.2.3 Surface Water Monitoring

Surface water monitoring is performed and reported as outlined in Condition 109 of ECA No. A460702. Surface water monitoring is performed three times per year to assess surface water quality and to estimate surface water flow at the BFI Navan Facility. Monitoring locations are shown in Figure 8.

Similar to groundwater, traditional compliance monitoring is not appropriate for the BFI Navan Facility. Surface water data at the BFI Navan Facility is variable over time and the Mer Bleue bog surface water quality is poor. It is difficult to assess surface water site compliance with scattered data. The BFI Navan Facility is an engineered landfill site; therefore, a release of leachate would be apparent in the underlying stratigraphic units prior to a surface water impact. As such, a surface water trigger mechanism would not be an effective component for the purpose of effectively protecting the off-site surface water/bog water regime. The site-specific groundwater based trigger mechanism discussed in Section 4.1.4 of this report is the appropriate approach for the BFI Navan Facility. Surface water quality monitoring continues at the BFI Navan Facility, with the samples analyzed for appropriate parameters of concern and evaluated for potential impacts. This approach was outlined in the approved Groundwater and Surface Water Trigger Mechanism report (Golder 2007a) and the MOE has agreed that this is the appropriate approach for the BFI Navan Facility.

4.2.4 Summary

Therefore, based on the EASR study and the surface water management system in place, the BFI Navan Facility landfill will not impact the surface water on the Claridge site. The site-specific groundwater trigger mechanism will detect landfill leachate impact in the groundwater before the BFI Navan Facility surface water is impacted. Steps would then be taken to prevent impacted groundwater from impacting the surface water at the BFI Navan Facility before it would have the potential to impact surface water outside of the BFI Navan Facility property.

4.3 Ground Settlement

Significant drawdown of the water table can cause ground settlement in clay soils. Drawdown of the water table in an area could be caused by dewatered excavations on adjacent land. The oldest western part of the BFI Navan Facility landfill operations consisted of placing waste essentially above the existing grade without a bottom leachate collection system. As shown on Figure 7, in the newer north central and eastern portions, an excavation has been made to a depth of about 12 metres into the clay escarpment to create the landfill cell and construct a leachate collection system. As mentioned previously, the hydraulic trap design in the north central and eastern portions induces groundwater flow towards/into the landfill, and lowers the water table within the

disposal area relative to the water table in the area beyond the landfill. Because of the low permeability silty clay deposit, the radius (or distance) of influence of the "dewatered" landfill disposal area is quite limited; this is shown by ongoing monitoring of groundwater levels on the BFI site both above and below the escarpment area within 10 of metres of the landfill. Considering that the "dewatered" portion of the BFI Navan landfill is physically separated by a minimum of about 500 metres from the closest east boundary of the Claridge lands, the BFI Navan Facility will not cause ground settlement on the Claridge site.

4.4 Visual Impact

An assessment of the visual impact from the approved BFI Navan Facility landfill expansion was performed as part of the EASR (Golder 2007b). Visual impact was assessed by determining the impact of the landfill from nine view points surrounding the BFI Navan Facility. View point 3, "From Field West of Landfill" is located in the eastern portion of the Claridge site. During the EASR, it was concluded that additional visual impact mitigation measures (berms) were only required for the north portion of the BFI Navan Facility site along Navan Road.

Existing visual impact mitigation measures along the west side of the landfill include a deciduous hedgerow, as well as planting along the existing crest of the landfill prior to the vertical expansion (raising) of the landfill. In the EASR (Golder 2007b), the landfill is noted as being visible between the deciduous trees, particularly during the leafless period of the year. Visibility of the landfill will decrease as growth at the base of the landfill continues. In addition, in the longer term the waste mound will be landscaped with plantings so as to blend into the escarpment. Lastly, the approved phasing of the landfill development involves first raising the west part of the fill area closest to the Claridge lands, so that this area can be completed, final cover and vegetation applied early on, which will shelter future filling activities further to the east from view on the Claridge lands.

4.5 Air, Odour and Noise

The following sections describe the studies undertaken regarding the potential for atmospheric impacts as a result of the expanded BFI Navan Facility, the improved atmospheric controls associated with the approved expansion, and the monitoring programs for air, odour and noise in place at the BFI Navan Facility.

4.5.1 Environmental Assessment Study Report

An air impact assessment for the BFI Navan Facility was produced as a component of the EASR (Golder 2007b) prepared for the then proposed (now approved) BFI Navan Facility expansion. The assessment considered the possible impacts to air, odour and noise from the design alternatives considered for the expansion. Sources of air quality and odour impacts from the landfill included dust from roads and loading/unloading activities, products of combustion from the landfill gas (LFG) flare and on-site vehicles, fugitive LFG emissions, and odour emissions from the active area of the landfill. Sources of noise impacts from the landfill site included operations equipment, the site maintenance facility, LFG flare, and leachate pumping facility.

Potential air quality and odour impacts from the landfill were assessed for compliance with O.Reg. 419/05 (MOE 2005) and for impacts to off-site receptors based on the predicted concentration of indicator compounds determined from dispersion modelling. Indicator compounds selected for the assessment included particulate matter associated with dust (suspended particulate matter (SPM) and particulate matter < 10 micrometres (PM_{10})), combustion gases associated with landfill gas flaring and on-site vehicles (nitrogen dioxide (NO_2) and sulphur dioxide (SO_2), hydrogen sulphide (H_2S), vinyl chloride, and odour. Off-site air quality indicator compounds and odour levels were predicted using the AERMOD dispersion modelling system, a regulatory

model recommended by the MOE. Four different groups of receptors used in the dispersion modelling; most notably, 285 sensitive receptors were placed in existing and future residential areas to establish the maximum exposure that residents near the landfill may experience. Figure 9 shows the location of all sensitive receptors considered in the modelling, and the Claridge site. Many of the sensitive receptor locations used in the modelling were within the Claridge site.

Potential noise impacts from the landfill were assessed at 17 existing or future receptor locations identified as the most sensitive in the vicinity of the BFI Navan Facility. Figure 10 shows the receptor locations, which included 3 future locations (R1, R2, R3) along the east limits of the Claridge site. Source sound level measurements at the BFI Navan Facility were taken using a sound level meter/realtime analyzer. Using the source sound level data, noise impact predictions were made for each receptor using the international standard ISO 9613-2 [AE4] on sound propagation outdoors.

The air quality and odour impact assessment found that all previously proposed landfill expansion alternatives, including the chosen alternative that received *Environmental Protection Act* approval in 2009, comply with O.Reg. 419/05 (MOE 2005). Predicted levels of air quality indicator parameters did not exceed Ontario criteria, while predicted odour levels, though infrequently marginally exceeding Ontario guideline criteria at certain sensitive receptor locations, were found to be within the allowable number of exceedances set out by the odour framework for Ontario at the time of the assessment.

The noise impact assessment found that all previously proposed landfill expansion alternatives, including the chosen alternative that received *Environmental Protection Act* approval in 2009, will generate noise levels that meet the MOE noise level limit for landfill operations and ancillary equipment at all off-site receptor locations, using the installation of the proposed noise barrier systems incorporated into the landfill operations design alternatives. Additionally, annual noise monitoring has previously indicated that noise levels caused by landfill operations do not significantly contribute to noise levels at the BFI Navan Facility property limits (Golder 2013b).

4.5.2 Improvements to Controls of Atmospheric Emissions from the BFI Navan Facility Expansion

The approved landfill expansion incorporated a number of mitigation measures that assist in the management of potential impacts to air quality, odour, and noise. These mitigation measures include:

- The installation of the leachate management system (mitigates potential air quality and odour impacts);
- Conveying of leachate off-site for treatment in a forcemain, therefore eliminating leachate tanker traffic (and associated traffic noise and/or odours off-site);
- Interim landfill gas and odour control system that went into operation in 2012 (mitigates potential odour impacts);
- The discontinuation of composting operations (mitigates potential air quality and odour impacts, reduces noise from on-site equipment);
- The proposed installation of an active LFG collection system, for the whole landfill site, to be installed progressively as filling is completed in an area of the landfill, equipped with an enclosed flare (mitigates potential air quality and odour impacts);

- Enclosing the leachate pump and LFG flare (Golder 2008b) (reduces noise impacts);
- The continuation of the landfill dust management practices including:
  - The application of gravel to unpaved on-site haul routes;
  - Watering and the addition of dust suppressants (calcium chloride) on unpaved roads;
  - Imposing a speed limit of 20 km/h on unpaved roads;
  - Implementation of truck tire-wash facility; and,
  - Cleaning of BFI Navan Facility site entrance.
- The installation of 4 metre high berms along Navan Road and tree planting as defined in the D&O Report (Golder 2008b) (mitigates noise impacts);
- The adoption of noise, odour, and dust monitoring plans as described in the D&O Report (Golder 2008b); and,
- Continuation of a complaints and response procedure as defined in the D&O Report (Golder 2008b).

4.5.3 Monitoring Program

Dust, noise, and odour monitoring programs were developed and approved during the previous expansion approval process, and are defined in the D&O Report (Golder 2008b), and required by the ECA for site operation.

4.5.3.1 Dust Monitoring

The BFI Navan Facility dust monitoring plan was developed in consultation with the MOE, National Capital Commission (NCC) and the City in accordance with EA Conditions 10.7 and 10.8. The plan comprised two parts: monitoring of dust, and monitoring of triggers of fugitive dust.

Dust monitoring was performed and reported as outlined in Condition 111 of ECA No. A460702. The monitoring of dust was performed from 2009 to 2011 using dust fall monitors located within the Mer Bleue Conservation Area and in areas of potential highest off-property impacts, with locations varying based on the movement of landfilling operations across the BFI Navan Facility site over time. Dust fall monitoring was performed for three years, and the program was discontinued following the results of the 2011 monitoring report (Golder 2012), as they did not indicate additional impact beyond existing conditions in the area, and the requirements under EA conditions 10.7 and 10.8 had been met.

The monitoring of triggers of fugitive dust is performed through maintaining records of mitigative dust control measures, any complaints and complaint response, and traffic, and by performing weekly site inspections that includes factors related to the generation of dust.

4.5.3.2 Noise Monitoring

Noise monitoring is performed and reported as outlined in Condition 111 of ECA No. A460702. The BFI Navan Facility noise monitoring program involves the use of noise monitors that log acoustic data every hour for the duration of the monitoring period. Monitoring is performed twice per year during peak landfilling activity.

Monitoring locations may vary depending on the active landfill phase. Current monitoring locations are presented in Figure 10. Noise monitoring to date indicates that the BFI Navan Facility is operating as expected.

4.5.3.3 Odour Monitoring

Odour monitoring is performed and reported as outlined in Condition 111 of ECA No. A460702. The BFI Navan Facility odour monitoring program involves inspecting the preventative measures that make up the Odour Management Plan. During the once weekly site inspection for fugitive dust, an inspection is also conducted of the landfill cap, to ensure there are no cracks and/ or gaps which would potentially allow LFG to escape. This inspection program also records any significant changes to on-site odour and initiates corrective action in cases where it is possible that off-property impacts may occur. Odour monitoring to date indicates that the BFI Navan Facility is operating as expected.

4.5.4 Summary

The predictive modelling of potential off-site impacts related to air quality, dust, odour and noise carried out as part of the approvals process for the BFI Navan Facility landfill expansion included potential receptor locations within the Claridge Phase 3 lands. The modelling prediction results indicated the site operations were expected to meet provincial requirements and not cause adverse effects off-site. There are a number of design and operational mitigation measures to control and minimize the potential for off-site atmospheric impacts. Ongoing monitoring programs demonstrate that the BFI Navan Facility is performing acceptably, as expected based on predictions. Considering that operations on the landfill are progressively moving eastwards, away from the Claridge Phase 3 lands, it is expected that the Claridge Phase 3 lands will not experience unacceptable atmospheric effects from the BFI Navan Site.

4.6 Soil Contamination

Contamination of soil on the Claridge site could only occur as a result of contaminant transport from the BFI Navan Facility landfill to the Claridge site via groundwater or surface water. As previously discussed in Sections 4.1 and 4.2, contaminant transport from the BFI Navan Facility by groundwater or surface water is not expected to occur due to the natural hydrogeology and engineered controls for the landfill site.

4.7 Hazardous Waste

Hazardous waste is not accepted at the BFI Navan Facility.

4.8 Landfill Gas

The following sections describe the potential for LFG migration in the subsurface from the BFI Navan Facility to the Claridge site. The natural geological and engineered barriers to LFG migration are considered, and LFG monitoring is described.

4.8.1 Geological Barriers

The natural potential for the subsurface migration of LFG was considered during the environmental assessment for the proposed landfill expansion in 2007, and in the D&O Report (Golder 2008b) for the landfill. LFG is composed of about 50% methane, which is of concern if it accumulates in potentially explosive concentrations in air within enclosed spaces. It was discussed in the D&O Report (Golder 2008b) that the geological setting in the area does not encourage the lateral migration of methane from LFG through the subsurface. The clay deposit

does not support migration of gas, causing the gas (which is lighter than air) to move preferentially to the atmosphere through the waste, surficial sand unit, or through passive ventilation through the LCS on the west, south and east limits of the waste area, and by stormwater ditches or leachate intervening trenches. Additionally, LFG migrates above the water table. In the *Guideline for Assessing Methane Hazards from Landfill Sites* (MOE 1987) it is stated that significant methane migration may extend for a distance equal to ten times the depth of landfill between the ground surface and the water table. If the depth of the water table in this site area can be conservatively considered to be 2 metres below the ground surface, the maximum distance of significant methane migration would be expected to be 20 metres from the toe of the waste footprint. As stated in the D&O Report (Golder 2008b), the buffer between the toe of the waste mound and the western property boundary of the BFI Navan Facility is 100 metres. An additional 100 metres of privately owned land (not used for residential purposes) separates the BFI Navan Facility property from the Claridge site. It is not anticipated that methane generated by the landfill would migrate off of the BFI Navan Facility site, or the additional 100 metres to the eastern edge of the Claridge site.

LFG migration is also impeded by barriers and passive ventilation on the BFI Navan Facility site. Low permeability clay cut-off walls, clay berms and intervening drainage trenches installed for the purpose of minimizing and containing the flow of leachate also act as a barrier against LFG migration. The low permeability barriers exist along the north, west and south perimeters of the waste footprint. Clay barriers will be installed along the east perimeter of the waste footprint as landfill development progresses (Golder 2013a).

4.8.2 Landfill Gas Management System

As an approved component of the BFI Navan Facility expansion, a LFG management system that complies with existing requirements under O.Reg. 232/98 (MOE 1998) was designed. A complete description of the proposed LFG management system is provided in Section 6.7 of the D&O Report (Golder 2008b). The LFG management system consists of LFG extraction wells, lateral and header piping, an abstraction facility and enclosed flare. The 31 vertical extraction wells will be drilled into the waste and connected to lateral piping which will direct the gas to the main header pipe. Maintenance manholes and the leachate collection sump (as proposed for the landfill expansion) will also be connected to the main header by lateral piping. The main header transmits the gas to the abstraction facility and flare. The blower within the abstraction facility extracts the gas under negative pressure, and the enclosed flare will destroy the LFG by combustion. It is estimated that the system will have 65-70% collection efficiency. The LFG management system is expected to significantly reduce or eliminate outward LFG pressure gradients, and by doing so contribute further to decreasing the potential for lateral migration away from the waste mound. Operation of the LFG management system will include regular monitoring and periodic adjustment to the well field and abstraction facility to maintain and balance the system. Figure 11 shows the proposed LFG management system layout. The LFG management system will be progressively installed as the development of the landfill continues.

An interim LFG odour control system has been installed and operated since April of 2012 with the purpose of reducing odour from LFG prior to the full-scale LFG collection system being completely installed. This system includes connections to the existing LCS cleanouts and to existing vertical LFG extraction wells, as well as lateral and header piping, condensate management facilities, an outdoor abstraction plant and candlestick flare.

4.8.3 Landfill Gas Monitoring Program

LFG monitoring is performed and reported as outlined in Condition 110 of ECA No. A460702. Figure 12 shows the locations on the BFI Navan Facility site where LFG is monitored. LFG monitoring at the locations shown in Figure 12 is performed three times per year. Additionally, routine monitoring for explosive methane gas levels within all buildings or structures at the BFI Navan Facility is performed at the same frequency as the current monitoring program of three times per year. LFG monitoring to date has indicated that there is no lateral migration of landfill gas from the landfill.

4.8.4 Summary

For all of the reasons described above, the combination of the natural geological setting and engineered features mitigate the potential migration of LFG in the subsurface from the BFI Navan Facility.

4.9 Post-closure Activities and Monitoring

Following the BFI Navan Landfill site reaching its approved disposal capacity, the ongoing post-closure activities will consist of: continued operation of the leachate collection system and conveyance for off-site treatment; continued operation of the landfill gas extraction system and flare; the site monitoring programs; and site inspection and maintenance.

5.0 PREVIOUS REVIEWS BY THE CITY OF OTTAWA

The City has retained consultants in the past to review studies about potential impacts from the BFI Navan Facility on the surrounding properties.

During the BFI Navan Facility expansion Environmental Assessment approval process, the EASR and supporting technical documents (Golder 2007b) were peer reviewed in full by Conestoga Rovers and Associates (CRA) on behalf of the City in 2007. The CRA peer review included all agents of the environment relevant to the buffer study. The peer review and resulting comments from the City were submitted to the MOE for consideration with regard to the previously pending expansion approval. The City concluded from the peer review that there were no outstanding technical concerns with the EASR, with the exception of comments regarding the odour and noise review, as stated in the attached letter from the City to the MOE dated April 23, 2007. These comments were addressed by Golder on behalf of BFI (formerly WSI (CA) Inc.), the owner of the BFI Navan Facility. The responses were submitted to the MOE as part of the application for expansion approval. The MOE subsequently granted EA and EPA approval of the expansion. The CRA peer review is included in Appendix A of this report.

In 2008, RWDI Air Inc. (RWDI) performed a peer review of the atmospheric portion of the EASR (Golder 2007b) on behalf of the City with regard to potential atmospheric impacts from the BFI Navan Facility to a proposed development located north of Navan Road. Golder provided responses to comments resulting from the peer review, and provided supplemental information to RWDI. Additionally, a buffer study was completed by Trow Associates Inc. (Trow) with regard to potential impacts to the same proposed development north of Navan Road resulting from the BFI Navan Facility. As a result of the peer review by RWDI and the buffer study by Trow, the City agreed to reduce the zone of influence of the BFI Navan Facility to exclude the proposed development. The City has recently requested that the buffer study by Trow be revisited to address any substantive changes to the environment that have occurred since the aforementioned buffer study, which was completed and accepted in 2008.

Jacques Whitford Ltd. (JWL), on behalf of the City, performed a peer review of work done by John D. Paterson and Associates (Paterson) for the Claridge lands, which included comments on potential impacts to the proposed Claridge site from the BFI Navan Facility. Comments resulting from this peer review were addressed by Golder, acting on behalf of Claridge, in a letter dated February 15, 2008, and in a presentation to the City on July 8, 2008. Outstanding concerns presented by JWL are addressed within this buffer study.

6.0 CONCLUSIONS

This buffer study was completed to satisfy Section 3.8.6 of the City's Official Plan, which requires any development requiring planning approval on land within the (presumed) influence area of 500 metres from an operating or non-operating solid waste disposal site to undertake a study to demonstrate that the solid waste disposal site will not have any unacceptable adverse effects on the proposed development and will not pose any risks to human health and safety.

As required by Section 3.8.7 of the Official Plan, this buffer study addressed the following areas of concern: potential contamination by leachate, surface runoff, ground settlement, visual impact, air (dust), odour, and noise, soil contamination, and LFG migration.

Based on the studies and design work performed during the BFI Navan Facility's expansion, which received EA approval in 2007 and EPA Approval in 2009, as well as historical and on-going monitoring at the BFI Navan Facility site, it can be concluded that the BFI Navan Facility will not have any unacceptable adverse effects on the proposed Claridge Spring Valley Trails Phase 3 development, and will not pose any risks to human health and safety. It is also not expected that the development of the Claridge site will impact the continued operation of the landfill. The proposed continuation of current operational practices and environmental monitoring, as well as the installation of environmental controls proposed as part of the continued expansion of the BFI Navan Facility is expected to result in continued compliance with Section 3.8.6 of the City's Official Plan.

It is recommended that the zone of influence of the BFI Navan Facility be reduced such that it excludes the Claridge Spring Valley Trails development lands.

7.0 LIMITATIONS AND USE OF REPORT

This report was prepared for the exclusive use of Claridge Homes. The report, which specifically includes all figures and attachments, is based on data and information collected by Golder Associates Ltd. and is based solely on the conditions of the properties at the time of the work, supplemented by historical information and data obtained by Golder Associates Ltd. as described in this report.

Golder Associates Ltd. has relied in good faith on all information provided and does not accept responsibility for any deficiency, misstatements, or inaccuracies contained in the report as a result of omissions, misinterpretation, or fraudulent acts of the persons contacted or errors or omissions in the reviewed documentation.

The assessment of environmental conditions and possible hazards at this site has been made using the results of physical measurements from a number of locations. The site conditions between sampling locations have been inferred based on conditions observed. Conditions may vary from these sampled locations.

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 practicing 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 Ltd. 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 Ltd. should be requested to re-evaluate the conclusions of this report, and to provide amendments as required.

8.0 CLOSURE

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

GOLDER ASSOCIATES LTD.

Andria Caletti, B.Sc.Eng.
Environmental Consultant

Paul Smolkin, P.Eng.
Principal

REGISTERED PROFESSIONAL ENGINEER
P. A. SMOLKIN
Dec 20/13
PROVINCE OF ONTARIO

ALC/MKF/PAS/sg
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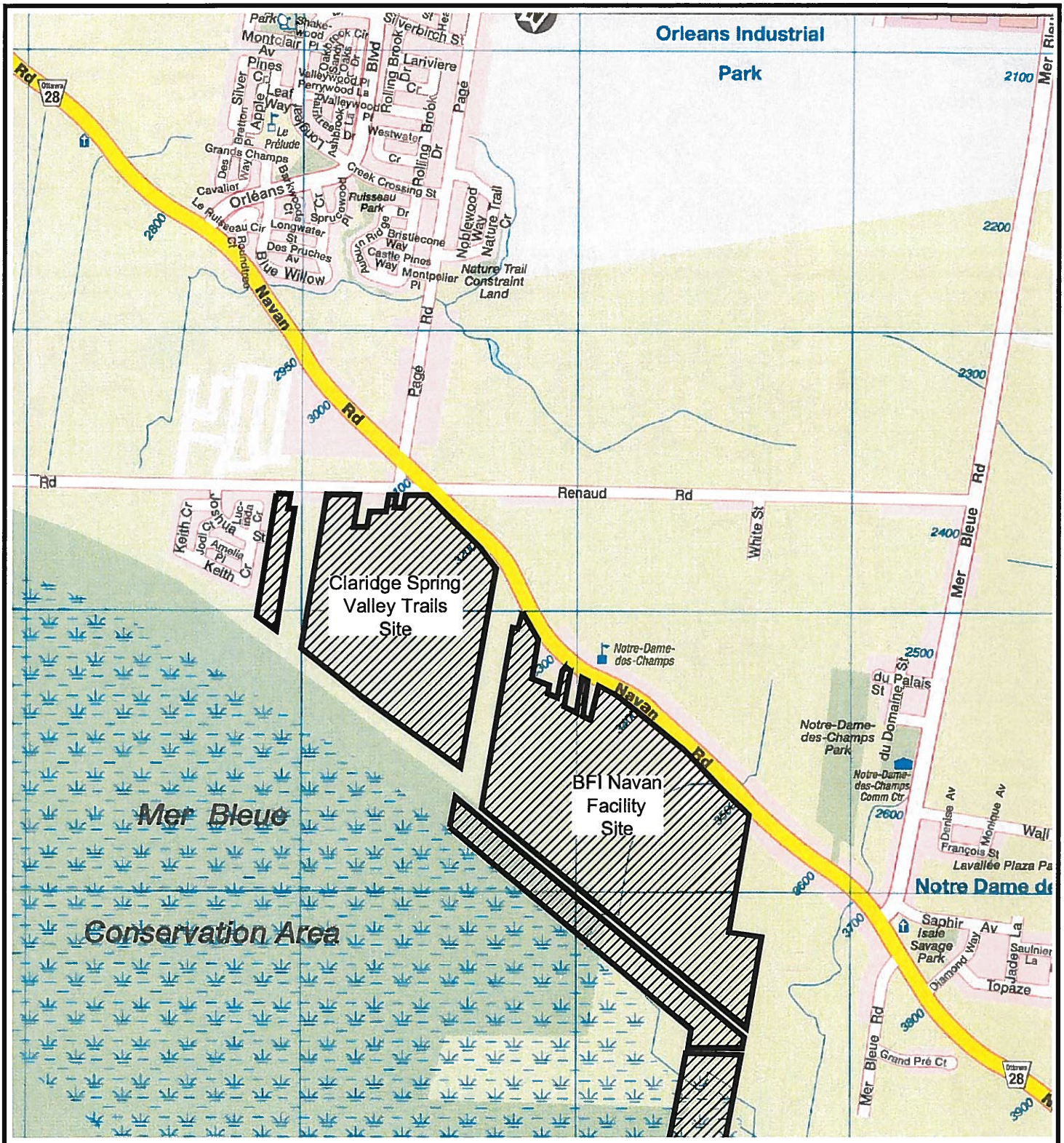

NOTE

THIS FIGURE IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GOLDER ASSOCIATES LTD. REPORT No. 07-1121-0232-2000

Golder Associates
Ottawa, Ontario, Canada

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DESIGN	
CAD	JM/BR
CHECK	ALC
REVIEW	PAS

TITLE

KEY PLAN

FILE No. 0711210232-2000-01.dwg

PROJECT No. 07-1121-0232 REV.

BUFFER STUDY
PHASE 3 - SPRING VALLEY TRAILS

FIGURE 1

PLOT DATE: December 20, 2013
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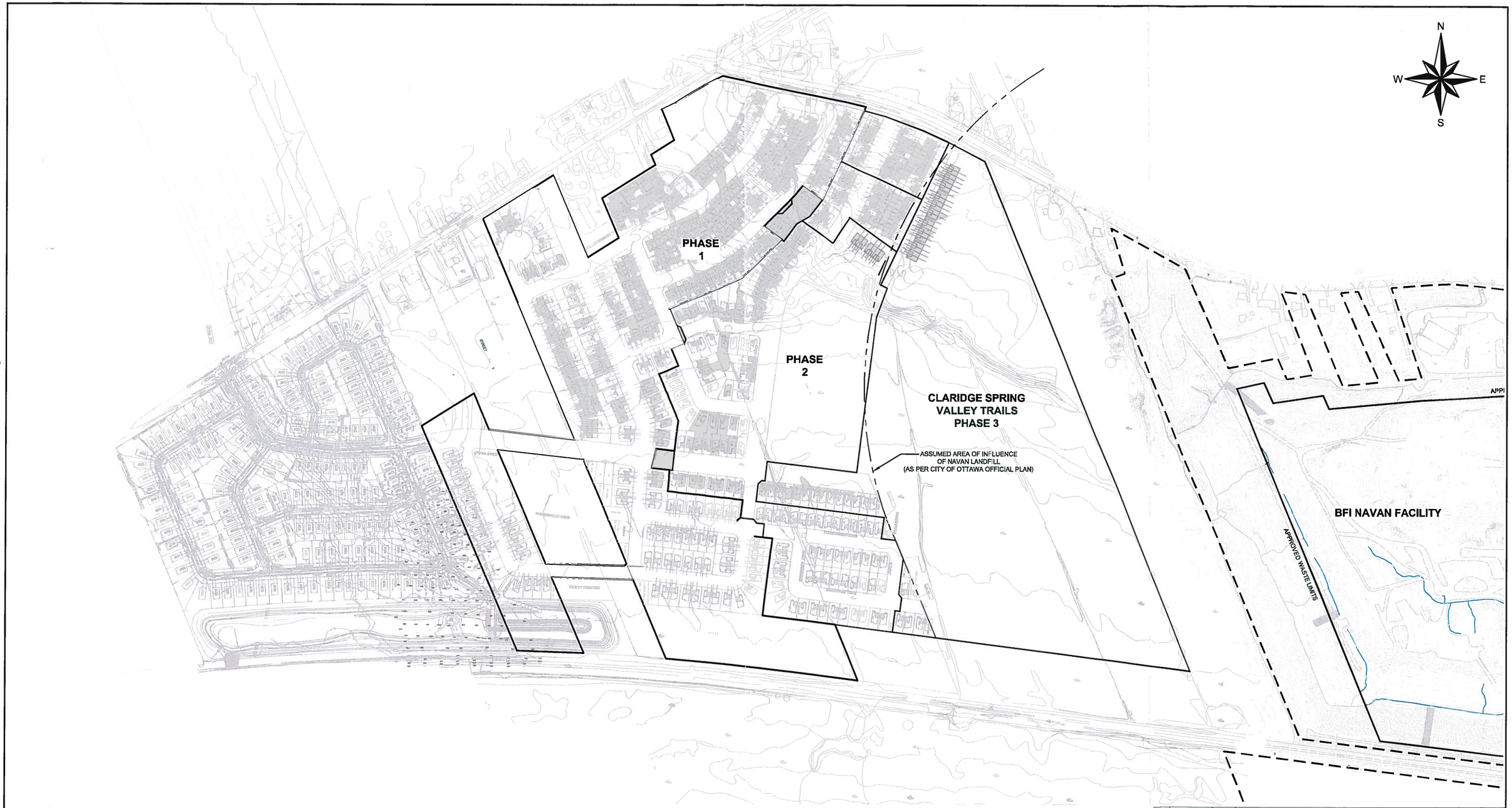

LEGEND

- CLARIDGE PROPERTY BOUNDARY
- EXISTING BUILDING
- ROAD
- BFI PROPERTY BOUNDARY
- FENCE LINE
- CLARIDGE SITE CONTOURS (SEP. 2006)
- BFI SITE CONTOURS (JULY 2010)

REFERENCE

1. BASE PLAN SUPPLIED IN ELECTRONIC FORMAT BY IBI GROUP AND THE BASE MAPPING CO. LTD.

NOTE

1. THIS FIGURE IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GOLDER ASSOCIATES LTD. REPORT No. 07-1121-0232-2000

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SCALE 1:5000 METRES

REV	DATE	DES	REVISION DESCRIPTION	CAD	CHK	RVW

PROJECT

BUFFER STUDY
PHASE 3 - SPRING VALLEY TRAILS
OTTAWA, ONTARIO

TITLE

CLARIDGE HOMES
SPRING VALLEY TRAILS
SITE PLAN

Golder Associates
Ottawa, Ontario, Canada

PROJECT No.	07-1121-0232		FILE No. 0711210232-2000-02.dwg
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REVIEW	PAS	2013-12-20	

PLOT DATE: December 20, 2013
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PHASE 2

CLARIDGE SPRING VALLEY TRAILS PHASE 3

ASSUMED AREA OF INFLUENCE OF NAVAN LANDFILL (AS PER CITY OF OTTAWA OFFICIAL PLAN)

BFI NAVAN FACILITY

APPROVED WASTE LIMITS

APPROVED WASTE LIMITS

APPROVED WASTE LIMITS

APPROVED WASTE LIMITS

A

A'

B

B'

N

W

E

S

LEGEND

- CLARIDGE PROPERTY BOUNDARY
- EXISTING BUILDING
- ROAD
- BFI PROPERTY BOUNDARY
- FENCE LINE
- CLARIDGE SITE CONTOURS (SEP. 2006)
- BFI SITE CONTOURS (JULY 2010)
- GROUNDWATER MONITORING STATION
- A A' CROSS-SECTION LOCATION. REFER TO FIGURES 4 AND 5 FOR CROSS-SECTIONS

REFERENCE

1. BASE PLAN SUPPLIED IN ELECTRONIC FORMAT BY IBI GROUP AND THE BASE MAPPING CO. LTD.

NOTE

1. THIS FIGURE IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GOLDER ASSOCIATES LTD. REPORT No. 07-1121-0232-2000

100 0 100 200

SCALE 1:5000 METRES

REV	DATE	DES	REVISION DESCRIPTION	CAD	CHK	RVW

PROJECT

BUFFER STUDY
PHASE 3 - SPRING VALLEY TRAILS
OTTAWA, ONTARIO

TITLE

BFI NAVAN FACILITY SITE PLAN

Golder Associates
Ottawa, Ontario, Canada

PROJECT No.	07-1121-0232		FILE No. 0711210232-2000-03.dwg
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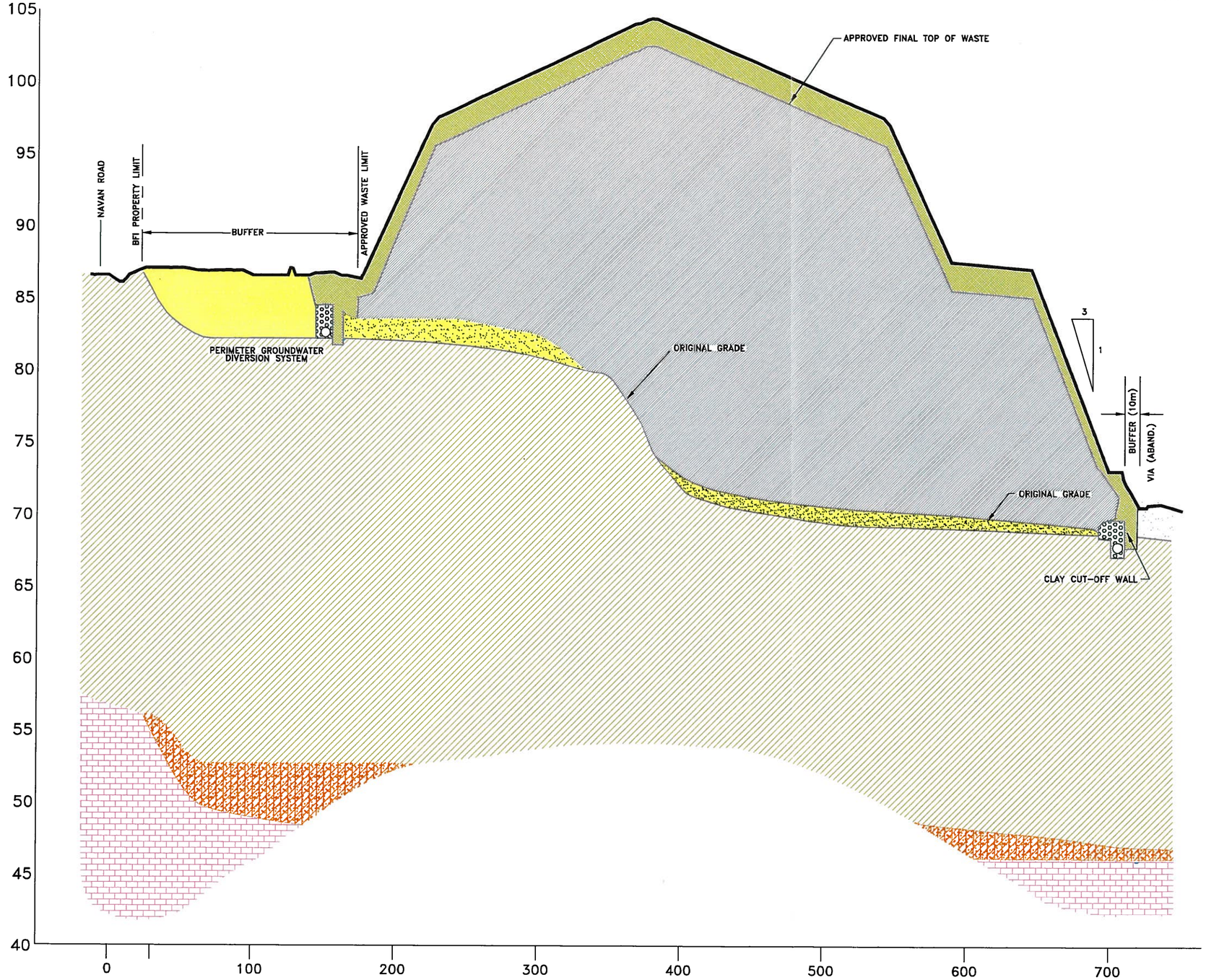


HORIZONTAL SCALE: 1:3,000
VERTICAL SCALE: 1:300
HORIZONTAL SCALE EXAGGERATED 10 TIMES THE VERTICAL SCALE FOR ILLUSTRATION PURPOSES

LEGEND

- CLAY FINAL COVER
- REFUSE
- CLEAR CRUSHED STONE
- SAND
- SILTY CLAY
- GLACIAL TILL
- BEDROCK

REFERENCE

1. BASE MAP PROVIDED BY WSI, DRAWING No.: 2005-2.9. DATED: FEBRUARY 2006

NOTE

1. THIS FIGURE IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GOLDER ASSOCIATES LTD. REPORT No. 07-1121-0232-2000

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
0	01/01/01	XXX	REV_DESC	XXX		

PROJECT

BUFFER STUDY
PHASE 3 - SPRING VALLEY TRAILS
OTTAWA, ONTARIO

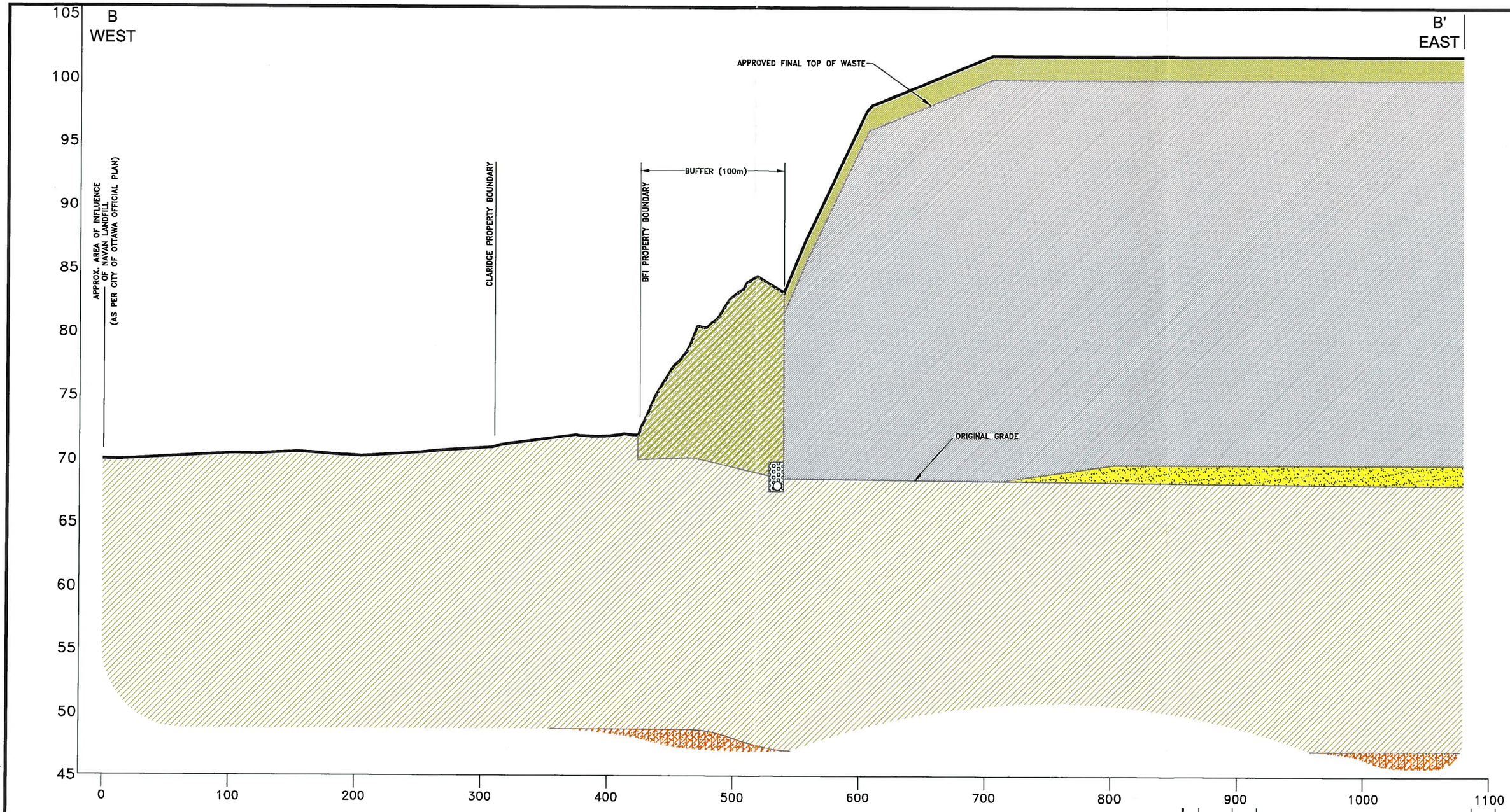
TITLE

SCHEMATIC CROSS-SECTION A-A'

Golder Associates
Ottawa, Ontario

PROJECT No. 07-1121-0232			FILE No. 0711210232-2000-03.dwg	
DESIGN			SCALE AS SHOWN	REV. 0
CADD	JM/BR	2013-12-20	FIGURE 4	
CHECK	ALC	2013-12-20		
REVIEW	PAS	2013-12-20		

Drawing file: 0711210232-2000-04.dwg Dec 20, 2013 - 11:21am



HORIZONTAL SCALE: 1:3,000
VERTICAL SCALE: 1:300
HORIZONTAL SCALE EXAGGERATED 10 TIMES THE VERTICAL SCALE FOR ILLUSTRATION PURPOSES

LEGEND

- CLAY FINAL COVER
- REFUSE
- CLAY BERM
- CLEAR CRUSHED STONE
- SILTY CLAY
- SAND
- GLACIAL TILL

REFERENCE

1. BASE MAP PROVIDED BY WSI, DRAWING No.: 2005-2.9. DATED: FEBRUARY 2006

NOTE

1. THIS FIGURE IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GOLDER ASSOCIATES LTD. REPORT No. 07-1121-0232-2000

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
1	01/01/01	XXX	REV_DESC	XXX		

PROJECT

BUFFER STUDY
PHASE 3 - SPRING VALLEY TRAILS
OTTAWA, ONTARIO

TITLE

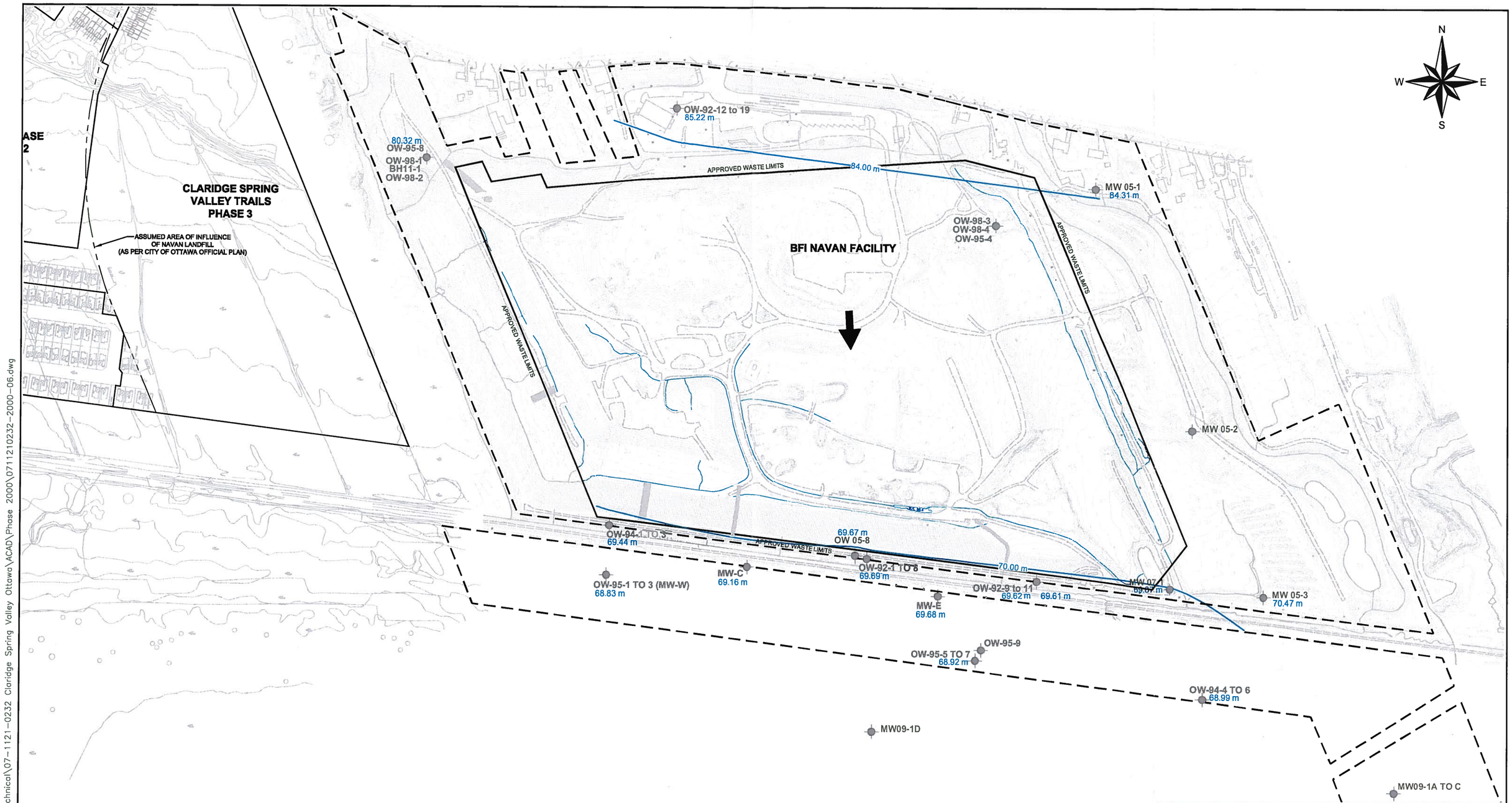
SCHEMATIC CROSS-SECTION B-B'

Golder Associates
Ottawa, Ontario

PROJECT No. 07-1121-0232			FILE No.	0711210232-2000-03.dwg
DESIGN			SCALE	AS SHOWN
CADD	JM/BR	2013-12-20	REV.	D
CHECK	ALC	2013-12-20		
REVIEW	PAS	2013-12-20		

FIGURE 5

Drawing file: 0711210232-2000-05.dwg Dec 20, 2013 - 11:24am



LEGEND

- CLARIDGE PROPERTY BOUNDARY
- EXISTING BUILDING
- ROAD
- BFI PROPERTY BOUNDARY
- FENCE LINE
- CLARIDGE SITE CONTOURS (SEP. 2006)
- BFI SITE CONTOURS (JULY 2010)
- GROUNDWATER MONITORING STATION
- –74.00 m– GROUNDWATER ELEVATION CONTOUR (MAY 21, 2013)
- 85.22 m GROUNDWATER ELEVATION, metres (MAY 21, 2013)
- INTERPRETED GW FLOW DIRECTION

REFERENCE

1. BASE PLAN SUPPLIED IN ELECTRONIC FORMAT BY IBI GROUP AND THE BASE MAPPING CO. LTD.

NOTE

1. THIS FIGURE IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GOLDER ASSOCIATES LTD. REPORT No. 07-1121-0232-2000

100 0 100 200
SCALE 1:5000 METRES

REV	DATE	DES	REVISION DESCRIPTION	CAD	CHK	RVW
△						

PROJECT
BUFFER STUDY
PHASE 3 - SPRING VALLEY TRAILS
OTTAWA, ONTARIO

TITLE
GROUNDWATER FLOW IN SURFICIAL SAND AND WEATHERED CLAY ZONE

Golder Associates
Ottawa, Ontario, Canada

PROJECT No.	07-1121-0232		FILE No.	0711210232-2000-06.dwg	
DESIGN			SCALE	1:5,000	REV.
CAD	JWBR	2013-12-20	FIGURE No.		
CHECK	ALC	2013-12-20		6	
REVIEW	PAS	2013-12-20			

PLOT DATE: December 20, 2013
FILENAME: N:\Active\2007\1121 – Geotechnical\07–1121–0232 Claridge Spring Valley Ottawa\ACAD\Phase 2000\0711210232–2000–06.dwg

PHASE 2

CLARIDGE SPRING VALLEY TRAILS PHASE 3

ASSUMED AREA OF INFLUENCE OF NAVAN LANDFILL (AS PER CITY OF OTTAWA OFFICIAL PLAN)

APPROVED WASTE LIMITS

(ABANDONED)

MH-12

MH-11

MH-10

MH-9

MH-8

MH-7

MH-6

MH-5

MH-4

MH-3

MH-2

MH-1

MH-0

MH-15

MH

MH

CENTRAL MANHOLE

APPROVED EXPANSION AREA

LEACHATE WET WELL AND PUMP STATION

N

W

E

S

LEGEND

- CLARIDGE PROPERTY BOUNDARY
- EXISTING MAINTENANCE HOLE
- EXISTING BUILDING
- ROAD
- BFI PROPERTY BOUNDARY
- FENCE LINE
- CLARIDGE SITE CONTOURS (SEP. 2060)
- BFI SITE CONTOURS (JULY 2010)
- EXISTING LEACHATE UNDERDRAIN COLLECTOR
- EXISTING PERIMETER LEACHATE COLLECTOR AND UNDERDRAINS
- EXISTING HYDRAULIC CONNECTIONS
- LEACHATE COLLECTOR PIPE (APPROVED, YET TO BE CONSTRUCTED)
- 200 mm DIA. NON-PERFORATED DRAIN PIPE
- FRENCH DRAIN
- CLAY FILL

REFERENCE

1. BASE PLAN SUPPLIED IN ELECTRONIC FORMAT BY IBI GROUP AND THE BASE MAPPING CO. LTD.

NOTE

1. THIS FIGURE IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GOLDER ASSOCIATES LTD. REPORT No. 07-1121-0232-2000

100 0 100 200

SCALE 1:5000 METRES

REV	DATE	DES	REVISION DESCRIPTION	CAD	CHK	RVW

PROJECT

BUFFER STUDY
PHASE 3 - SPRING VALLEY TRAILS
OTTAWA, ONTARIO

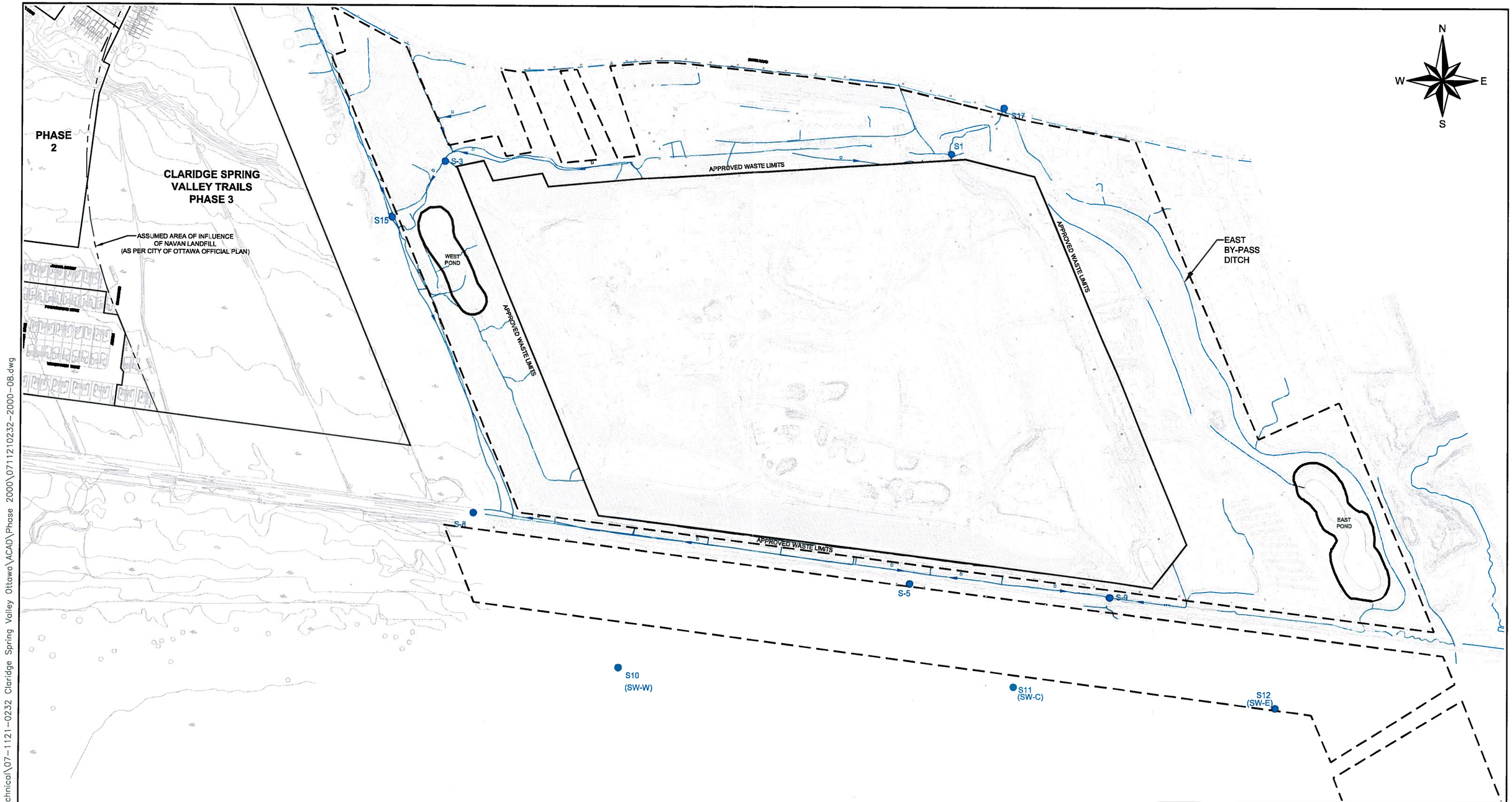
TITLE

LEACHATE COLLECTION SYSTEM

Golder Associates
Ottawa, Ontario, Canada

PROJECT No.	07-1121-0232		FILE No. 0711210232-2000-07.dwg
DESIGN			SCALE 1:5,000 REV.
CAD	JM/BR	2013-12-20	FIGURE No.
CHECK	ALC	2013-12-20	7
REVIEW	PAS	2013-12-20	

PLOT DATE: December 20, 2013
FILENAME: N:\Active\2007\1121 - Geotechnical\07-1121-0232 Claridge Spring Valley Ottawa\ACAD\Phase 2000\0711210232-2000-07.dwg



LEGEND

- CLARIDGE PROPERTY BOUNDARY
- D — DITCH
- DRAINAGE FLOW DIRECTION
- EXISTING BUILDING
- ROAD
- BFI PROPERTY BOUNDARY
- FENCE LINE
- CLARIDGE SITE CONTOURS (SEP. 2006)
- BFI SITE CONTOURS (JULY 2010)
- SURFACE WATER SAMPLING STATION

REFERENCE

1. BASE PLAN SUPPLIED IN ELECTRONIC FORMAT BY IBI GROUP AND THE BASE MAPPING CO. LTD.

NOTE

1. THIS FIGURE IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GOLDER ASSOCIATES LTD. REPORT No. 07-1121-0232-2000

100 0 100 200
SCALE 1:5000 METRES

REV	DATE	DES	REVISION DESCRIPTION	CAD	CHK	RVW

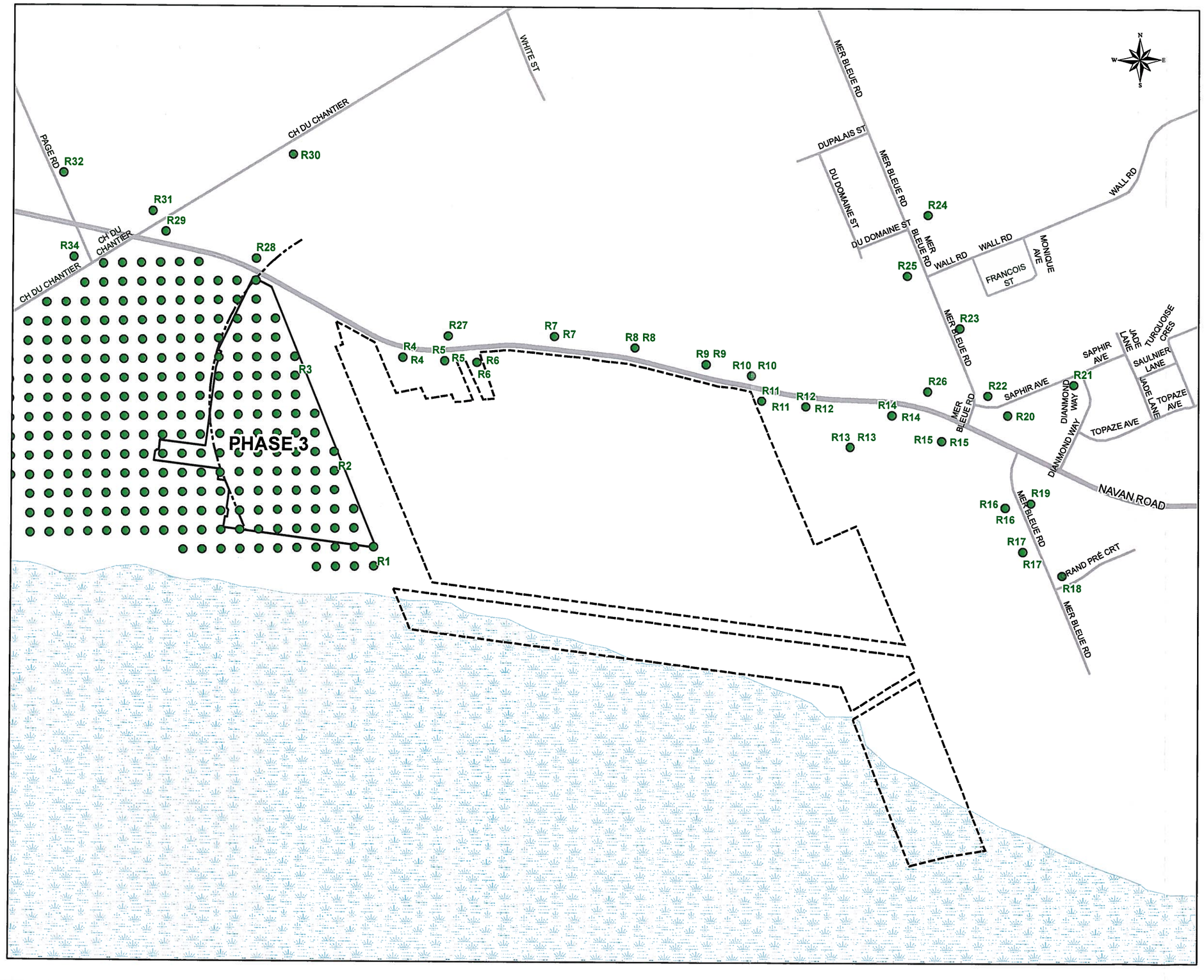
PROJECT
BUFFER STUDY
PHASE 3 - SPRING VALLEY TRAILS
OTTAWA, ONTARIO

TITLE
SURFACE WATER MANAGEMENT PLAN

Golder Associates
Ottawa, Ontario, Canada

PROJECT No.	07-1121-0232		FILE No. 0711210232-2000-08.dwg		
DESIGN			SCALE 1:5,000	REV.	
CAD	JWBR	2013-12-20	FIGURE No.		
CHECK	ALC	2013-12-20	8		
REVIEW	PAS	2013-12-20			

PLOT DATE: December 20, 2013
FILENAME: N:\Active\2007\1121 - Geotechnical\07-1121-0232 Claridge Spring Valley Ottawa\ACAD\Phase 2000\0711210232-2000-08.dwg



LEGEND

- SENSITIVE RECEPTOR LOCATION
- ASSUMED AREA OF INFLUENCE OF NAVAN LANDFILL (AS PER CITY OF OTTAWA OFFICIAL PLAN)
- BFI PROPERTY BOUNDARY
- CLARIDGE PHASE 3 BOUNDARY
- ROADWAY
- WETLAND (MER BLEUE)

REFERENCE

DIGITAL BASE MAP DATA SUPPLIED BY DMTI SPATIAL INC. CANMAP, 2006.
PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 18

200 0 200
SCALE 1:5,000 METRES

PROJECT
BUFFER STUDY, PHASE 3
SPRING VALLEY TRAILS

TITLE
AIR AND ODOUR MODELING
SENSITIVE RECEPTOR LOCATIONS

Golder Associates
Ottawa, Ontario

PROJECT No. 07-1121-232			SCALE AS SHOWN	REV. 0
DESIGN	DDS	2007-02-07		
GIS	PJM	2013-12-20		
CHECK	ALC	2013-12-20		
REVIEW	PAS	2013-12-20		

FIGURE: 9

Document Path: N:\Active\Spatial_IM\Claridge Homes\SpringValleyTrails\GIS\MXDs\12-1121-0232\Reporting\Phase2000_Air\07-1121-0232-2000-9.mxd

LEGEND

- NOISE MONITOR LOCATION
- NOISE RECEPTOR LOCATION
- ASSUMED AREA OF INFLUENCE OF NAVAN LANDFILL (AS PER CITY OF OTTAWA OFFICIAL PLAN)
- BFI PROPERTY BOUNDARY
- CLARIDGE PHASE 3 BOUNDARY
- ROADWAY
- WETLAND (MER BLEUE)

REFERENCE

DIGITAL BASE MAP DATA SUPPLIED BY DMTI SPATIAL INC. CANMAP, 2006.
PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: UTM ZONE 18

200 0 200
SCALE 1:5,000 METRES

PROJECT
BUFFER STUDY, PHASE 3
SPRING VALLEY TRAILS

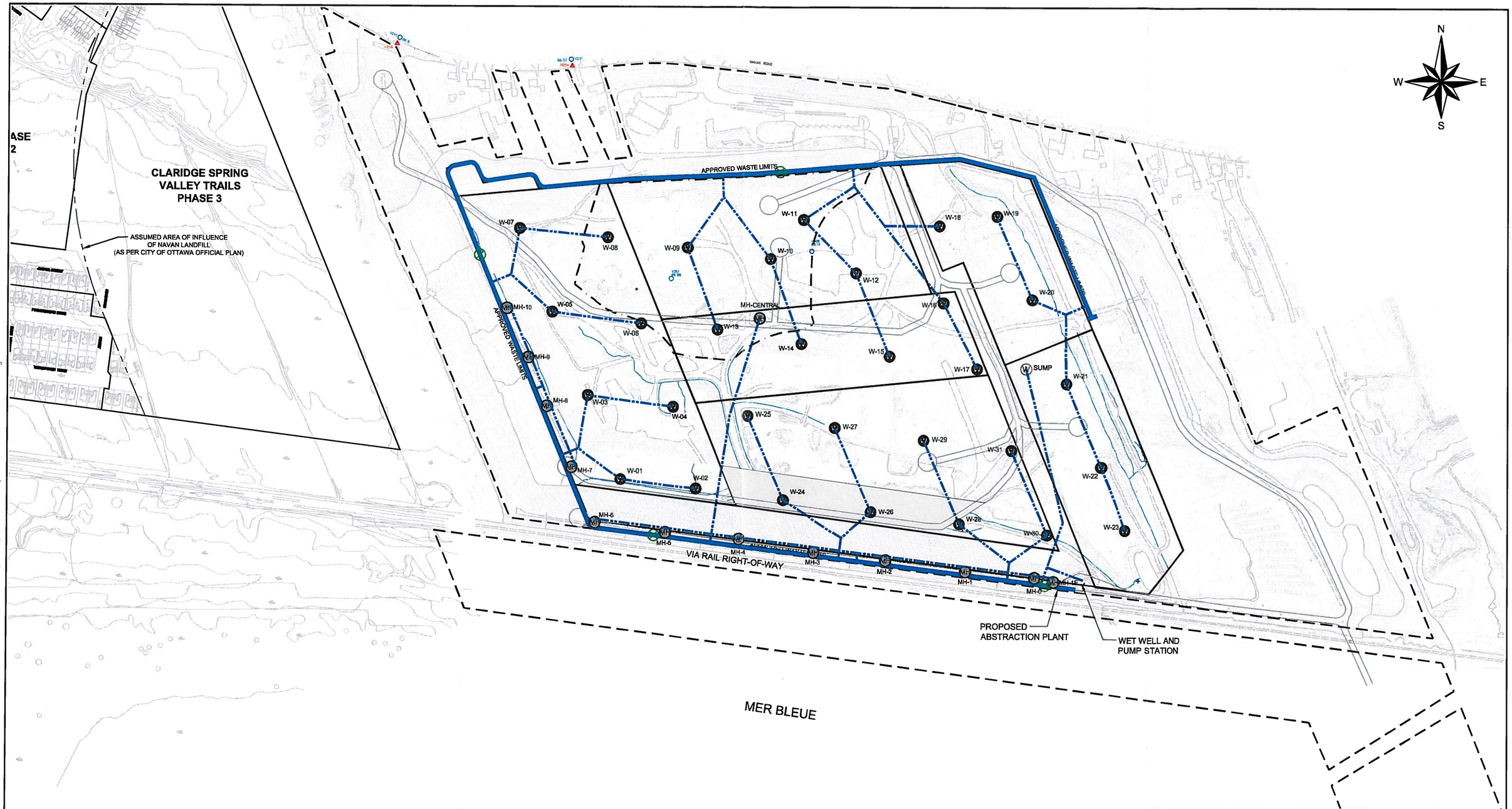
TITLE
NOISE RECEPTORS AND 2012 MONITOR LOCATIONS

Golder Associates
Ottawa, Ontario

PROJECT No. 07-1121-232			SCALE AS SHOWN	REV. 0
DESIGN	DDS	2007-02-07		
GIS	PJM	2013-12-20		
CHECK	ALC	2013-12-20		
REVIEW	PAS	2013-12-20		

FIGURE: 10

Document Path: N:\Active\Spatial_IM\ClaridgeHomes\SpringValleyTrails\GIS\MXDs\12-1121-0232\Reporting\Phase2000_Noise\07-1121-0232-2000-10.mxd



LEGEND

- PROPOSED LANDFILL GAS LATERAL PIPE
- PROPOSED LANDFILL GAS HEADER PIPE
- W-01 PROPOSED LANDFILL GAS EXTRACTION WELL
- PROPOSED CONDENSATE TRAP
- SUMP PROPOSED LEACHATE COLLECTION SUMP
- MH-1 EXISTING MAINTENANCE MANHOLE
- EXISTING WET WELL AND LEACHATE PUMP STATION
- VERTICAL / HORIZONTAL CONTROL
- EXISTING BUILDING
- ROAD
- BFI PROPERTY BOUNDARY
- FENCE LINE
- CLARIDGE SITE CONTOURS (SEP. 2006)
- BFI SITE CONTOURS (JULY 2010)

REFERENCE

1. BASE PLAN SUPPLIED IN ELECTRONIC FORMAT BY IBI GROUP AND THE BASE MAPPING CO. LTD.

NOTE

1. THIS FIGURE IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GOLDER ASSOCIATES LTD. REPORT No. 07-1121-0232-2000

100 0 100 200

SCALE 1:5000 METRES

REV	DATE	DES	REVISION DESCRIPTION	CAD	CHK	RVW

PROJECT

BUFFER STUDY
PHASE 3 - SPRING VALLEY TRAILS
OTTAWA, ONTARIO

TITLE

APPROVED LANDFILL GAS COLLECTION SYSTEM LAYOUT

Golder Associates
Ottawa, Ontario, Canada

PROJECT No.	07-1121-0232		FILE No.	0711210232-2000-11.dwg	
DESIGN			SCALE	1:5,000	REV.
CAD	JM/BR	2013-12-20	FIGURE No.		
CHECK	ALC	2013-12-20		11	
REVIEW	PAS	2013-12-20			

PLOT DATE: December 20, 2013
FILENAME: N:\Active\2007\1121 - Geotechnical\07-1121-0232 Claridge Spring Valley Ottawa\ACAD\Phase 2000\0711210232-2000-11.dwg

CLARIDGE SPRING VALLEY TRAILS PHASE 3

ASSUMED AREA OF INFLUENCE OF NAVAN LANDFILL (AS PER CITY OF OTTAWA OFFICIAL PLAN)

APPROVED WASTE LIMITS

MH-10 MH-9 MH-8 MH-7 MH-6 MH-5 MH-4 MH-3 MH-2 MH-1 MH-0 MH-1E

GW-1 GW-2 GW-3 GW-4

PUMP STATION

N W E S

LEGEND

- G56 AMBIENT AIR COLLECTOR PIPES
- G68 CENTRAL AREA-MISCELLANEOUS
- G45 AIR VENTS
- G5 WEST AND SOUTH FACES
- EXISTING LANDFILL GAS EXTRACTION WELL
- G30 OFFICE/BUILDING AREA
- G50 FORMER COMPOST AREA
- G90 NORTH AND EAST FACES
- G101 AIR VENTS
- MAINTENANCE HOLE LOCATION
- EXISTING BUILDING
- ROAD
- BFI PROPERTY BOUNDARY
- FENCE LINE
- CLARIDGE SITE CONTOURS (SEP. 2006)
- BFI SITE CONTOURS (JULY 2010)

REFERENCE

1. BASE PLAN SUPPLIED IN ELECTRONIC FORMAT BY IBI GROUP AND THE BASE MAPPING CO. LTD.

NOTE

1. THIS FIGURE IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GOLDER ASSOCIATES LTD. REPORT No. 07-1121-0232-2000

100 0 100 200

SCALE 1:5000 METRES

REV	DATE	DES	REVISION DESCRIPTION	CAD	CHK	RVW

PROJECT

BUFFER STUDY
PHASE 3 - SPRING VALLEY TRAILS
OTTAWA, ONTARIO

TITLE

LANDFILL GAS MONITORING LOCATIONS

Golder Associates
Ottawa, Ontario, Canada

PROJECT No.	07-1121-0232		FILE No. 0711210232-2000-12.dwg
DESIGN			SCALE 1:5,000 REV.
CAD	JM/BR	2013-12-20	FIGURE No.
CHECK	ALC	2013-12-20	12
REVIEW	PAS	2013-12-20	

PLOT DATE: December 20, 2013
FILENAME: N:\Active\2007\1121 - Geotechnical\07-1121-0232 Claridge Spring Valley Ottawa\ACAD\Phase 2000\0711210232-2000-12.dwg

APPENDIX A

City of Ottawa Peer Review of Environmental Assessment Study Report

December 2013
Report No. 07-1121-0232 (2000)

Golder Associates

File No. W21-06-07-NAVAN/45838

23 April 2007

VIA FACSIMILE AND E-MAIL

Ms. Solange Desautels
Project Officer
Ministry of the Environment
Environmental Assessment and Approvals Branch
2 St. Clair Avenue West, Floor 12A
Toronto, Ontario M4V 1L5
FAX (416) 314-8452
Email: solange.desautels@ontario.ca

Dear Ms. Desautels:

Re: Environmental Assessment (EA) – Environmental Assessment Study Report (February 2007) – Waste Services (CA) Inc., Ottawa (Navan), Ontario

Introduction

This letter and attachments provides the City's comments on the Environmental Study Report (ESR) prepared on behalf of Waste Services (CA) Inc. (WSI). These comments have been compiled from staff in the City's Public Works and Services Department and by the City's consultant, Conestoga Rovers & Associates (CRA). As you are aware, these staff comments are subject to ratification by the City's Planning and Environment Committee (PEC) and Council. It is expected that these comments will be considered by PEC on May 22, 2007 and forwarded to Council for approval on May 23, 2007.

Focused Peer Review Comments

The City's consultant, CRA, was tasked with doing a high-level, focused peer review of the ESR. The City has adopted CRA's report attached as Document 1 to this letter with the following summary conclusions:

1. Consultation – The consultation conducted satisfies the Province's EA consultation requirements. Consistent with the City's comments on the Terms of Reference (ToR), the City expects that an EA monitoring strategy be required as a condition of EA approval and/or will be incorporated into any *Environmental Protection Act* (EPA) or *Ontario Water Resources Act* (OWRA) approvals. The City requests that WSI describe how it intends to continue to consult with stakeholders pending approval of the expansion;

2. Conceptual Site Design – The proposed expansion design alternatives appear to comply with *O.Reg. 232/98 Landfilling Sites* and no other issues were identified;

3. Geologic/Hydrologic – Based on review of geology and hydrologeology, the site is suitable for use as a landfill site. The modeling assessment was appropriate and applied correctly with regards to the requirements of regulations and industry standards. The predicted results of no future impact are reasonable based on the modeling work conducted;

4. Surface Water – The modeling assessment was appropriate and applied correctly with regards to the requirements of regulations and industry standards. No issues were identified with the proposed drainage/surface water management measures associated with the proposed expansion and WSI has identified that these measures will be in accordance with O.Reg. 232/98 Landfilling Site and subject to OWRA approval;

5. Atmospheric Impact (Odour & Noise) – The odour modeling did not include the odour emissions from fugitive landfill gas emitted from the surface of the landfill that is not collected by the landfill gas collection system. The report assumed that approximately 5% of the landfill gas will be emitted as fugitive emissions from the surface (see Section 5.6.2). A September 27, 2006 Odour Sampling report by Zorix indicates that there is odour in the landfill gas emitted from a passive gas vent. This same landfill gas also has a potential to contribute to off-site odour as it is currently assumed to be emitted from the landfill surface at a rate of 5% of the total gas generated. The City recommends that fugitive landfill gas emissions through the landfill cap be incorporated into the odour modeling evaluation and that appropriate mitigation measures be developed in conjunction with a future EPA section 9 application, as required.

   With respect to noise modeling, several of the residential receptors, including R5, R6, R7, R8, and R11 are predicted to have a noise level of 55 dBA even with the proposed noise barriers. Given the inherent uncertainty in the modeling results, the proposed noise barrier designs should be revised to achieve theoretical noise levels less than 55 dBA at the sensitive receptors. The modeling does show that compliance with noise criteria can be achieved and the City recommends that the noise barrier designs be revisited during the EPA section 9 approvals process;

6. Site Mitigation Measures – The selection of site mitigation measures to address odour, noise, dust, visual impact, property value and end use are appropriate at this time;

7. Preferred Alternative Selective Methodology – The preferred selection methodology is appropriate, however, a quantitative approach might have been more useful in confirming the identification of the preferred alternative.

Thus, in regards to the matters examined, with the exception of odour and noise review assessments noted above, the City has concluded that there are no outstanding technical concerns with the ESR.

Planning Act Comments

The ESR identified planned land use matters in Section 5.13 of the ESR. While the City has no concerns with the factual issues discussed therein, the ESR did not outline the requirement to submit a required rezoning application with the City for the proposed expansion. This requirement has been noted in the City's Official Plan Policy 3.8.4 available at http://www.ottawa.ca/city_hall/ottawa2020/official_plan/vol_1/designtns_lnd_use/solid_waste_sites/index_en.html.

Agreement between the Friends of Mer Bleue Community Association (FOMB) & WSI

Staff have obtained and reviewed a recent agreement signed by FOMB and WSI, attached as Document 2 to this letter. The City is in support of the substantive matters as outlined in the agreement. The City recommends that each substantive matter be incorporated as a condition of EA approval by the Minister of the Environment as follows:

- **Formation and composition of membership of a Public Advisory Committee (PAC);**

  This recommendation is consistent with the City's prior submission on the Navan Landfill Terms of Reference (ToR) and the present membership composition of the City's Trail Landfill Liaison Committee. The role of the PAC would be to review new issues that may arise out of approvals issued under the *EA Act*, *Environmental Protection Act* or *Ontario Water Resources Act*, to incorporate the recommendations of the City's Industrial, Commercial & Institutional (IC&I) Waste Strategy, encourage enhanced waste diversion measures at the Landfill site and be supplied with monitoring data regarding potential environmental impacts or emissions from the Landfill site.

- **Formation of a Dispute Resolution Strategy to be employed by WSI and the PAC;**

  This recommendation is consistent with the City's prior comments on the Terms of Reference that were submitted, and recently withdrawn, by Waste Management of Canada Corporation for their Carp Ottawa Waste Management Facility.

- **Expansion of WSI's Property Value Protection Plan to include the properties on Mer Bleue Road and on Grandpre, directly east of the Navan Landfill;**

- **WSI work with the City of Ottawa, FOMB and the PAC to identify and develop community projects to enhance and improve the local community and public spaces; and**

- **In issuing any future approval under the *Environmental Protection Act*, the City of Toronto would be specifically excluded from the service area for the Navan Landfill site.**

  This recommendation is consistent with the 2001 Settlement Agreement which obliges WSI to reserve 75% capacity of the Site for waste generated within Ottawa and prior City communications to the Ministry of the Environment regarding shipment of waste from the City of Toronto.

Conclusion

As previously noted, the City's Planning and Environment Committee will be considering these comments on May 22, 2007 with the anticipated Council consideration to follow on May 23, 2007. Any changes to staff's comments or Council resolutions related to the proposed Navan Landfill expansion will be forwarded to you for the MOE's consideration as soon as possible after the Council meeting.

In the interim, please do not hesitate to contact the undersigned at (613) 580-2424 ext. 21268, should you have any questions or concerns about the City's comments.

Yours truly,

Original signed by

R.G. Hewitt. P.Eng.
Deputy City Manager
Public Works and Services

Attach. (2)

cc: Kenneth J. Brothers, Director, Utility Services Branch
M. Rick O'Connor, City Solicitor, Legal Services Branch

Brian Forrestal, Vice President, Environmental Mgmt. & Engineering, Waste Services Inc.
Mike Benson, Conestoga Rovers & Associates

CONESTOGA-ROVERS
& ASSOCIATES

179 Colonnade Rd, Ottawa, Ontario, Canada K2E 7J4
Telephone: (613) 727-0510 Facsimile: (613) 727-0704
www.CRAworld.com

April 23, 2007 Reference No. 45838-10

Ms. Jennifer Jackson
Special Projects Manager
Utility Services Branch
Public Works and Services
City of Ottawa
100 Constellation Crescent
Ottawa, ON K2G 6J8

Dear Ms. Jackson:

Re: Focused Peer Review of Environmental Study Report
Waste Services (CA) Inc.
Proposed Expansion of the Navan Landfill, Ottawa, Ontario

Conestoga-Rovers & Associates (CRA) was retained by the City of Ottawa (City) to complete a focused peer review of the Environmental Assessment (EA) Study Report prepared by Waste Services (CA) Inc. (WSI) for the proposed expansion of the Navan Landfill (Site). The scope of work consisted of the following tasks:

Task 1 – Review of Consultation Process
Task 2 – Review of Conceptual Expansion Design
Task 3 – Review of Geologic/Hydrogeologic Impact Assessment
Task 4 – Review of Surface Water Assessment
Task 5 – Review of Atmospheric Impact Assessment
Task 6 – Review of Proposed Site Mitigation Measures
Task 7 – Review of Preferred Alternative Selection Methodology

The purpose of the focused peer review was to establish whether WSI completed the necessary technical studies described above in a manner consistent with the requirements of the Environmental Assessment Act (EA Act), and whether the results described therein are technically accurate and representative of existing and/or anticipated Site conditions under an expansion scenario. The above issues were considered to be of particular relevance to the City and, as such, were subject to the focused peer review process.

Representatives of CRA (Mike Benson, Mike Mateyk, Don Campbell, Gordon Reusing) and the City (Jennifer Jackson, Anne-Marie Fowler) further met with representatives of WSI (Brian Forestal, Norm Castonguay, Sylvio Richard) and Golder Associates Ltd. (Mr. Paul Smokin) on April 18, 2007 to review CRA's preliminary comments on the EA Study Report in an effort to resolve any outstanding issues or questions.

Review of Consultation Process

Consultation was undertaken by WSI during the EA Terms of Reference (ToR) review process consisting, in part, of two Open Houses, two workshops and newsletters distributed amongst area residents. Public consultation during the EA (i.e. post-ToR approval) consisted of the following:

- Open House No. 3 held on December 14, 2006;
- Open House No. 4 held on February 15, 2007;
- letters to City Council, community associations, Chambers of Commerce and local land owners and developers;
- media releases;
- electronic mailings;
- meetings with public and regulatory agencies;
- preparation of consultation reports;
- project website;
- EA hotline and contact person;
- EA newsletters; and
- a comment tracking database.

Stakeholders for the consultation program included the public, First Nation communities and regulatory agencies.

Based on the consultation guidance procedures set out in the document entitled Guideline on Consultation in the Environmental Assessment Process (Draft), MOE, December 15, 2000, which was in effect at the time that the ToR were being prepared by WSI but which has since been replaced by the document entitled Code of Practice, Consultation in Ontario's Environmental Assessment Process (Draft), MOE, October 2006, CRA believes that, overall, the consultation undertaken by WSI satisfies the Province's EA consultation requirements. CRA is not aware of

any outstanding issues derived from the consultation process that were not addressed in the EA Study Report.

Notwithstanding the above, there does not appear to be a discussion in the EA Study Report to an EA monitoring strategy for commitments made in respect of the preferred alternative. Although the MOE did not specifically require that an EA monitoring strategy be identified in the ToR, the City expects that an EA monitoring strategy will be required as a condition of any EA approval and/or will be incorporated into the conditions for EPA/OWRA approvals.

WSI is requested to describe how it will continue to consult with stakeholders pending EA Act approval for the proposed expansion.

Review of Conceptual Expansion Design

The review of the conceptual expansion design was undertaken to assess the design components in relation to current landfill design standards and practices and to identify any areas of concern with the proposed design that may not have been adequately addressed in the EA Study Report. Since the proposed expansion involves an increase in the currently approved capacity of the Site, the proposed expansion is subject to the requirements of Ontario Regulation (O. Reg.) 232/98, Landfilling Sites, under the Environmental Protection Act. O. Reg. 232/98 provides design standards for new and expanding landfill sites and provides a proponent with the option of using either a "generic" design approach, or a "site specific" design approach. Although not specifically stated in the EA Study Report, the proposed conceptual expansion design alternatives for the Navan Landfill would be considered as site specific designs. It is also noted that the Navan Landfill accepts primarily industrial, commercial and institutional (ICI) and construction and demolition (C & D) waste and avoids accepting putrescible waste.

The EA Study Report identified five alternative designs for the expansion of the Navan Landfill. Each alternative consisted, in general, of a lateral expansion to the east in conjunction with a vertical expansion within the existing landfill area. The maximum limits of the horizontal expansion were dictated by maintaining a minimum 100 m buffer area on Site property to the east. The maximum limits of the vertical expansion were dictated by slope stability analysis. Through follow-up discussions with Golder Associates, it is understood that an additional objective of the conceptual expansion design alternatives was to provide for additional Site life of at least 10 years.

Of the five alternatives presented, Alternative 3 was identified as the preferred alternative. Alternative 3 consists of a horizontal expansion of 130 m to the east for a total expansion area of

8.5 ha., and a vertical expansion of 13 m. Alternative 3 is predicted to provide an increase in Site life of 10.8 years.

Details of the conceptual expansion designs were provided in the Conceptual Design Document, Technical Support Document For The Environmental assessment of the Proposed WSI Navan Landfill Expansion, (Golder Associates Ltd, February 2007) (design document). The following is a summary of the key design components presented in the report:

- Base Contours
  - The conceptual design proposes that the base of the expansion cell be excavated to a depth that will approximate the base grades in the existing landfill area. These proposed base grades will result in excavation of approximately 515,000 m^3 of native soil at depths of up to 12 m at the north end of the expansion area. The proposed base of the expansion cell will be consistent with the existing landfill area in that the excavation surface will form the base of the cell. No additional engineered components (e.g., recompacted clay layer, HDPE liner, etc.) is proposed. The base will be contoured to facilitate the overlying leachate drainage layer.

- New Site Entrance
  - The conceptual design proposes a new Site entrance, located approximately 100 m east of the existing Site entrance. The new Site entrance has been designed to align with a future intersection on Navan Road and will accommodate a truck queuing area, more flexibility for on-site traffic flow and enhanced visual and sound screening features.

- On-Site Roads
  - On-Site roads have been proposed for the expanded Site. The proposed roads will consist of paved surface roads for all roads located outside the limits of waste. For roads within the limits of waste, the roads will have a granular surface.

- Composting Area
  - The report indicates that the current composting operations on-Site will be discontinued as part of the expansion undertaking. It is understood that this is intended as a mitigative measure to eliminate potential odour concerns associated with the composting operation.

- Site Buffer Zones
  - O.Reg. 232/98 stipulate buffer zones around the limits of waste of a minimum of 100 m, or a minimum of 30 m if a written report confirms that the narrower buffer zone is adequate for landfill operations and is sufficient to ensure that potential effects of the

landfill operations do not have any unacceptable impact outside the Site. The buffer zones around the existing landfill limits consist of 30 m, 100 m, 10 m and 260 m to the north, west, south and east, respectively. The 10 m buffer to the south abuts a VIA rail right-of-way. An additional 100 m buffer zone along the south side of the VIA right-of-way is also owned by WSI and considered part of the Site. The proposed expansion cell would extend 130 m to the east from the edge of the existing eastern waste limit, resulting in a buffer zone width of 130 m along the east side of the Site.

- Landfill Sequencing and Phasing
  - The design document outlines criteria that were assumed for development of the proposed landfill sequencing and phasing including approximate duration per phase (2 years), maximum permitted landfilling rate (234,750 tonnes per year), compacted waste density (0.85 tonnes per m^3), waste to cover soil ratio (4:1), and soil excavation rate (140,000 m^3 per year). The design document states that the sequencing and phasing will be refined during the detail design stages.

- Final Cover
  - The final cover design currently approved for the Site consists of a 0.6 m thick clay layer, overlain by a 0.3 m sand layer and a 0.1 m topsoil layer. The design document indicates that consideration will be given to increasing the thickness of the clay layer to between 1.5 m and 3.0 m to accommodate surplus excavated clay. It is noted that increasing the clay thickness of the final cover may aid in reducing leachate generation due to reduced infiltration, and will also aid in reducing landfill gas emissions from the landfill through the final cover. It is noted, however, that the existing final cover design is in accordance with O. Reg. 232/98.

- Excavation of Soils
  - The excavation of soil for the expansion area will result in a significant surplus of soil at the Site. A portion of the surplus soil will be used for final cover construction and screening berm construction, however, a significant volume of soil will be required to be stockpiled on Site. The proposed stockpile location is in the eastern buffer area. The conceptual design report recognizes and addresses the potential for settlement of the native ground beneath the stockpile, which is anticipated to be significant (3-5 metres) due to the characteristics of the marine clay that is present at the Site.

- Geotechnical Evaluation
  - A slope stability and settlement analysis was performed in support of the environmental assessment for the landfill expansion. The slope stability analysis consisted of both static and seismic (earthquake) analysis. The results of the slope stability analysis

indicated that the design of the expansion will provide for a factor of safety of greater than 1.4 for the static analysis. Under the design earthquake analysis, a displacement of less than 200 mm for the waste slopes was predicted.

- The results of the settlement analysis predicted settlement of the base of the expansion cell due to waste surcharge in the order of 3-5 metres. Settlement of this magnitude is considered significant, however, the design report acknowledges this and has modified the design of the expansion to accommodate this settlement.

- Leachate Management
  - The leachate management system for the existing landfill consists of an underdrain system in the northwest portion of the Site, connected to a perimeter leachate collection trench, which runs along the west and south sides of the waste mound. An underdrain system is also located in the northeast portion of the existing landfill. All leachate collected by the existing system is drained to a wet well in the south east corner of the existing landfill where it is loaded into tank trucks for haulage and off-Site disposal at the City of Ottawa municipal sewage treatment plant. The report also indicates that a recent agreement with the City will result in the construction of a forcemain from the Site to the City's municipal sewage system, for future disposal of the leachate.
  - The expansion cell will be constructed with a full underdrain consisting of a granular drainage layer and HDPE piping to convey leachate to a central pumping sump. Collected leachate will be pumped from this sump to the existing wet well. The configuration of the proposed leachate underdrain system for the expansion cell has been designed to accommodate the anticipated significant settlement predicted for the expansion cell base. The design report states that the leachate underdrain system will be designed in accordance with O.Reg. 232/98.

- Landfill Gas and Odour
  - A landfill gas management system is proposed for the expanded site to control potential landfill gas odour. The proposed landfill gas management system consists of a series of vertical extraction wells drilled into the waste, which would be connected to blowers to extract, under negative pressure, the landfill gas from the waste. The extracted landfill gas would be conveyed to an enclosed flare for thermal destruction. The design report does not anticipate off-Site migration of landfill gas will occur due to the soil conditions and presence of the leachate collection trench and storm water diversion ditches around the perimeter of the Site.

- Stormwater
  - See Review of Surface Water Assessment

In summary, the proposed conceptual expansion design alternatives were developed to a level of detail to permit comparison of the alternatives for the purpose of selecting a preferred alternative. CRA did not identify any components of the proposed expansion design alternatives presented that were in potential contravention of O. Reg. 232/98 requirements or that CRA felt should have been considered further at this stage. The design document indicates that the major components of the expansion design will be designed to meet the requirements of O. Reg. 232/98. Further, it is noted that a detailed design of the proposed expansion will be required to be prepared by the proponent and submitted to the Environmental Assessment and Approval Branch of the MOE in support of an EPA Section 5 approval, prior to implementation of the expansion.

Review of Geologic/Hydrogeologic Impact Assessment

The purpose of this task was to review the geologic and hydrogeologic impact assessment presented in the EA Study Report to determine if the technical studies undertaken by WSI were consistent with the following:

- Environmental Assessment Act (EA Act);
- Ontario Regulation 232/98; and
- Industry standards.

Under this task the relevant sections of the following documents were reviewed:

- EA Study Report (Volumes I and II);
- Conceptual Design Document;
- 2005 Operations and Monitoring Report;
- 2006 Monitoring Report; and
- POLLUTE model output files not provided in Appendix E of Volume II of the EASR.

Description of the Geology and Hydrogeology

The description of the geology and hydrogeology of the Site is presented in Volume I of the EA Study Report. A separate Technical Supporting Document for this environmental component was not presented. This is understandable since investigation of the geology and hydrogeology of the existing Site began in the 1980s and has been described in previous reports. The EA Study Report presents an adequate summary description of the geology and hydrogeology environment for the purpose of the EA. The description presented was verified by CRA

through the examination of existing monitoring well stratigraphic and instrumentation logs, geologic cross-sections and groundwater level information presented in the above-noted reports.

Based on our review of the Site geology and hydrogeology, CRA concurs that it is suitable for use as a landfill due the significant thickness of marine clay and glacial till overlying the principal aquifer (shale/limestone bedrock). This clay/till sequence acts an aquitard protecting the bedrock from leachate-impacted groundwater.

Description of Groundwater Quality

A general description of the current groundwater quality in the various hydrostratigraphic units was presented in Volume I of the EA Study Report. It is noted that groundwater monitoring has occurred at the Site since 1981. There was a measured impact in the shallow sand unit downgradient of the Site. In response to the measured impact, WSI installed a perimeter collection drain along the west and south side of the Site to contain and collect leachate-impacted groundwater migrating in the shallow sand unit. The perimeter drain has been effective is preventing further off-Site migration.

The description in the EA Study Report stated that currently the existing Site had no measurable impact on the downgradient groundwater quality. However, no actual groundwater data were presented in the EA Study Report. In order to verify the conclusion of no current impact, CRA reviewed the 2005 and 2006 Monitoring Reports. These reports included the measured groundwater concentrations for the various parameters included in the monitoring program. This independent examination of the 2005 and 2006 groundwater data confirmed that the existing Site has had no measurable impact on groundwater quality.

The review of the most recent monitoring reports has also shown that the monitoring network is suitable for the purpose of establishing background conditions and measuring any potential impact. Typically, the MOE, under O. Reg. 232/98, requires the use of the Reasonable Use Guideline (RUG) to assess landfill impact on groundwater quality. However, because of the nature of the groundwater on and in the vicinity of the Site, the MOE has agreed that RUG is not applicable. We concur with this assessment. The method to evaluate the potential groundwater impacts was modified in 2007 to compare measured groundwater concentrations to the range of background values. This approach is appropriate for the Site.

Predictions of Future Impact

It is required under O. Reg. 232/98 to conduct appropriate modelling to assess future groundwater impacts, if any, for landfill expansions. Groundwater modelling was undertaken

as part of the EA to assess the effects of the expansion alternatives on groundwater quality. The modelling assessment was presented in Appendix E of the EA Study Report. The modelling assessment was conducted using the contaminant transport model POLLUTE. This model is approved by the MOE and is commonly used in the consulting industry. Appendix E described the conceptual Site model, modelling approach, leachate generation rates, key contaminants (parameters that were evaluated), service life of the leachate collection system, predicted leachate mound heights, vertical leakage rates and results.

Based on our review, the modelling approach and assumptions used were appropriate for the Site and consistent with the requirements of O. Reg. 232/98. The hydraulic conductivity values used for the various hydrostratigraphic units were obtained primarily from historical reports. We could not verify the correctness of the historical testing. However, based on our professional experience, the input parameters are reasonable.

The modelling assessment concluded that none of the landfill expansion alternatives resulted in measurable impact to the bedrock aquifer. However, no model output results were presented in Appendix E. CRA requested this information from Golder Associates, and the breakthrough curves were provided for the various alternatives. Our examination of these breakthrough curves show that the conclusions presented by Golder Associates are valid.

In summary, the method used in the modelling assessment to predict future impact was appropriate and was applied correctly with respect to the requirements of the regulations and industry standards. The predicted results of no future impact are reasonable based on the modelling work conducted.

Review of Surface Water Assessment

The conceptual design document presents the existing stormwater management features for the Site and the proposed stormwater management plan for the Site. As noted in the design report, the Site is located on a watershed divide between two major watersheds- the Rideau River watershed to the west and the South Nation River watershed to the east. The design document states that the surface water system operates at the Site to maintain the pre-landfill drainage conditions to each watershed; to divert surface water and shallow groundwater flow originating upstream of the Site around the landfill; to minimize the amount of surface water that comes in contact with the waste; and to maximize the removal of suspended sediment from surface water prior to release to the down stream watershed. The report indicates that upgrades to the stormwater system at the Site are currently underway to meet the requirements of O.Reg. 232/98. A generic, conceptual stormwater management plan for the expanded Site was provided in the design report, which included a new pond in the southeast corner of the

Site. The report also presented preliminary stormwater modeling results for the proposed storm water management pond sizing.

The Visual OTTHYMO (2.0) model was used to predict peak flows and runoff volumes for the east and west drainage portions of the Site. The use of this model is acceptable. Flows were predicted for each of the alternatives for the 1:2, 5; 10; 25; 50; and 100 year return period storm events. Flows for existing conditions were also modeled. The volumes of the stormwater management ponds required on the east and west side of the Site to maintain peak flows at existing condition levels were then calculated for each alternative. Since the stormwater management ponds have been designed to prevent increases in peak flows downstream of the landfill, there are no differences in the alternatives. There are, however, differences in the size of the ponds required for each alternative. For each of the alternatives, there is enough space to construct ponds of the required sizes within the Site boundaries.

The EA Study Report concludes that, under baseline conditions, the landfill does not having an adverse impact on water quality downstream of the landfill, either in the perimeter lagg of the Mer Bleue bog or the drainage course discharging to Mud Creek. The drainage improvements associated with the proposed expansion including segregation of clean and potentially impacted runoff, ponds on the east and west sides to remove sediment and improve water quality, leachate collection system and ongoing surface water and groundwater monitoring programs will be in place to maintain and protect water quality downstream of the landfill. Considering that approved Site operations will require that these measures are implemented and maintained, the EA Study Report concluded that future water quality impacts on downstream receiving waters are not expected under any alternative.

Based on CRA's review of the design document, there were no issues identified with surface water management associated with the proposed expansion. The proposed stormwater management plan will be designed in accordance with O. Reg. 232/98 and will also be designed to meet re-development conditions. Further, the design of the stormwater management plan is subject to Ontario Water Resources Act (OWRA) approval.

Review of Atmospheric Impact Assessment

The Atmospheric Environment Part I – Air and Odour Assessment Report generally followed standard MOE procedures for emissions estimates and dispersion modeling. The air compliance assessment with Regulation 419 Schedule 3 standards shows that particulate matter, particulate matter less than 10 microns (PM-10), nitrogen oxides, sulphur dioxide, hydrogen sulphide and vinyl chloride are well below the applicable criteria (see Table 8.1-1).

The odour concentration assessment using the proposed hydrogen sulphide 10-minute standard shows that there will be some exceedances of the standard for Alternatives 1 and 2 (see Table 8.1-3), however the fraction of time that the exceedances occur is less than the proposed allowable frequency of 0.15%. There are no predicted exceedances of the proposed hydrogen sulphide 10-minute odour standard for Alternatives 3 and 4.

The predicted maximum whole odour concentration using odour units (OU) for all Alternatives is 1.01 OU. The MOE typically uses 1 OU as a standard for sensitive receptors within the Section 9 Approvals process. A value of 1 OU indicates that 50% of a normal population would be able to detect an odour. CRA was informed that if the maximum eight hours of odour concentrations were removed from each year of modeling data (as allowed by the MOE in their dispersion modeling guidance), the maximum odour unit level would drop to 0.54 OU.

The odour modeling did not include the odour emissions from fugitive landfill gas emitted from the surface of the landfill that is not collected by the landfill gas collection system. The report assumed that approximately 5% of the landfill gas will be emitted as fugitive emissions from the surface (see Section 5.6.2). A September 27, 2006 Odour Sampling report by Zorix indicates that there is odour in the landfill gas emitted from a passive gas vent. This same landfill gas also has a potential to contribute to off-Site odour as it is currently assumed to be emitted from the landfill surface at a rate of 5% of the total gas generated. Therefore, CRA recommends that this landfill gas odour emission be included in the EPA Section 9 Approvals application. CRA was informed by Golder Associates that the inclusion of this landfill gas odour emission in the dispersion modeling would likely have a small impact on the modeling results. Nevertheless, pending the results of the dispersion modeling prepared in support of the EPA Section 9 application, it may be necessary to evaluate additional odour controls to address fugitive landfill gas emissions through the landfill surface. It may also be necessary to modify the EA Study Report to reflect the corresponding impact generated by the modeling results, and communicate those results accordingly.

The Atmospheric Environment Part II – Noise Assessment report generally followed accepted MOE procedures for noise assessments, using ISO 9613 -2 calculation procedures with source-specific sound power levels estimated for each significant noise source at the Site. There are numerous sensitive receptors (residences) located along Navan Road, many within 100 metres of the Site boundary. The report calculates that the estimated noise level at the sensitive receptors will be at or below 55 dBA for all four alternatives (Tables 6.2-1, 6.2-2, 6.2-3 and 6.2-4). The EA Study Report concluded that all four alternatives will require extensive noise attenuation measures to shield the noise sources from the sensitive receptors.

Several of the receptors, including R5, R6, R7, R8, and R11 are predicted to have a noise level of 55 dBA even with the proposed noise barriers. Given the inherent uncertainty in the modeling

results, the proposed noise barrier designs should be revised to achieve theoretical noise levels less than 55 dBA at the sensitive receptors. The modeling does show that compliance with noise criteria can be achieved and CRA recommends that the noise barrier designs be revisited during the EPA Section 9 Approvals process.

Section 6 of the report Tables 6.1-1 and 6.1-2 summarizes the minimum nighttime and minimum daytime noise levels for six days of ambient noise measurements. Appendix B has 13 days of noise monitoring data. There is no explanation given in the report regarding the missing 7 days of data in Tables 6.1-1 and 6.1-2. CRA was informed that the missing data was left out due to poor weather conditions.

In summary, CRA recommends that fugitive landfill gas emissions through the landfill cap be incorporated into the odour modeling evaluation and that appropriate mitigation measures be developed in conjunction with future EPA Section 9 Approvals, as required. Further, CRA recommends that noise attenuation designs be revised, as required, to reflect achievement of noise levels less than 55 dBA at sensitive receptors.

Review of Proposed Site Mitigation Measures

Site mitigation measures identified in the EA Study Report included the following:

- Odour – Leachate forcemain; active gas management system; discontinuation of composting
- Noise – Berms
- Dust and Dragout – Best management plan for dust control
- Visual Impact – Vegetation of sideslopes and berms
- Property Value – Property Value Protection Plan
- End Use – Plan within 3 years of closure

Details relating to design of the above mitigation measures were not provided in the EA Study Report and will instead be provided in future design and operation documents submitted to the Environmental Assessment and Approval Branch of the MOE in support of an EPA Section 5 approval, prior to implementation of the expansion. CRA is in agreement that selection of the proposed Site mitigation measures appears appropriate for the Site at this time, pending confirmation of potential fugitive odour and noise related impacts noted above.

Review of Preferred Alternative Selection Methodology

In order to establish the relative importance of the various environmental evaluation criteria used to select the preferred alternative, WSI consulted the public during the ToR process. The public provided input into whether certain environmental evaluation criteria were Very Important (e.g. air quality, odour), Important (e.g. groundwater quality, surface water quality) or Less Important (e.g. archaeological resources, economic benefit to community), and each alternative was evaluated on the basis of whether it was Most Preferred, Less Preferred or Least Preferred under the various environmental evaluation criteria importance categories. Mitigation measures were considered to reduce or eliminate potential adverse effects of each alternative on the environment. The preferred alternative was determined by identifying the alternative that was Most Preferred the greatest number of times in the most important categories with the fewest number of Less Preferred or Least Preferred. This approach is qualitative in nature.

In its approval of the ToR, the MOE did not require that environmental effects be considered independent of mitigation measures, nor did the MOE require that non-qualitative (i.e. quantitative) methods be employed to evaluate the various alternatives and identify the preferred alternative.

Mitigation measures are typically implemented under approvals subject to other legislation (e.g. Environmental Protection Act, Ontario Water Resources Act, etc.) and are not assumed to be pre-approved. In this instance, WSI has indicated that other approvals will be applied for subsequent to EA Act approval.

Quantitative methods (e.g. weighted additive method, non-parametric additive method, dominance set method, etc.) are used to provide confidence in the results of the evaluation: if the same alternative consistently appears as the preferred alternative from one evaluation method to another, then that alternative is considered the most preferred. The assignment of preferences indicating the importance of one criterion relative to another is inherently difficult. For example, how much more or less important is groundwater quality than surface water quality? The qualitative (subjective) preference values assigned are necessarily uncertain and, thus, the ability to test the sensitivity of the selection process through use of quantitative methods gives confidence to the robustness of the selection of the preferred alternative. This is why quantitative methods are employed instead of or in addition to qualitative methods.

As the above methods were deemed acceptable through the consultation process and were not challenged by the public and the MOE, and as there are no "hard and fast" rules governing alternative selection methodology, it is concluded that the preferred alternative selection

methodology used is acceptable. It is noted, however, that a quantitative approach may be useful in confirming the identification of the preferred alternative.

We trust the enclosed to be satisfactory for your consideration. Please do not hesitate to contact our office should you have any question or comments concerning this submission.

Yours truly,

CONESTOGA-ROVERS & ASSOCIATES

Michael A. Benson, M.A., RPP

MAB/dma/2

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