
Sears Canada Inc. Soil Vapour Monitoring Report Winter 2019/2020 Hounsfield Heights and North Hill Mall Calgary, Alberta

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Soil Vapour Monitoring Report Winter 2019/2020 Hounsfield Heights and North Hill Mall, Calgary, Alberta

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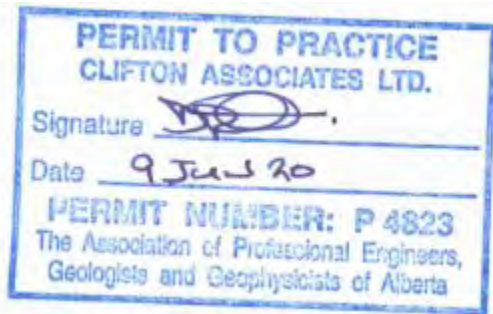
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Sears Canada Inc.

Soil Vapour Monitoring Report

Winter 2019/2020

Hounsfield Heights and North Hill Mall
Calgary, Alberta

Executive Summary

Clifton Associates Ltd. is pleased to present this Soil Vapour Monitoring Report Winter 2019/2020 prepared for the account of Sears Canada Inc. to the stakeholders. The Report describes in detail the methodology of soil vapour sample collection, Quality Assurance/Quality Control implementation and interpretation of soil vapour sampling results in the Hounsfield Heights community and North Hill Mall area within the City of Calgary conducted by Clifton in January and February 2020.

The soil vapour monitoring event described in this report constituted an extension of the soil vapour monitoring program with 3-years duration at the Site, stipulated in the document: Clifton Associates Ltd.: *Sears Canada Inc., Revised Soil Vapour Monitoring Program (Update Fall 2016), Hounsfield Heights and North Hill Mall, Calgary, Alberta*, 20 October 2016, and approved by AEP for the implementation at the Site. A total of 7 community-wide sampling events have been executed to date at the Site providing valuable data regarding the soil vapour concentrations distribution.

Clifton carried out the soil vapour monitoring event at the Site from 20 January 2020 to 7 February 2020. A total of 48 (44 primary soil vapour samples and 4 field duplicates) soil vapour samples were collected at external, nested and delineation monitoring points and analysed for Contaminants of Potential Concern (CoP) concentrations. There were no recorded exceedances for the investigated CoPCs compared either to the Soil Vapour Quality Guidelines protective of indoor air quality, soil vapour remediation guidelines protective of indoor air quality for a commercial building, or to the increased monitoring frequency trigger values.

The soil vapour analytical laboratory results collected during the Winter 2019/2020 monitoring event showed that a potential vapour intrusion pathway into the residential and commercial structures within the investigated area should not pose immediate health risk for the occupants, and therefore, an instantaneous application of exposure controls is not deemed necessary.

Soil vapour inhalation is currently only potentially active exposure pathway at the Site that might lead to a deleterious effect for the human health. Soil vapour monitoring at the Site should thus continue until the exposure risk to the residents at the Site can be considered eliminated. Collected information for the Site, in Clifton's opinion, supports the case for the recommended further course of the action and refinement of the soil vapour monitoring program at the Site outlined in Section 7.0 of this Report, providing regulatory approval.

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1.0 Introduction

Clifton Associates Ltd. (Clifton) is pleased to present this Soil Vapour Monitoring Report Winter 2019/2020 (Report) prepared for the account of Sears Canada Inc. to the stakeholders. The Report describes in detail the methodology of soil vapour sample collection, Quality Assurance/Quality Control (QA/QC) implementation and interpretation of soil vapour sampling results in the Hounsfield Heights area and North Hill Mall area within the City of Calgary (the Site) conducted by Clifton in January and February 2020.

The presented document is partially based on the previous environmental work completed for Sears in both the Mall area and the Hounsfield Heights area by Clifton and by Intrinsik Environmental Sciences Inc. (Intrinsik). Therefore, the presented document should be read and understood in conjunction with the following reports:

- Clifton Associates Ltd.: *Sears Canada Inc., Revised Soil Vapour Monitoring Program (Update Fall 2016), Hounsfield Heights and North Hill Mall, Calgary, Alberta*, 20 October 2016 (Revised SVMP);
- Clifton Associates Ltd.: *Sears Canada Inc., Soil Vapour Monitoring Points Installation Report, Hounsfield Heights and North Hill Mall, Calgary, Alberta*, 20 October 2016 (Installation Report);
- Clifton Associates Ltd.: *Subsurface Investigation-Mall Area and Hounsfield Heights*, 22 January 2016 (2016 SI);
- Clifton Associates Ltd.: *Updated Site Management Plan (2014), Hounsfield Heights-Briar Hill Community, Calgary, Alberta*, April 2014 (2014 Updated SMP);
- Intrinsik Environmental Sciences Inc.: *Draft Report-Human Health and Ecological Risk Assessment for the Hounsfield Heights Community and North Hill Mall Areas, Calgary, Alberta*, December 2015 (2015 HHERA); and
- Intrinsik Environmental Sciences Inc.: *Final Report-Development of Soil Vapour Quality Guidelines*, 31 August 2016.

The presented Report follows guidance, protocols, scientific rationale and best practices as outlined in the following documents:

- Alberta Environment and Parks: *Alberta Tier 1 Soil and Groundwater Remediation Guidelines*, 2019 (2019 AEP Tier 1 Guidelines);
- Alberta Environment and Parks: *Alberta Tier 2 Soil and Groundwater Remediation Guidelines*, 2019 (2019 AEP Tier 2 Guidelines);
- Canadian Council of Ministers of the Environment: *A Protocol for the Derivation of Soil Vapour Quality Guidelines for Protection of Human Exposures via Inhalation of Vapors*, 2014 (2014 CCME Protocol);
- British Columbia Ministry of Environment: *Technical Guidance on Contaminated Sites 4*, version 1, September 2010 (BC TG-4);

- Golder Associates Ltd.: *Guidance on Site Characterization for Evaluation of Soil Vapour Intrusion into Buildings*, Submitted to the British Columbia Ministry of Environment by Science Advisory Board for Contaminated Sites in British Columbia, May 2011 (2011 Golder Guidance);
- Health Canada: *Federal Contaminated Site Risk Assessment in Canada, Part VII: Guidance for Soil Vapour Intrusion Assessment at Contaminated Sites*, September 2010 (2010 HC); and
- Johnson, P.C., & R. Ettinger: *Heuristic Model for predicting the Intrusion Rate of Contaminant Vapours into Buildings*, 1991(J&E Model).

2.0 Project Background

Since 1998, site investigations have revealed the presence of PHCs in the subsurface soils and groundwater beneath City of Calgary properties in the Hounsfield Heights community in Calgary, Alberta. The source of the PHCs is a former gasoline station on the property owned by Sears located at the North Hill Shopping Centre as stipulated in the 2014 Updated SMP. Evidence suggests that gasoline may have leaked from underground fuel storage tanks prior to their removal in the mid-1990s when the gasoline station was decommissioned.

In 2006, Intrinsik (operating as Cantox Environmental at the time of the report) completed a risk assessment of the Hounsfield Heights area (Cantox 2006). The purpose of the assessment was to identify the potential health risks to people residing in the Hounsfield Heights community, as well as to ecological receptors that frequent the area, from the PHC-impacted subsurface soils and groundwater. Concentrations of various petroleum hydrocarbon constituents (e.g., benzene, toluene, ethyl benzene, xylenes-BTEX) and PHCs fractions (e.g., F1 and F2) measured in the soils and groundwater beneath the City-owned properties (e.g. parks, roads, and alleyways) were compared to the corresponding generic (Tier 1) guidelines from Alberta Environment and Parks (AEP) (formerly Alberta ESRD and Alberta Environment, “regulator”) for the protection of human health, safety, and the environment. In addition, site-specific (Tier 3) risk management guidelines were developed for selected petroleum hydrocarbons (i.e., benzene and the F1 PHC fraction). Overall, assessment results indicated that the potential for adverse effects to human health and ecological receptors was low. However, some uncertainties were identified surrounding the on-site impacts (i.e., Mall Area), presence of liquid petroleum hydrocarbons (LPH) off-site (Hounsfield Heights area), and an expanding dissolved phase plume off-site. These uncertainties were addressed through the implementation of remediation and monitoring programs.

Since 2006, a summary of the remediation and monitoring programs is as follows (2014 Updated SMP):

- Between 2006 and 2007, remedial excavation of the impacted soils in the Mall area was completed;
- Groundwater monitoring has continued within the Hounsfield Heights and Mall area at specific monitoring wells through a groundwater sampling program on an approximate bi-annual basis; and
- A dual-phase vapour extraction (DPVE) system was installed in 2008 to remove LPH in the Hounsfield Heights area. The system began running full time in 2011.

On 20 July 2012, AEP requested that Sears update its Site Management Plan for the Mall and Hounsfield Heights area and address the following points:

- Fully delineate the dissolved plume south of 11th Avenue NW;
- Sample the groundwater adjacent to where it discharges to the surface in the southern portion of Zone 3 (south of 11th Avenue NW) and evaluate it for risk to ecological receptors;
- Delineate the soil gas/vapour plume at the Site;
- Assess potential risks from indoor air infiltration of petroleum hydrocarbon vapours in areas where the vapour inhalation pathway exceeds guidelines, and in areas where it has been determined that elevated soil gas/vapours are present;
- Establish a soil gas monitoring program on properties that may be at risk from indoor air infiltration. Compare current needs with those previously identified in the Clifton April 5, 2007 response to Alberta Environment regarding the soil vapour monitoring;
- Implement additional remediation techniques to deal with the expanding dissolved phase plume;
- Review the groundwater monitoring and sampling program to ensure adequate coverage based on current conditions and trends; and
- Apply the 2014 AEP Tier 1 Guidelines to monitoring well locations along 11th Avenue NW and include these wells in the groundwater monitoring and sampling program.

In order to address these requirements, Clifton abandoned groundwater monitoring wells not meeting requirements in 2014, in preparation for a future environmental monitoring program. The next step (fall 2014-spring 2015) included the installation of 70 new groundwater monitoring wells coupled with a soil sampling program focused on better understanding of the soil stratigraphy south of 11th Avenue NW. In addition, the 2015 Subsurface Investigation included four rounds of the groundwater sampling in the Mall and Hounsfield Heights areas, as well as limited (five residences) indoor air quality monitoring.

Indoor air sampling locations were determined based on historically (i.e. before 2015 Site Investigation) measured benzene concentrations in groundwater monitoring wells that were above guidelines for the protection of the vapour inhalation exposure pathway as defined by the 2014 AEP Tier 1 Guidelines. One round of the indoor air sampling was conducted at five residential properties located along 11th Avenue NW.

In addition, the indoor air sampling also included one sub-slab soil gas sample from one of the residential properties. For collected data and description of the sampling methodology refer to 2015 HHERA, Table D-1. This data was not included as part of the identification of Chemicals of Potential Concern (CoPCs) but were used as part of additional lines of evidence in Risk Characterization for 2015 HHERA completed by Intrinsik.

The 2015 HHERA included detailed investigation of the vapour inhalation pathway for human receptors present at the Site for both soil and groundwater and compared the results against the Residential/Parkland Land Use Guidelines (Hounsfield Heights area) and Commercial Land Use Guidelines (North Hill Mall area) as defined by AEP Tier 1 and 2 Guidelines. The following CoPCs in soil at the Site were identified for the vapour inhalation pathway:

Table 2.1 – Constituents identified as CoPCs by the 2015 HHERA in soil for vapour inhalation pathway and human receptors at the Site¹

Constituent in Soil	Hounsfield Heights Area (Residential/Parkland Land Use)	North Hill Mall Area (Commercial Land Use)
Petroleum Hydrocarbons		
Benzene	YES	YES
Toluene	NO	NO
Ethylbenzene	NO	NO
Xylenes	YES	NO
F1-BTEX (C ₆ —C ₁₀)	YES	NO
F2 (C ₁₀ —C ₁₆)	YES	NO
Polycyclic Aromatic Hydrocarbons (PAHs)		
Naphthalene	YES	NO
Volatile Organic Compounds (VOCs)		
1,2 Dichloroethane (1,2-DCA)	YES	YES

The following CoPCs in groundwater at the Site were identified for the vapour inhalation pathway:

¹ Please note that other constituents in soils may be present at the Site in concentrations exceeding different exposure pathways for human and ecological receptors as defined by the 2019 AEP Tier 1 Guidelines but are not part of the objectives of this SVMP.

Table 2.2 – Constituents identified as CoPCs by the 2015 HHERA in groundwater for vapour inhalation pathway and human receptors at the Site²

Constituent in Groundwater	Hounsfield Heights Area (Residential/Parkland Land Use)	North Hill Mall Area (Commercial Land Use)
Petroleum Hydrocarbons		
Benzene	YES	NO
Toluene	NO	NO
Ethylbenzene	NO	NO
Xylenes	YES	NO
F1-BTEX (C ₆ —C ₁₀)	YES	NO
F2 (C ₁₀ -C ₁₆)	NO	NO
Polycyclic Aromatic Hydrocarbons (PAHs)		
Naphthalene	NO	NO
Volatile Organic Compounds (VOCs)		
1,2 Dichloroethane (1,2-DCA)	YES	NO

Based upon the results of the 2015 Subsurface Investigation, Intrinsic prepared and submitted to the regulator an updated HHERA for the Site in December 2015. The 2015 HHERA recommended implementing a soil vapour monitoring program for assessing vapour inhalation and possible infiltration into indoor air, which should meet the following guiding principles:

- The program should provide broader spatial measurement of soil-gas concentrations in the Hounsfield Heights Area. Soil vapour monitoring locations should take into consideration the PHC levels present in groundwater throughout the community and the Site-specific geology;

² Please note that other constituents in groundwater may be present at the Site in concentrations exceeding different exposure pathways for human and ecological receptors as defined by the 2019 AEP Tier 1 Guidelines but are not part of the objectives of this SVMP.

- The program should include the installation of vapour monitoring points that collect soil-gas at multiple depth intervals. Ideally, three collection intervals would be installed with the lowest interval located above the groundwater and the upper interval located 2 to 3 metres below ground surface. The middle interval would be evenly spaced between the upper and lower interval. This would allow calculation of site-specific attenuation coefficients, which includes natural diffusion and biodegradation; and
- The vapour monitoring points should be located in areas that would not restrict access (e.g., public areas) to allow for repeated sampling at fixed time intervals throughout the year.

In order to address the regulator's requirements and recommendations contained in the 2015 HHERA regarding the soil vapour delineation at the Site and assessment of potential presence of an active vapour intrusion pathway, Clifton prepared and submitted Revised SVMP on 20 October 2016. The following sections of this Report describe implementation of the methods outlined in the Revised SVMP.

3.0 Site Overview

The Site consists of two distinctive portions separated by 14th Avenue NW - the Hounsfield Heights area and the North Hill Mall (Mall) area:

- The Hounsfield Heights area is bound by: the southern edge of the LRT line to the north; 14th Street NW to the east; 10th Avenue SW (extending west to 17A Street NW) to the south; and, 17A Street NW to the west. The area is zoned as residential, as it primarily consists of single detached dwellings with basements. There are three areas of the Site that are zoned as Special Purpose: Hounsfield Heights Park; a parcel of land along 10th Avenue SW between 16th Street NW and 16th A Street NW; and, the area between the LRT line and 13th Avenue NW.
- The Mall area is bound by: 16th Avenue NW to the north; 14th Street NW to the east; the northern edge of the LRT line to the south; and, to the west by the western edge of the North Hill Centre property and a line extending south to the northern edge of the LRT line.

Capitol Hill, a residential area, is located to the north of the Site. To the east is SAIT Polytechnic and the Alberta College of Art + Design. Hillhurst and Briar Hill, both residential areas, are found south and west of the Site, respectively. The Site layout and land use are shown in Appendix A, Figures 1 and 2.

The Site topography is characterized by a gently south-sloping river valley plateau on the northern portion of the Site, and a more moderately sloping valley wall towards the southeast portion. The Site varies in elevation from approximately 1,094 m above sea level in the northwestern corner along 13th Avenue NW, to approximately 1,068 m above sea level in the southeastern corner, north of the intersection of 15th Street NW and 10th Avenue NW.

4.0 Objective and Scope of Work

The principle objective of the executed Soil Vapour Monitoring Program (SVMP) was to evaluate potential risk to human health from inhalation of subsurface vapours in indoor air in both residential and commercial structures present at the Site. To address this objective, Clifton carried out the following Scope of Work within the SVMP:

- Collected representative soil vapour samples from areas identified by 2015 Site Investigation as having CoPCs concentrations in groundwater or soil exceeding the 2019 AEP Tier 1 Guidelines for the vapour inhalation exposure pathway;
- Sampled nested soil vapour monitoring points at locations representing changing stratigraphy of the Site to provide representative data for evaluation of the Site-specific vertical soil vapour migration and biodegradation;
- Sampled soil vapour monitoring locations constituting lateral transects to facilitate lateral delineation of the soil vapour plume extent at the Site;
- Forwarded collected soil vapour and air samples to Bureau Veritas Laboratories (BV Laboratories) under Chain-of-Custody protocols for laboratory analyses of CoPCs;
- Implemented QA/QC procedures to assure quality and defensibility of the collected data;
- Compared CoPCs concentrations in soil vapour from soil vapour monitoring points against the Site-specific soil vapour quality guidelines developed based on the 2014 CCME Protocol by Intrinsik; and
- Compared CoPCs concentrations in soil vapour from soil vapour monitoring points against trigger threshold values for additional investigation set as 90% of guidelines.

5.0 Sampling Methodology

The following sections provide a description of the soil vapour, sub-slab soil vapour and indoor air sampling methodologies. Where applicable, activities were completed as per *Compendium of Methods for the Determination of Compounds in Ambient Air, Second Edition, Compendium Method TO-15, Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially-prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GCMS)*. EPA/625/R96/01b, 1999.

The laboratory analytical and quality assurance/quality control (QA/QC) programs are also described in the following section.

5.1 Soil Vapour Monitoring Points

In order to achieve required resolution of the laboratory detection limits for investigated constituents (especially 1,2 – DCA), and to extend validity of collected samples, Clifton collected soil vapour samples in 1.4L Summa™ canisters, which were proofed and cleaned by the laboratory as per the United States Environmental Protection Agency (USEPA) reference method TO-14A. The sampling train included: an orifice equipped flow controller calibrated for a sampling rate of 70 mL/min; and, a length of the dedicated PTFE tubing with stainless steel fitting to connect to a valve at the top of the soil vapour monitoring point.

Before any sampling, Clifton completed a seal integrity check of the monitoring point using helium tracer. All monitoring points meeting seal integrity criteria were subsequently purged by the SKC PGX-R8 vacuum pump calibrated for a flow rate of 70 mL/min for 20 minutes. Purging vacuum rate did not exceed 10" (254 mm) of water column in order to avoid excessive moisture influx to the radius of influence.

The soil vapour sampling also included: measuring the initial and final Summa™ canister vacuum levels by standalone vacuum gauge; recording the start and finish time of the sampling; monitoring point identifier check; and weather observations, including barometric pressure and precipitation at the time of sampling. The stainless-steel valve installed at the top of a soil vapour monitoring point were kept in a closed position, except when purging and sampling. Layout of the soil vapour monitoring points installed at the Site is shown in Appendix A, Figure 3.

5.2 Sub-Slab Soil Vapour Monitoring Points

The sub-slab monitoring point installed at the residential property on 11 Avenue NW as a part of the soil vapour monitoring program was not sampled during this event at the request of the homeowner.

5.3 Indoor Air Quality Sampling

Indoor air quality sampling to be carried out concurrently with sub-slab soil vapour sampling within the same property at 11 Avenue NW not carried out for the reasons described in Section 5.2.

5.4 Quality Assurance/Quality Control (QA/QC)

A comprehensive QA/QC program was implemented to ensure that the sampling and analyses follow established protocols and provide defensible, representative results. The program included all aspects of data collection from the field to the laboratory.

The field QA/QC consisted of the following components:

- Labelling air sampling containers with the specific sample number to ensure adequate identification;
- Using laboratory-prepared batch-proofed and cleaned air sampling containers cleaned as per USEPA TO-14A reference method;
- Conducting a 5-minutes shut-in test on sampling trains to eliminate any potentially leaking part of the train that might introduce a negative bias into the collected soil vapour sample;
- Conducting helium tracer competent seal integrity testing by creating and recording an initial helium shroud above monitoring point, maintaining helium shroud during pre-sampling purge and recording final helium concentration in the sampling train to prove that seal integrity of a soil vapour monitoring point was not compromised and collected soil vapour sample will be representative;
- Limiting purging vacuum to a flow rate of 70 mL/min (i.e., less than 254 mm of water column) in order to avoid excessive moisture influx to the radius of influence;
- Collecting field duplicates at a rate of 1 duplicate per 10 primary samples and evaluating Relative Percent Difference (RPD) ratio using the following equation:

$$\text{RPD (\%)} = [\text{abs}(x_1 - x_2) / (x_1 + x_2) / 2] * 100^3$$

- Measuring initial vacuum levels at the sampling canisters by the standalone vacuum gauge to ensure initial sampler integrity;
- Measuring final vacuum levels at the sampling canisters by the standalone vacuum gauge to avoid a potential for soil vapour sample infectivity during the transport to analytical laboratory;
- Evaluating weather conditions throughout the sampling process duration that might affect recorded soil vapour concentrations;
- Forwarding collected samples under the Chain-of-Custody protocols to an accredited analytical laboratory; and
- Reviewing the laboratory quality assurance data.

QA/QC results and weather observations are discussed in Sections 6.3 and 6.4 of this Report.

5.5 Analytical Suite and Methods

Clifton selected to use soil vapour analytical methods compatible with performance-based reference method USEPA TO-15 based on the gas chromatography and mass spectrometry (GC/MS). All CoPCs for the vapour inhalation pathway as identified by the 2015 HHERA were investigated. Therefore, the proposed analytical suite included the following:

- PHCs fraction F1⁴;
- PHCs fraction F2⁵;
- BTEX (benzene, toluene, ethylbenzene, xylenes);
- Naphthalene;
- 1,2 Dichloroethane (1,2-DCA); and
- Matrix Gases (O₂, N₂, CO₂, CH₄)⁶

Clifton used BV Laboratories as a provider of the laboratory services for this SVMP. BV Laboratories are accredited analytical laboratory under ISO 9001 Standard, ISO 14001 Standard and are certified by the Standards Council of Canada.

6.0 Sampling Results

6.1 Selection of Assessment Criteria

³ Where x_1 and x_2 are concentration parameters for the primary and secondary sample.

⁴ Expressed in form of the constituting aliphatic and aromatic sub-fractions.

⁵ Expressed in form of the constituting aliphatic and aromatic sub-fractions.

⁶ Applicable for soil vapour samples collected from sub-slab, nested monitoring points and external soil vapour monitoring points located in the vicinity of the residential properties.

The selection of the assessment criteria outlines the rationale for selecting applicable exposure pathways and indicates which guidelines should apply at the investigated Site. This evaluation is based on guidance presented in the documents further referenced in the text.

The owners of the two residential properties located in the Hounsfield Heights area, declared a presence of the crawl spaces with earthen floors during the “door-to-door” survey at the Site. Clifton contacted these owners with an offer of an indoor air quality monitoring and sub-slab soil vapour monitoring point installation for their property. Both owners declined the offer, therefore Clifton used the following conservative approach to estimate indoor air quality in these structures based on the Revised SVMP, Section 6.1:

- An external soil vapour monitoring point located in the shortest distance from the property was used for a rough estimate of indoor air quality. No allowance was made for either lateral or vertical biodegradation of soil vapour regardless of the soil vapour monitoring point installation depth, i.e., recorded concentrations of CoPCs in soil vapour were directly projected within the property and compared against SVQG for depth of 0 m bgs (Appendix B, Tables 3 and 4).

Soil vapour sampling analytical results were generally compared to SVQG for fine-textured soils and protective of indoor air quality for a residential building (Appendix B, Tables 5 -15 B), or a commercial building (Appendix B, Table 16) based on the installation depth. 2014 CCME Protocol assumes that at least 1 m of clean soil is present immediately beneath the building as a condition for validity of the provided SVQG derivation model. Considering shallow groundwater in a portion of the Site to the south of 11th Avenue NW and default basement depth 2.44 m bgs (2019 Alberta Tier 1), this assumption may not be met for soil vapour monitoring points listed in Appendix B, Tables 5 and 6. Analytical results for these monitoring points were thus compared to SVQG based on the default attenuation factors.

In addition, AEP approved on a trial basis increased monitoring frequency triggers for soil vapour and sub-slab soil vapour monitoring points at the Site. These trigger values were set at 90% of a pertaining SVQG for CoPC. Comparison of analytical results to the trigger values is shown in Appendix B, Tables 5-15B.

6.2 Sampling Results

External Soil Vapour Monitoring Points

Clifton carried out the soil vapour monitoring event at the Site from 20 January 2020 to 7 February 2020. A total of 48 (44 primary soil vapour samples and 4 field duplicates) soil vapour samples were collected at external, nested and delineation monitoring points and analysed for CoPC concentrations. There were no recorded exceedances for the investigated CoPCs compared either to the SVQG protective of indoor air quality, soil vapour remediation guidelines protective of indoor air quality for a commercial building, or to the increased monitoring frequency trigger values.

Distribution of the investigated CoPCs in soil vapour at the Site based on the analytical results for the Winter 2019/2020 sampling event is shown in Appendix A. Analytical Results Tables for these soil vapour monitoring points are presented in Appendix B, Tables 5-15B. A summary of all historical soil vapour results for each probe is provided in Appendix C.

Soil vapour monitoring points SV 27, and SV 13 (nested soil vapour monitoring point) were not sampled during this monitoring event for the following technical reasons:

- SV27 – a rip found in the connection between the sampling insert and head valve precluding collection of the representative soil vapour sample. The soil vapour monitoring sample will require a repair before next sampling event; and
- SV13 – sampling trains frozen solid in the ground, attempts at defrosting were abandoned to prevent further damage to this sampling point.

Estimates of Indoor Air Quality

A rough estimate of indoor air quality for properties with reported unusual features such as earthen crawl spaces is based on the soil vapour samples collected from the nearest soil vapour monitoring points. Sample ID 15/9857 and ID 19/9768 were used for these purposes. Albeit these monitoring points have installation depths of 6.0 m bgs (SV15), and 5.5 m bgs (SV19), respectively, no allowance was made for vertical or horizontal biodegradation to add a level of conservatism to the estimate. Analytical Results Tables for these soil vapour monitoring points are presented in Appendix B, Tables 3 and 4.

In addition, the same method to estimate indoor air quality was used for the residential properties located at 10th Avenue NW and 15th Street NW, respectively. Additional soil vapour monitoring points in the immediate vicinity of these properties were installed as a part of the regulatory-approved Risk Management and Contingency Plan implementation following recorded exceedances of SVQG at SV32 in winter and spring 2019. Clifton installed two additional soil vapour monitoring points in the immediate vicinity of the residential property at 10th Avenue NW on 13 May 2019.⁷ Both monitoring points were installed in an approximate distance of 1.0 m from the foundations of the residence. A total installation depth of 1.0 m bgs was selected considering water table elevation at the location. One of the points (ID SV321) was installed directly between soil vapour monitoring point SV32 and residence. Soil vapour monitoring point SV322 was installed along the west wall of the structure.

On 12 November 2019, one additional soil vapour monitoring point (ID SV323) was installed in an approximate distance of 1.0 m from the foundation of the residential structure on 15th Street NW to a total installation depth of 1.0 m bgs.⁸

⁷ Refer to the report: Clifton Associates Ltd.: Sears Canada Inc., *Supplemental Soil Vapour Monitoring Points Installation and Monitoring Report, Hounsfeld Heights and North Hill Mall, Calgary, Alberta*, 10 June 2019, for further details.

⁸ Refer to the report: Clifton Associates Ltd.: Sears Canada Inc., *Supplemental Soil Vapour Monitoring Point Installation and Monitoring Report, Hounsfeld Heights and North Hill Mall, Calgary, Alberta*, 13 January 2020, for further details.

Analytical results for the soil vapour samples collected from the soil vapour monitoring points SV321, SV322 and SV323 were compared to SVQG based on default attenuation factors using the methodology described in Section 6.1. No exceedances for CoPCs criteria protective of indoor air quality were recorded, thus an active vapour intrusion pathway into these structures (if present) should not pose immediate health risk for the occupants. Analytical Results Tables for these soil vapour monitoring points are presented in Appendix B, Tables 1 and 2.

6.3 QA/QC Results

A total of four field duplicates (Sample IDs 910/9772, 932/9776, 917 and 920) were collected and analyzed for CoPCs during sampling as a part of QA/QC program. These duplicates were compared against primary samples and RPD values were calculated. USEPA TO-15 method recommends the RPD difference to be below 25%. Summary of field duplicates analytical results and the RPD calculations are presented in Appendix D, Table 2.

The RPD values for PHCs aliphatic sub-fraction >C12-C16 (samples 17 and 917), and toluene (samples 20 and 920) exceeded the recommended threshold of 25%. RPD threshold for other duplicates and investigated constituents were below recommended threshold. RPD exceedances were investigated with the analytical laboratory and were likely caused by an interference caused by moisture present in sampling canisters and differences in final vacuum levels between primary and duplicate sample.

Prior to the sampling, soil vapour monitoring points were tested for seal integrity by a helium tracer gas method. Test results are summarized in Appendix D, Tables 1 A -1 D. The threshold limit applied was at least 95% differential between recorded initial He shroud concentration and final recorded concentration of He in the sampling train after purging. Final He shroud concentration was also recorded as a part of the process to ensure that He was still present in a significant concentration. All soil vapour monitoring points passed these integrity criteria.

6.4 Meteorological Conditions

As ambient meteorological conditions, especially precipitation and barometric pressure, might affect soil vapour sampling, Clifton conducted limited meteorological observations during sampling, which are summarized in the following table:

Table 6.1 – Summary of Meteorological Conditions – Sampling Event Winter 2019/2020^{9,10}

Date	Average Wind Speed (km/h)	Average Wind Direction	Total Precipitation (mm)	Barometric Pressure (kPa)	Pressure Tendency
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⁹ Based on the Calgary International Airport meteorological station data as recorded at 12:00 pm for each sampling day.

¹⁰ Weather data stated only for the actual sampling days.

20 January 2020	15	SSW	0.0	101.27	Falling
21 January 2020	4	N	0.0	100.72	Falling
23 January 2020	7	SW	0.0	101.32	Falling
28 January 2020	9	SW	0.0	101.39	Rising
29 January 2020	15	S	0.0	101.33	Rising
30 January 2020	22	W	0.0	102.18	Falling
31 January 2020	11	S	0.0	101.19	Falling
4 February 2020	15	SW	0.0	101.58	Falling
5 February 2020	13	W	0.0	100.57	Falling
6 February 2020	19	NW	0.0	101.01	Rising
7 February 2020	11	W	0.0	101.63	Falling

As apparent from the presented meteorological data, no major precipitation events occurred and barometric pressure had predominantly falling trend throughout the soil vapour sampling duration, therefore, prevalent weather conditions were unlikely to affect recorded soil vapour concentrations.

6.5 Organic Vapour in Groundwater

To investigate possible correlation between CoPCs in groundwater and soil vapour at the Site, Clifton recorded organic vapour (OVA) concentrations present in the headspace at two groundwater monitoring wells installed in proximity to the soil vapour monitoring point SV32:

- Groundwater monitoring well BH1947 located approximately 12 m south west of SV32; and
- Groundwater monitoring well BH1948 located approximately 25 m north of SV32.

OVA concentrations were measured concurrently with the soil vapour collection at SV32 using an appropriately calibrated photo-ionization detector. OVA concentrations at both investigated groundwater monitoring wells were below the detection limit of the analyzer.

It should be however noted that neither BH1947, nor BH1948 are completed in water-bearing strata closest to the surface in this portion of the Site (Unit 3), and as a result, the OVA readings presented above may not fully represent the relationship between COPCs concentration in groundwater and soil vapour concentration in the location around SV32.

7.0 Discussion of Results and Recommendations

A total of 48 soil vapour samples were collected at external, nested and delineation monitoring points and analysed for CoPC concentrations throughout the duration of the Winter 2019/2020 soil vapour monitoring event. There were no recorded exceedances for the investigated CoPCs compared either to the SVQG protective of indoor air quality, soil vapour remediation guidelines protective of indoor air quality for a commercial building, or to the increased monitoring frequency trigger values.

The soil vapour analytical laboratory results collected during the Winter 2019/2020 monitoring event showed that a potential vapour intrusion pathway into the residential and commercial structures within the investigated area should not pose immediate health risk for the occupants, and therefore, an instantaneous application of exposure controls is not deemed necessary.

Soil vapour monitoring event described in this report constituted an extension of the soil vapour monitoring program with 3-years duration at the Site, stipulated in the document: Clifton Associates Ltd.: *Sears Canada Inc., Revised Soil Vapour Monitoring Program (Update Fall 2016), Hounsfield Heights and North Hill Mall, Calgary, Alberta*, 20 October 2016, and approved by AEP for the implementation at the Site. A total of 7 community-wide sampling events were to the date executed at the Site providing valuable data regarding soil vapour concentrations distribution.

Soil vapour inhalation is currently only potentially active exposure pathway at the Site that might lead to a deleterious effect for the human health. Soil vapour monitoring at the Site should thus continue until the exposure risk to the residents at the Site can be considered eliminated. Collected information, and recently approved Revised Remediation Plan (RRP) for the Site in our opinion support the case for the following recommended further course of the action and refinement of the soil vapour monitoring program at the Site provided an approval of the Regulator:

Based on the recorded soil vapour concentrations distribution recorded throughout the community-wide soil vapour sampling events executed to the date, the Site can be divided into three distinctive areas:

- Area A – The North Hill Mall;
- Area B – Area including and between Lions Park and 11th Avenue NW; and
- Area C – Area between 11th Avenue NW and 10th Avenue NW.

Area A – Area A contains 2 soil vapour monitoring points (SV1 and SV2) installed in the vicinity of the Kal-Tire building. Soil vapour concentration data collected at these points during 7 sampling events do not show any exceedances of the soil vapour remediation guidelines protective of indoor air quality for a commercial building on fine-textured soil as derived by Intrinsik in 2016. Collected monitoring data thus imply that likelihood of the soil vapour intrusions in concentrations considered as a potential health hazard into the Kal-Tire building is negligible.

Clifton therefore recommends discontinuing of the regular soil vapour monitoring in this area. However, soil vapour monitoring points SV1 and SV2 should be maintained in good working order and used for a confirmatory sampling after the RRP for the Site is concluded.

Area B – Soil vapour monitoring points in this area did not record any exceedances of the soil vapour quality guidelines protective of indoor air quality for residential buildings determined by Intrinsik. Soil vapour concentration data collected during 7 monitoring events in this area were predominantly below the Reportable Detection Limits for the investigated constituents, or an order of magnitude below the applicable guidelines. Based on the collected monitoring data, the likelihood of the soil vapour intrusions in concentrations considered as a potential health hazard into the residential buildings in the area can be considered as very low.

Clifton recommends discontinuing of the regular soil vapour monitoring in this area. Soil vapour monitoring points installed in the area should be maintained in good working order and used for a confirmatory sampling after the RRP for the Site is concluded. Additional sampling should be also conducted if high organic vapour readings, or groundwater contamination exceedances in the area are recorded.

Area C – This area includes soil vapour monitoring points installed along 11th Avenue NW and to the south of 11th Avenue NW. Based on the collected soil vapour monitoring data, the area at the time being should be considered as an area where soil vapour intrusions in concentrations considered as a potential health hazard into the residential buildings in the area cannot be excluded. This conclusion is consistent with known geology of the Site (proximity of water table to the surface, undeveloped protective clay strata). Until the RRP for the Site is completed, special attention must be paid to south east extremity of the area where exceedances of the applicable soil vapour guidelines were recorded in Winter and Spring 2019.

Soil vapour monitoring points SV32, SV321, SV322 and SV323 are thus recommended to re-sampled seasonally (i.e., next sampling should occur in May or June 2020) until 5 consecutive readings below the applicable guidelines are recorded. In Area C as a whole, the soil vapour monitoring program should continue with sampling executed at least twice a year in the winter and summer.

In lieu of the continuation of the regular soil vapour monitoring in Areas A and B, Clifton proposes the following refinement/expansion of the soil vapour monitoring program in the Area C:

- To improve soil vapour concentrations delineation in the area, installation of additional (3-4) soil vapour monitoring points in the same laneway as SV32, with one of these additional soil vapour points potentially located immediately south of 10th Avenue NW; and
- To better understand the relationship between groundwater contamination and soil vapour concentration in the Area, Clifton recommends installing 2 groundwater monitoring wells completed in Unit 3, located up- and downstream of the groundwater flow direction relative to SV32.

Any possible additional soil vapour-related mitigation action recommended at the Site will depend on the results obtained from additional environmental investigation described above.

8.0 Closure

This report was prepared by Clifton Associates Ltd. for the account of Sears Canada Inc. The material in it reflects Clifton Associates Ltd. best judgment available to it at the time of preparation. Any use that a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Clifton 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.

This report has been prepared in accordance with generally accepted engineering practice common to the local area. No other warranty expressed or implied is made.

This report focuses exclusively at indoor air quality in the investigated buildings. No conclusions should be made based on this report regarding any concentrations of substances in other areas of the Site. Other Contaminants of Concern may be present at the Site in areas that were not investigated. Clifton Associates Ltd. accepts no responsibility for any deficiencies or inaccuracies in the information provided in this report that are the direct result of intentional or unintentional misrepresentations, errors or omissions of the persons interviewed, or information reviewed.

No environmental site investigation or remediation can wholly eliminate uncertainty regarding environmental conditions in connection with a property. This investigation is intended to reduce, but not eliminate the uncertainty regarding environmental conditions. Conclusions regarding the condition of the Site do not represent a warranty that all areas within the site and beneath structures are of the same quality as those sampled. Further, contamination could also exist in forms not indicated by the investigation.

The work was based in part upon the environmental quality guidelines and regulations in effect when the work was begun. Future regulatory changes may require reassessment of the findings of this investigation.

Reference List

Clifton Associates Ltd.: *Supplemental Soil Vapour Installation and Monitoring Report, November 2019, Hounsfield Heights and North Hill Mall, Calgary, Alberta*, 13 January 2020

Clifton Associates Ltd.: *Soil Vapour Monitoring Report, Summer 2019, Hounsfield Heights and North Hill Mall, Calgary, Alberta*, 23 October 2019

Clifton Associates Ltd.: *Supplemental Soil Vapour Installations and Monitoring Report, Hounsfield Heights and North Hill Mall, Calgary, Alberta*, 20 June 2019

Clifton Associates Ltd.: *Soil Vapour Monitoring Report, Winter 2019, Hounsfield Heights and North Hill Mall, Calgary, Alberta*, 15 April 2019

Clifton Associates Ltd.: *Soil Vapour Monitoring Report, Summer 2017 and Spring 2018, Hounsfield Heights and North Hill Mall, Calgary, Alberta*, 4 May 2018

Clifton Associates Ltd.: *Soil Vapour Monitoring Report, Spring 2016, Hounsfield Heights and North Hill Mall, Calgary, Alberta*, 8 December 2016

Alberta Environment and Parks. (2019). *Alberta Tier 1 Soil and Groundwater Remediation Guidelines*

Alberta Environment and Parks. (2019). *Alberta Tier 2 Soil and Groundwater Remediation Guidelines*

The United States Environmental Protection Agency. *Compendium of Methods for the Determination of Compounds in Ambient Air, Second Edition, Compendium Method TO-15, Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially-prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GCMS)*. EPA/625/R96/01b, 1999.

Clifton Associates Ltd.: *Subsurface Investigation-Mall Area and Hounsfield Heights*, 22 January 2016

Clifton Associates Ltd.: *Updated Site Management Plan (2014), Hounsfield Heights-Briar Hill Community, Calgary, Alberta*, April 2014

Intrinsik Environmental Sciences Inc.: *Draft Report, Human Health and Ecological Risk Assessment for the Hounsfield Heights Community and North Hill Mall, Calgary, Alberta*, December 2015

Canadian Council of Ministers of the Environment: *A Protocol for the Derivation of Soil Vapour Quality Guidelines for Protection of Human Exposures via Inhalation of Vapors*, 2014

British Columbia Ministry of Environment: *Technical Guidance on Contaminated Sites 4*, version 1, September 2010

Health Canada: *Federal Contaminated Site Risk Assessment in Canada, Part VII: Guidance for Soil Vapour Intrusion Assessment at Contaminated Sites*, September 2010

Johnson, P.C., & R. Ettinger: *Heuristic Model for predicting the Intrusion Rate of Contaminant Vapours into Buildings*, 1991

Pennsylvania Department of Environmental Protection: *Land Recycling Program Technical Guidance for Vapor Intrusion into Buildings from Groundwater and Soil under Act 2*. 2015.

Clifton Associates Ltd.: *Sears Canada Inc., Revised Soil Vapour Monitoring Program (Update Fall 2016), Hounsfield Heights and North Hill Mall, Calgary, Alberta*, 20 October 2016.

Clifton Associates Ltd.: *Sears Canada Inc., Soil Vapour Monitoring Points Installation Report, Hounsfield Heights and North Hill Mall, Calgary, Alberta*, 20 October 2016.

Appendix A

Clifton Associates Figures

Clifton Associates



Calgary Office

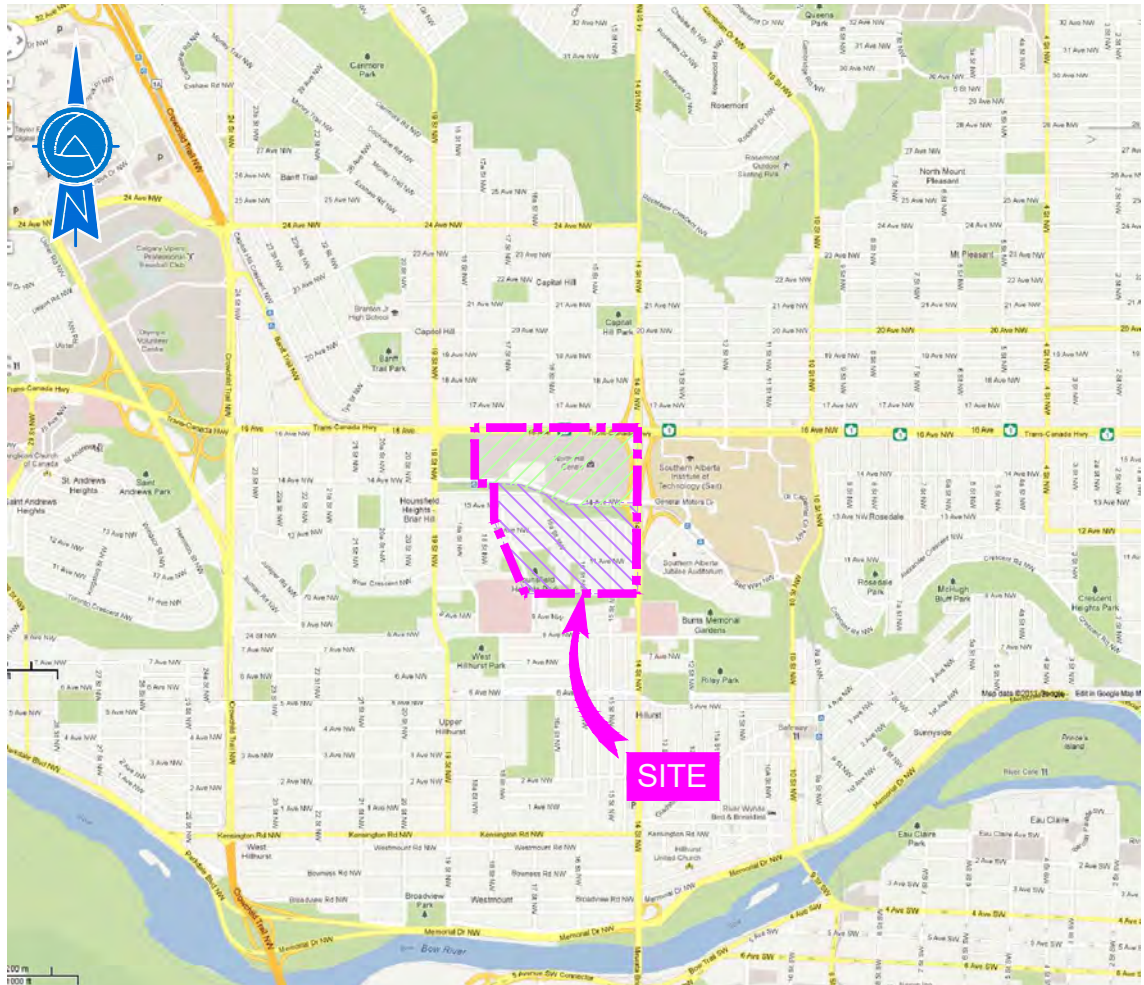
2222 30th Avenue NE
Calgary, Alberta T2E 7K9

T (403) 263 2556

F (403) 234 9033

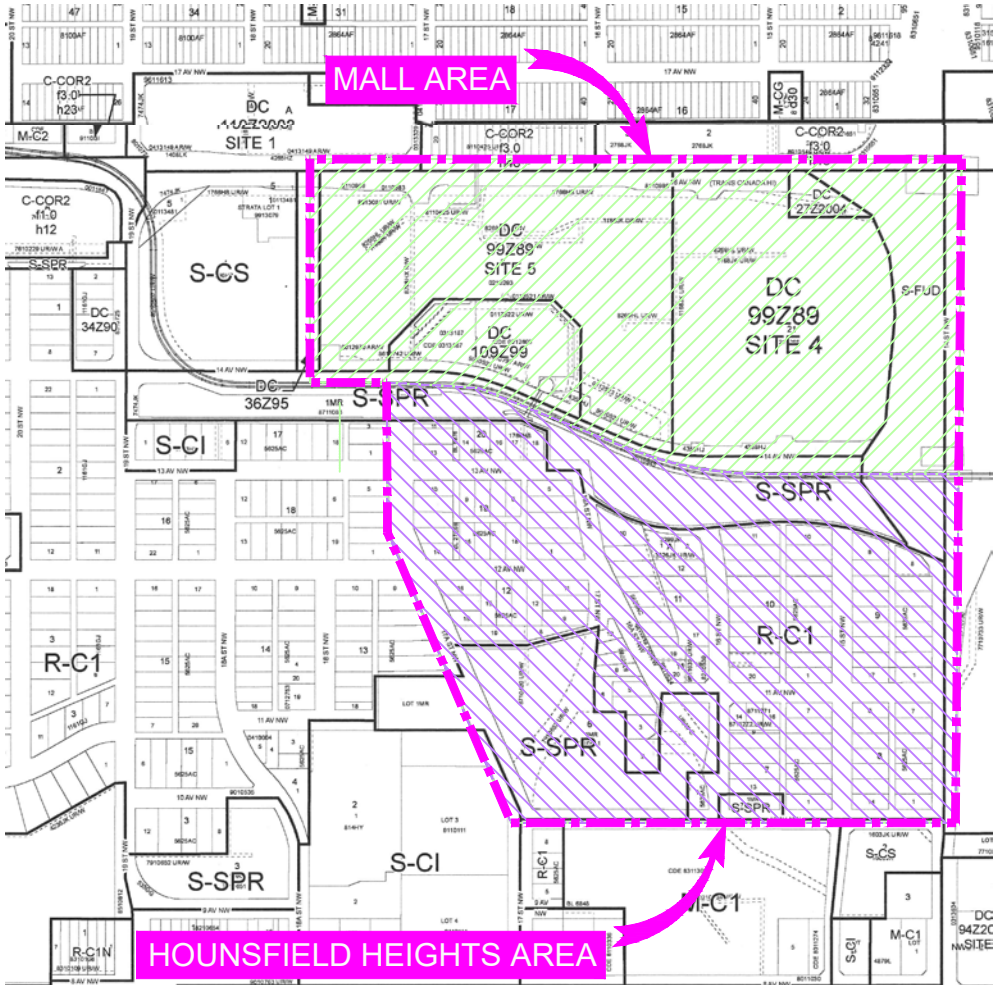
calgary@clifton.ca

www.clifton.ca



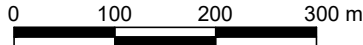
GENERAL SITE LOCATION

SCALE 1:30,000



SURROUNDING LAND USE

SCALE 1:7,500



LEGEND:

SITE BOUNDARY	
MALL AREA	
HOUNSFIELD HEIGHTS AREA	
CITY OF CALGARY BY-LAW ZONING	

LAND USE DISTRICTS:

RESIDENTIAL - CONTEXTUAL ONE DWELLING DISTRICT	R-C1
MULTI-RESIDENTIAL - CONTEXTUAL LOW-PROFILE DISTRICT	MC-1
MULTI-RESIDENTIAL - CONTEXTUAL GRADE-ORIENTED DISTRICT	MC-G
COMMERCIAL - CORRIDOR 2 DISTRICT	C-COR2
SPECIAL PURPOSE - SCHOOL, PARK, AND COMMUNITY RESERVE DISTRICT	S-SPR
SPECIAL PURPOSE - COMMUNITY INSTITUTION DISTRICT	S-CI
SPECIAL PURPOSE - COMMUNITY SERVICE DISTRICT	S-CS
SPECIAL PURPOSE - FUTURE URBAN DEVELOPMENT DISTRICT	S-FUD
DIRECT CONTROL DISTRICT	DC

NOTES:

1. CITY OF CALGARY ROAD MAP PROVIDED BY CANADIAN CARTOGRAPHICS CORPORATION, 2012.
2. LAND USE MAP PROVIDED BY THE CITY OF CALGARY.

ENGINEER	
CLIENT	SEARS
PROJECT	SOIL VAPOUR MONITORING REPORT WINTER 2019 / 2020 HOUNSFIELD HEIGHTS AND NORTH HILL MALL CALGARY, ALBERTA
TITLE	SITE LOCATION AND SURROUNDING LAND USE
DESIGNED	SCALE AS SHOWN DATE 2020-05-27
DRAWN	PROJECT NO. CG2430.1 E47 FIG. 1
CHECKED	FILE NO. CG2430.1-E47-1



LEGEND:

SITE BOUNDARY

MALL AREA

HOUNSFIELD HEIGHTS AREA

NOTES:

1. AERIAL PHOTOGRAPH PROVIDED BY GOOGLE EARTH PRO. AIR PHOTO DATE: OCT 23, 2015.

0 50 100 150 200 250 m

SCALE 1:5000 PLOT SIZE 11x17

ENGINEER

CLIENT

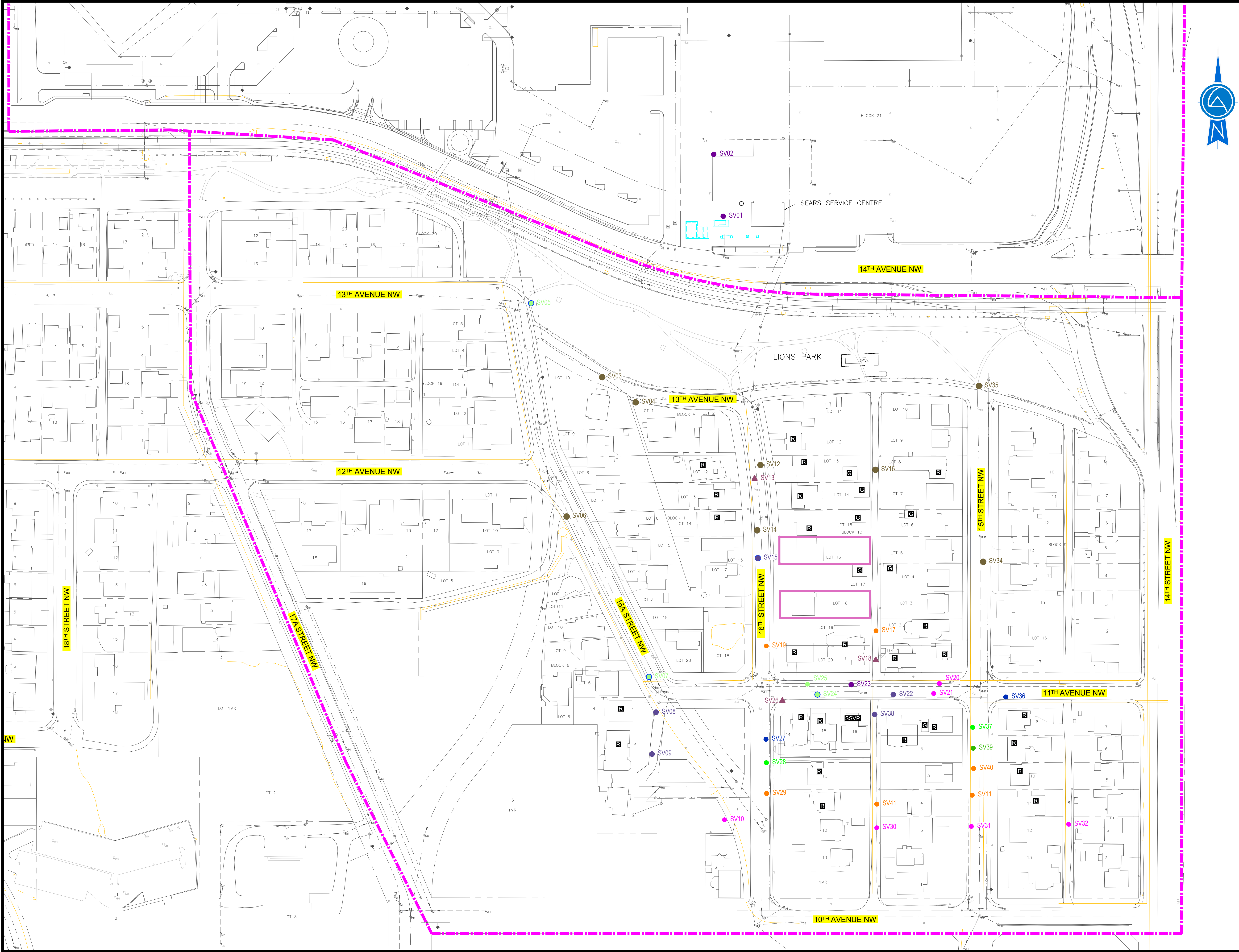
PROJECT

TITLE

SITE AND SURROUNDING PROPERTIES

DESIGNED	SCALE	1:5000	DATE	2020-05-27	
DRAWN	IW	PROJECT NO.	CG2430.1 E47	FIG.	2
CHECKED	DB	FILE NO.	CG2430.1-E47-2		

W:\CG2430.1-SEARS\CG2430.1-E47-2.dwg 05/27/2020 9:08:34 AM



- LEGEND**
- SITE BOUNDARY
LRT TRACKS
FENCE LINE
LEGAL LINE
FORMER FACILITY/FEATURE
- BUILDING
SOIL VAPOUR PROBES INSTALLED AT 1.0 mbgs
SOIL VAPOUR PROBES INSTALLED AT 1.5 mbgs
SOIL VAPOUR PROBES INSTALLED AT 2.0 mbgs
SOIL VAPOUR PROBES INSTALLED AT 2.5 mbgs
SOIL VAPOUR PROBES INSTALLED AT 3.0 mbgs
SOIL VAPOUR PROBES INSTALLED AT 3.5 mbgs
SOIL VAPOUR PROBES INSTALLED AT 4.0 mbgs
SOIL VAPOUR PROBES INSTALLED AT 4.5 mbgs
SOIL VAPOUR PROBES INSTALLED AT 5.0 mbgs
SOIL VAPOUR PROBES INSTALLED AT 5.5 mbgs
SOIL VAPOUR PROBES INSTALLED AT 6.0 mbgs
NESTED SOIL VAPOUR MONITORING POINT
ADDITIONAL SOIL VAPOUR MONITORING POINTS
INSTALLED IN MAY 2019
ADDITIONAL SOIL VAPOUR MONITORING POINTS
INSTALLED IN NOVEMBER 2019
RESIDENTIAL STRUCTURES WITH REPORTED
UNUSUAL FEATURES (EARTHEN FLOORS)

- RESIDENTIAL
DETACHED GARAGE
SUB-SLAB SOIL VAPOUR POINT
- UTILITY LINES & SYMBOLS
NATURAL GAS LINE
SANITARY SEWER
STORM SEWER
WATER
CATCH BASIN
FIRE HYDRANT
LIGHT STANDARD
MANHOLE
UTILITY POLE

NOTES:
1 DRAWING COMPILED FROM PLANIMETRIC FILES SUPPLIED BY THE
CITY OF CALGARY (INCLUDING U/G UTILITIES) & FROM SITE ASSESSMENT
INFORMATION. ADDITIONAL REFERENCES FROM SEACOR
ENVIRONMENTAL ENGINEERING INC., DRAWINGS 149-SA11.DWG,
149-SA6.DWG.



ENGINEER			
CLIENT			
PROJECT	SOIL VAPOUR MONITORING REPORT WINTER 2019 / 2020 HOUNSFIELD HEIGHTS AND NORTH HILL MALL CALGARY, ALBERTA		
TITLE	SOIL VAPOUR MONITORING POINTS INSTALLATION LAYOUT (PUBLIC RIGHT -OF-WAYS)		
DESIGNED	KD	SCALE	1:1000
DRAWN	IW	PROJECT NO.	CG2430.1 E47
CHECKED	DB	FILE NO.	CG2430.1-E47-3
DATE	2020-05-27	FIG.	3

