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SMALL-SCALE SITES RESURVEY - PROPERTY SURVEY REPORT FOR SITE

Port Hope Area Initiative Port Hope Project

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Revision 0

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ATOMIC ENERGY OF CANADA LIMITED
PORT HOPE, ONTARIO, CANADA

SMALL-SCALE SITES RESURVEY AND REMEDIATION TRIALS COST ASSESSMENT

PROPERTY SURVEY REPORT FOR

PORT HOPE

CLIENT: ATOMIC ENERGY OF CANADA LIMITED (AECL)

PROJECT: SMALL-SCALE SITES RESURVEY AND REMEDIATION TRIALS COST ASSESSMENT (SRCA)

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1.0 INTRODUCTION

Under the Port Hope Area Initiative (PHAI), properties within Ward 1 of the Municipality of Port Hope will be resurveyed for the presence of historic low-level radioactive waste (LLRW). Properties found to have LLRW above the established PHAI Clean-up Criteria (PHAI CC) will be remediated. These properties are described as small-scale remediation sites and include residential, industrial / commercial, institutional, woodlot and park properties.

Atomic Energy of Canada Limited (AECL), on behalf of the Port Hope Area Initiative Management Office (PHAI MO), retained SNC-Lavalin Inc. (SLI) to provide the field resurvey and remediation / restoration trials for the Small-Scale Sites Resurvey and Remediation Trials Cost Assessment (SRCA) project. SLI subcontracted Kinectrics Inc. to provide services and equipment for the radiological component of the resurvey and remediation work and laboratory analysis of soil and other materials. The Low-Level Radioactive Waste Management Office (LLRWMO) provided project management on behalf of AECL and also provided technical support and radiological laboratory analysis of soils for Ra-226.

The SRCA project included the resurvey of 35 selected sites, and the planned remediation of selected sites. The information gathered during the trials resurvey and remediation program was used to develop resurvey and remediation procedures and to provide an updated estimate of the cost for the larger re-survey and remediation project to follow.

An initial survey and site investigation was undertaken on each of the 35 sites to determine the potential presence of historic LLRW. The resurvey of the site consisted of the following components:

- indoor radon survey;
- interior and exterior gamma radiation dose rate surveys;
- interior and exterior surface contamination surveys;
- exterior intrusive investigation (drilling and soil sampling);
- gamma radiation survey of the soil core and borehole; and
- analytical testing of the soil.

The clean-up criteria adopted for the SRCA project (Ref. 1) are defined in terms of primary and secondary Contaminants of Potential Concern (COPCs). The clean-up criteria and their application are described in more detail in Section 5.3.3.

Under the SRCA project, small-scale sites are separated into five generic types:

1. Type A: Property with survey results less than PHAI CC;
2. Type B: Property with survey results above the PHAI CC, but not from historic LLRW;
3. Type C: Property with LLRW contaminated soils not exceeding 25% of the area of the property;

4. Type D: Property with LLRW contaminated soils exceeding 25% of the area of the property; and
5. Type E: Property with LLRW contaminated materials in unique conditions requiring site-specific (i.e. one-of-a-kind) remediation plans and cost estimates.

This report details the results of the resurvey activities undertaken at in July and August of 2010 and in March of 2011. This site was classified under the SRCA project as a Type D site, and is identified as Site within the SRCA project. Property type classifications were based on a high-level review of the historical property file. Detailed file and subsequent field data reviews conducted following the start of work indicated that there are exceedances of the PHAI CC.

Property owner consent was required prior to inclusion of this property in the SRCA project. PHAI MO Communications staff were responsible for arranging a meeting with the property owner to describe the program and to obtain consent for the resurvey at the site. The resurvey work was scheduled with the owner by SLI staff, and a letter confirming the time of the initial work (Initial Site Screening) was hand delivered to the owner in advance of the work. Notices were also delivered by PHAI MO Communications Staff to neighbours to advise them of the program. The subsequent Site Investigation work (drilling) was also scheduled with the property owner by SLI staff.

The signed consent form, the notice of work, and the notice provided to the neighbours are attached in Appendix A.

2.0 SITE LOCATION

is located in of the Municipality of Port Hope. It occupies part of Municipality of Port Hope. The property is rectangular-shaped covering an area of approximately 0.217 acres.

A copy of the legal survey obtained for this site is attached in Appendix B. The legal survey shows the subdivision of the property as of 1850, and the historic property file indicates a development date of the current structures prior to 1976.

The property is fully developed with a two (2) storey detached house and a detached garage. The house occupies the northwest portion of the property. The garage is located south of the house. During this investigation, renovations were being conducted on the property including an addition of a new kitchen and the installation of a front porch respectively east and west of the dwelling.

Access to the front of the property is by the driveway off There is potential for rear access to the property via an unused laneway connecting with

2.1 Site Mapping

A base map of this site was prepared based upon existing ortho-rectified air photo mapping available through the LLRWMO, and the legal survey. The base map was used for the geo-referencing of data collected for each site in subsequent investigations.

Figure 1 shows the base map prepared for this site.

Historical data as well as data from the resurvey were compiled in a GIS database. Each property in the database is assigned a unique identifier number which is linked to the roll number obtained from the LLRWMO's Port Hope property fabric. The unique database identifier for

3.0 HISTORIC FILE INFORMATION

The LLRWMO maintains files containing radiological information for properties located within the Municipality of Port Hope. These files are comprehensive and include all correspondence with the owner of the property, and the findings of any radiological investigations that may have occurred. Often, the correspondence is initiated for a purchase or sale of a property, or for investigations undertaken for the Construction Monitoring Program (CMP) for the field testing and management of contaminated soil in the town. However, there are properties where significant investigations and remediation were undertaken in the late 1970's and early 1980's by the Atomic Energy Control Board (AECB), now the CNSC.

Prior to conducting any site activities for this SRCA project, a review of the property file was undertaken. A gamma radiation survey dated 1976 revealed readings above background in the front yard and throughout the backyard. Elevated radon measurements were noted in the basement of the house. A gamma radiation survey, undertaken in 2010 as part of a CMP, revealed gamma radiation readings above background in the area of the new porch within the first 15 cm of soil.

Notes from the file review are provided in Appendix C.

4.0 FIELD ACTIVITIES

The following outlines the field activities that were undertaken at Site

4.1 Stage 1A – Site Screening

This stage comprised the deployment of the indoor radon monitors, interior and exterior gamma radiation dose rate surveys and surface and objects assessments. This portion of work was undertaken by Kinectrics staff.

Prior to conducting the initial site screening, photographs of relevant interior and exterior property features were taken to record initial site conditions or actual / potential issues. These photos were kept by Kinectrics for later retrieval, if necessary.

4.1.1 Indoor Radon Surveys

Indoor radon measurements were performed using Electret Passive Environmental Radon Monitors (EPERMs). The EPERMs were placed in the basement and in the living room on the main floor. Gamma radiation exposure rate readings were recorded at the monitor locations in order to correct measured data for effects due to ambient gamma radiation levels. During retrieval, the monitors were inspected for tampering and/or damage which may have potentially invalidated the measurements. The radon monitors were deployed on July 19, 2010, and were retrieved on July 26, 2010. Results of the radon survey are presented in Appendix F.

4.1.2 Interior Gamma Radiation Survey

The interior gamma radiation survey was done using a gamma radiation detector (Thermo FHZ 672 E-10 NBR coupled to a rate meter Thermo FH 40 GL-10). The detector is factory calibrated to read in units of nano Sieverts per hour (nSv/h); the reading is corrected for natural background radiation. For interior surveys, the equipment was strapped to a shoulder harness and readings were collected at hip level on an approximately 1 x 1 m grid. Measurements were taken in individual rooms on all levels of the house. If an elevated gamma radiation reading was found in any room, further assessment was carried out to identify reasons for the elevated gamma radiation reading and to locate potential surface contamination. Results of the interior gamma radiation survey are presented in Appendix D.

4.1.3 Exterior Gamma Radiation Survey

For the exterior gamma radiation survey, a mobile cart equipped with Global Positioning System (GPS) capability and two gamma radiation detector systems (Thermo FHZ 672 E-10 NBR coupled to a rate meter Thermo FH 40 GL-10) was used. The GPS unit is capable, after post-processing, of outputting positional information within 30 cm accuracy. Both detectors provide readings in units of nSv/h. The gamma radiation detectors were mounted on the cart at distances of 15 cm and 1 m above ground level. All accessible areas on the site, including the driveway, were surveyed using the cart, based approximately on a 1 x 1 m grid. Data for both

detectors as well as the GPS location were automatically logged and finally displayed on a property map for further evaluation. Where site features such as porches, decks, sheds and landscaped areas interfered with the survey grid, readings were taken using one of the detachable cart mounted gamma radiation measurement devices as close to the grid location as possible. This survey data was recorded manually on a site map and is included as Appendix D.

Data collected by Kinectrics during the site screening was transferred to SLI for overlay onto base maps. This geo-referenced data was returned to Kinectrics for identification of any areas exhibiting elevated gamma radiation readings that were to be considered for further investigation in Stage 1B – Initial Intrusive Investigation.

4.1.4 Surfaces and Objects Assessment

Locations for surface radiation measurements were identified in areas where elevated gamma radiation readings were found during either the interior or exterior survey, and/or where visual inspection of surfaces or objects indicated potential presence of historic LLRW waste or materials. If locations for surface radiation measurements were not identified through gamma readings or visual inspection, locations were selected in typically high traffic areas such as stairs and doorways. Total surface radiation activity was recorded using a hand-held radiation detector with an active face area of 125 cm^2 (Thermo FHZ 742 coupled to a FH-40 rate meter). If the surface area of the measurement location was smaller than the face of the detector, the measured area of the surface was recorded. Total surface contamination (TSC) readings were taken for alpha, beta and gamma radiation, then with a filter plate in place to measure only gamma radiation. All TSC readings are taken in counts per second (cps). The location of the radiation measurement was recorded on area plans by measuring its distance from reference walls as well as by photographing the area. Total surface contamination readings were then converted to Becquerel per square centimeter (Bq/cm^2), and corrected for reduced surface area, if required, to compare to the PHAI CC of 1 Bq/cm^2 averaged over 100 cm^2.

Locations for swipe samples to measure for loose alpha radiation were determined based on the surface radiation readings. The PHAI CC for removable (loose) contamination states that, "the removable radioactivity must not exceed 0.4 Bq/cm^2 for beta and gamma emitters and for "low toxicity" alpha emitters (U isotopes, ^{232}Th, ^{230}Th, ^{228}Th, and ^{222}Rn plus daughters), averaged over 300 cm^2, and 0.04 Bq/cm^2 for other alpha emitters." As ^{226}Ra, one of the signature parameters of LLRW, is considered a high toxicity alpha emitter, the criterion of 0.04 Bq/cm^2 averaged over 300 cm^2 for other alpha emitters is used. Swipe samples were obtained over 300 cm^2, with the exception of the swipe taken on the front door threshold, which was taken over 100 cm^2. Locations for swipe samples were selected in areas where the measured total surface radiation varied from the gamma radiation, indicating locations of alpha and beta radiation. The location of the swipe sample was recorded on area plans by measuring its distance from reference walls as well as by photographing the area. Swipes were sent to Kinectrics laboratory for analysis. Swipe samples were analyzed using an automated system connected to a proportional counter, with a 30 minute count time per swipe, and results were

compared to the PHAI CC of 0.04 Bq/cm^2 averaged over 300 cm^2. For the swipe sample obtained over 100 cm^2, assuming that the radiation results are normally distributed, the data based on 100 cm^2 is only marginally less certain than the data based on 300 cm^2.

4.1.5 Satisfaction Survey

At the completion of the Site Screening activities, the property owner was asked to complete a Satisfaction Survey to indicate their general level of satisfaction with the activities that were undertaken at the property. The completed Satisfaction Survey presented in Appendix D showed a very positive result.

4.2 Stage 1 B – Initial Intrusive Investigation

Prior to undertaking any intrusive investigation, locating of underground and overhead services was undertaken. Locating services were provided by ProMark, and local public providers (Cogeco, Veridian), and overseen by SLI. Utility locations were marked with flags or marking paint and cleared on the ground at each site. The locators provided marked site plans for each site. Marked utility locations on the ground were compared to the Site Plan to ensure that flags or marking paint were not disturbed between the time of locating utilities and drilling.

4.2.1 Drilling Program

The drilling program was dependant on the initial property type classification (i.e. types A to E). is a D Type site, therefore three (3) initial boreholes (BH) were planned to confirm the presence of LLRW at locations that were determined following the Stage 1A -Site Screening and the review of the historic file information for this site. Considering the size and the multiple areas of concern, four (4) initial boreholes were advanced on the property. Once the presence of LLRW was confirmed, an additional five (5) boreholes were planned to be drilled on the property to delineate the extent of the contamination. However, the multiple areas of concern required more significant investigation, so nine (9) hand-augered holes in addition to the boreholes were drilled in an effort to accurately delineate the contamination.

Prior to and following the drilling program, the SLI Site Supervisor photographed and took notes to document site conditions and identify actual / potential issues.

The drilling program was undertaken by Strata Soil Drilling under the supervision of the SLI Site Supervisor. Drilling was conducted using a Geoprobe 420M, a gasoline operated hand-held unit. This drill collects a continuous sample of a diameter of 5.7 cm to 1 m length, encased in a plastic sleeve. Borehole drilling in the SRCA project was done in 1 metre increments to a depth of approximately 3 metres, to refusal, or to native material. At the boreholes extended to depths varying from 0.40 m to 2.20 m. The hand-augered holes extended to depths varying from 0.50 m to 0.80 m. Borehole and hand-augered hole logs are provided in Appendix E.

4.2.2 Down-hole Gamma Radiation Readings

Down-hole gamma radiation readings were taken by Kinectrics at 15 cm increments using a FHZ 512 BGO detector with telescoping adapters. The same detector was also used to take readings from the soil cores which were laid on a plastic table which was covered with a metal sheet to shield the sample from other gamma radiation sources at ground level. Gamma radiation readings along the soil core were also taken with a Geiger-Mueller detector and portable rate meter. These readings were not used to determine radiation dose, but rather to identify changes in radiological activity at specific depths in the borehole and along the extracted core to create a profile of radiological activity. The down-hole gamma radiation profiles are provided in Appendix E.

4.2.3 Sampling Program

All drilling and soil sampling procedures were conducted in a manner that complies with the project-specific health and safety plan. Sampling personnel were required to wear personal protective equipment including clean, disposable, waterproof gloves, safety boots, side shielded safety glasses and a hard hat.

A tarp was placed beneath the soil sampling area to contain soil that may fall to the ground.

Soil Sampling

Upon retrieval of the soil core, soil samples were taken in 10 to 15 cm intervals from ground surface to the end of the boreholes and hand-augered holes. The samples were collected using a hand trowel at regular intervals along the core, and placed into a polyethylene sample bag. The samples collected from each borehole and hand-augered hole were labelled ·BH and -HA respectively, followed by the borehole or hand-augered hole identifier and the sequential sample number (e.g. BH01-001, ·HA11-001). The samples were double poly-bagged so as to provide maximum containment and to ensure that the resulting data was representative of the site conditions at this location. The soil samples were placed in a cooler containing ice to reduce the sample temperature to approximately 4 degrees Celsius (°C).

Soil samples were delivered directly to the Kinectrics laboratory by the Site Supervisor for laboratory analysis of COPCs. A Chain of Custody (COC) record was completed for each borehole and accompanied the samples. When the samples were transferred, both the receiving and relinquishing individuals signed the record.

Two (2) samples from each of the four (4) initial boreholes (BH01 to BH04) were selected for analysis based upon elevated gamma radiation profiles from down-hole gamma radiation readings and visual observation. One (1) sample from each of the additional five (5) boreholes and nine (9) hand-augered holes was selected for analysis based upon the analytical results of the previous soil samples. The rest of the samples were kept on hold at the laboratory.

Four (4) on hold samples collected (BH01-005, BH05-003, BH06-004 and BH08-003, were later selected for analysis in order to further delineate the contamination.

4.2.4 Site Cleanup

After completion of drilling, the boreholes were filled with bentonite, covered with topsoil and grass seed placed on top.

The remaining soil associated with the drilling and sampling program that was not a part of the sampling event was bagged for transfer to the Pine Street Extension Temporary Storage Site. This included the remainder of the soil core that was not part of the sample and soil collected on the underlying tarp.

Before leaving the site, all personnel, equipment and material were scanned with a contamination meter. The detector was held at a distance of 1 to 2 cm from the surface to be monitored and moved at a rate of approximately 10 cm/s. All equipment and soil containers were scanned on all sides.

5.0 FINDINGS

5.1 Radiation Survey

All gamma radiation readings were measured in nSv/h. Measurements were made using devices calibrated using Cs-137, and may vary somewhat from historical information from the LLRWMO property files. All data collected using the automated cart system and from the hand-held measurement device is shown on Figures 3 and 4. All the original forms for the hand-held survey are provided in Appendix D.

Total surface radiation was measured in counts per second (cps), averaged over 125 cm^2, and was converted to Bq/cm^2 to compare to the PHAI CC of 1 Bq/cm^2 averaged over 100 cm^2 for total surface contamination. Swipe samples were taken over 300 cm^2 with the exception of the swipe taken on the front door threshold which was taken over 100 cm^2, to measure for loose radiation and compared to the PHAI CC of 0.04 Bq/cm^2 averaged over 300 cm^2 for high toxicity alpha emitters. Surface radiation measurement locations and readings are shown in cps on the original field notes included in Appendix D, and in Bq/cm^2 in Appendix I. Loose radiation measurement results obtained from the assessment of swipe samples are presented in Appendix I.

5.1.1 Interior

The results of the interior gamma radiation survey taken at a height of 1 meter above surface are provided in Figure 2 and typically ranged from 43 to 78 nSv/h on the main and second floor of the house. The gamma radiation readings taken from the basement ranged from 68 to 123 nSv/h. Elevated gamma radiation readings were attributed to the naturally occurring radionuclide material within the fieldstone located in the basement (120 to 200 nSv/h). No other anomalous readings were detected in the house.

Total surface radiation readings were taken on the front door threshold, doorknob, floor and wall. In all locations tested, total surface contamination readings were at or below 0.26 Bq/cm^2. Three swipe samples were taken, from the front door wall, threshold and floor. The results were below the PHAI CC with readings of 0.0001 Bq/cm^2 and 0.0003 Bq/cm^2 for loose radiation on the front door floor and threshold, respectively. The result was non-detectable on the front door wall.

5.1.2 Exterior

The exterior gamma radiation survey was conducted at ground level and at approximately 1 m above the ground. The results of the ground level exterior gamma radiation survey and the gamma radiation survey at 1 m level are provided in Figures 3 and 4, respectively. Some areas could not be surveyed using the cart, therefore these readings were obtained using the hand-held detector.

The driveway exhibited readings typically ranging from 42 to 70 nSv/h. Elevated readings were noted in the area south of the driveway (71 to 140 nSv/h), interspersed with readings between 141 and 210 nSv/h toward the west property line. Elevated readings were also observed in the front garden of the property (140 to 210 nSv/h) and near the walkway along the side of the house (300 nSv/h). The backyard gamma radiation readings typically ranged from 71 and 140 nSv/h. Higher readings (141 and 210 nSv/h) were noted towards the north and south property line.

Total surface radiation measurements were taken on the front porch, the side deck, the garage floor and the driveway. The total surface contamination readings for all locations were at or below 0.21 Bq/cm^2. Swipe samples were taken, from each of these locations. The results were below the PHAI CC with a reading of 0.0001 Bq/cm^2 and 0.0003 Bq/cm^2 for loose radiation on the front porch and the side deck, respectively. The results were non-detectable on the garage floor and the driveway.

5.2 Indoor Radon Measurement

Short-term radon monitoring was performed using four EPERMs installed in pairs at two locations inside the house. The monitors were installed in the basement and in the living room on the main level. Deployment locations are shown in the field notes in Appendix D and on Figure 2. Details of the radon monitor deployment and the analysis of the results are provided in Appendix F. Test analysis results are summarized in Table 5-1:

Table 5-1: Site Radon Concentration

Average Radon Concentration in the Basement	**208**	**Bq/m3**
Relative % Difference (RPD)	**3%**	
Average Radon Concentration in the Main Level – Living Room	**17.7**	**Bq/m3**
Relative % Difference (RPD)	**16%**	
Average Radon Concentration in the House	**113**	**Bq/m3**
Relative % Difference (RPD)	**169%**	

Note: RPD = Relative percentage difference between the monitors at each location

The reported results in the basement not only exceeded the PHAI interior radon criterion of 125 Bq/m^3, but also the Health Canada action level for indoor radon of 200 Bq/m^3. An investigation of the soils adjacent to the house foundation was undertaken to determine if the source of radon was LLRW. This investigation is described in Section 5.3.

5.3 Intrusive Investigation

5.3.1 Drilling and Soil Sampling

Nine (9) boreholes and nine (9) hand-augered holes were drilled on the property. Visual observation of the cores indicated the presence of topsoil underlain by sandy granular fill and by native silty sand till, to the bottom of the boreholes (0.40 m to 2.20 m). Sandy granular fill with slag was encountered in BH04 from 0.30 to 0.40 m, in BH 09 from 0.70 to 0.80 m, in HA12 from 0.40 to 0.50 m and in HA16 from 0.20 to 0.40 m.

5.3.2 Down-hole and Soil Core Gamma Radiation Readings

In general, the down-hole gamma radiation readings in each borehole showed increased activity at the same depth. BH01 to BH07, located in the backyard, showed increased activity at a depth of 0.15 to 0.30 m. BH09 located in the southeast corner of the property showed a first increase at 0.15 m followed by a second increase in activity at 0.90 m. BH08 located near the southeast portion of the house showed relatively low gamma radiation readings with a decrease in activity from 0.15 to 0.90 m. The increases in activity were generally not seen on the gamma radiation readings taken directly from the soil core. The locations of these boreholes are shown on Figure 1.

5.3.3 Analytical Results

The PHAI CC for Inorganic COPCs are set out in Table 5-2. The criteria are defined in terms of primary and secondary COPCs. A sub-set of four signature parameters are used to identify the presence of LLRW. These are radium, thorium, arsenic, and uranium. For the SRCA project, the COPCs for sites without development constraints were used as these relate to the residential nature of the properties being assessed.

Table 5-2: Recommended Clean-up Criteria[1,2] for Inorganic COPCs in Soils

	Without Development Constraints[3]	LTWMFs and Port Hope Sites with Development Constraints[4]	Industrial Sites (where no LLRW present)[5]
Primary COPCs			
^{226}Ra(Bq/g)[6]	0.24	0.92	-
^{230}Th (Bq/g)[6]	1.11	4.62	-
^{232}Th (Bq/g)[6]	0.103	0.343	-
Arsenic	20/*25*[7]	40/*50*[7]	40[7]
Antimony	13[7]	40/*44*	40(13)[9]
Cobalt	40/*50*	80/*100*	80
Copper	225 (150)/*300 (200)*	225/*300*	225
Nickel	150/*200*	150/*200*	150
Uranium	35	76	76
Lead	200[7]	1000	1,000 (200)[9]
Fluoride[8]	N/A	2,000	N/A
Secondary COPCs			
Barium	750/*1000*	1500/*2000*	1,500 (750)[9]
Beryllium	-	-	1.2
Boron	1.5	2.0	2.0
Cadmium	12 (3)/(*4*)	12	-
Mercury	10	10	10
Molybdenum	40 (5)	40	40 (20)[9]
Selenium	10 (2)	10	10
Silver	20/*25*	40/*45*	40
Vanadium	200	200	200
Zinc	600/*800*	600/*800*	600

1 Criteria expressed as incremental concentrations for radionuclides, total concentrations for other COPCs. Italicized values apply to medium and fine-grained soils only. Those not in italics apply to either all soils (where italicized values are absent) or to coarse soils. All four designated industrial waste-contaminated sites are known to have coarse soils.

2 Concentrations as µg/g unless otherwise stated.

3 Lower values (in parentheses) represent MOE "Table 2" values for agricultural land use in potable groundwater situations, for use where applicable. Values not in parentheses are applicable to residential land uses (where values in parentheses are also listed) or to both residential and agricultural land uses. Italicized values in parentheses apply to medium and fine-grained agricultural land uses.

4 Concentrations higher than criteria listed may be acceptable at depths >1.5 m at the new LTWMFs.

5 Categorization of Primary and Secondary COPCs at industrial waste-contaminated sites differ from those for LLRW sites.

6 Summation rules apply to ^{226}Ra, ^{230}Th and ^{232}Th, and also account for any dose contribution from uranium. Radionuclide Criteria represent incremental concentrations.

7 Alternate site-specific values may be appropriate for As, Sb and Pb in surficial soil, depending on site-specific conditions, as discussed in Section 4.4.3.3 and as detailed in EcoMetrix (2005).

8 Fluoride criterion based on CCME criterion for industrial land use, applicable at Port Granby WMF only where all fluoride-rich wastes are deposited.

9 Lower values applicable at John Street former Coal Gasification Plant site if clean-up is to meet residential land use. (Lower values indicated only for COPCs present at John Street site).

The results of the analysis of the soil samples collected from this site are summarized in Table 5-3 and Table T-1 at the end of the document. The COCs and soil analysis results are

provided in Appendix G, and the results of the Ra-226 analyses conducted by the LLRWMO laboratory are provided in Appendix H.

Table 5-3: Site - Analytical Results for Soil Samples

BH / HA #	Sample #	Depth (cm)	Date of Analysis	Primary COPCs									
				^{226}Ra (Bq/g)	^{230}Th (Bq/g)	^{232}Th (Bq/g)	Arsenic (µg/g)	Antimony (µg/g)	Cobalt (µg/g)	Copper (µg/g)	Nickel (µg/g)	Uranium (µg/g)	Lead (µg/g)
				PHAI Clean-up Criteria									
				0.29	1.16	0.158	20	137	40/*50*	225/*300*	150/*200*	35	200
				Background Value									
				0.048		0.055	17	1	21	85	43	1.9/2.1	120
BH01	002	10-20	05-Aug-10	0.271	<0.2	0.009	**74.7**	11.8	15.1	86.7	41.6	**35.9**	**835**
	004	30-40	05-Aug-10	0.063	<0.2	0.011	**26.7**	5.29	11.1	45.5	32.3	16.5	**588**
	005	40-50	03-Sep-10	0.021	<0.2	0.013	15.1	4.12	10.5	22.9	31.9	9.37	**271**
BH02	002	10-20	05-Aug-10	**0.388**	<0.2	0.005	**113**	15.6	36.7	217	87	**46.9**	**849**
	004	30-40	05-Aug-10	0.025	<0.2	0.001	3.95	<0.5	6.39	6.35	22.8	2.34	17.7
BH03	002	10-20	05-Aug-10	0.054	<0.2	0.011	**33.9**	5.66	20.8	67.8	55.4	**44.6**	**468**
	004	30-40	05-Aug-10	*	<0.2	0.003	5.42	0.873	13.9	33.6	73.9	4.91	46.4
BH04	002	10-20	05-Aug-10	0.124	<0.2	0.014	**44**	9.2	17	82.3	43.5	28.3	**662**
	004	30-40	05-Aug-10	0.122	<0.2	0.009	**26.5**	4.84	38.2	97.1	87.9	12.7	**684**
BH05	002	10-20	17-Aug-10	*	<0.2	0.002	**44.3**	1.9	8.01	17.1	22.3	**38.3**	112
	003	20-30	03-Sep-10	0.07	<0.2	0.015	**33.8**	2.09	10.5	17.9	35.4	28.7	121
BH06	002	10-20	17-Aug-10	*	0.383	0.011	**139**	7.67	14.9	68	30.5	**63.6**	**201**
	004	30-40	03-Sep-10	0.025	<0.2	0.007	8.89	2.39	11.1	12.4	35.2	9.66	43.2
BH07	002	10-20	19-Aug-10	0.012	<0.2	0.013	16.5	1.34	10.2	20	39.7	5.83	106
BH08	001	0-10	17-Aug-10	*	<0.2	0.005	16.5	0.799	4.71	38.2	10.5	**79.4**	99.5
	003	30-40	03-Sep-10	0.005	<0.2	0.004	**21.4**	<0.5	12.3	20.5	26.5	4.75	23
BH09	007	70-80	17-Aug-10	*	<0.2	0.007	**65**	28.3	9.52	54.4	36.5	22.1	**411**
HA10	003	20-30	13-Sep-10	0.068	<0.2	0.02	**31.2**	3.66	10.2	33	19.9	**40.3**	**931**
HA11	003	20-30	13-Sep-10	0.016	<0.2	0.008	2.59	<0.5	3.7	3.54	8.6	3.15	9.87
HA12	002	10-20	13-Sep-10	0.175	<0.2	0.02	**65.6**	5.48	13.7	69.8	29.1	34.2	**1690**
HA13	002	10-20	13-Sep-10	0.266	<0.2	0.025	**65**	12.4	16.7	59.7	30.2	32.6	**671**
HA14	004	30-40	13-Sep-10	0.045	<0.2	0.025	**24.3**	4.02	12.2	38.2	24.6	14.9	**531**
HA15	004	30-40	13-Sep-10	0.043	<0.2	0.024	18.7	19.2	8.65	34.7	17.4	14.6	**207**
HA16	005	40-50	13-Sep-10	0.033	<0.2	0.008	18.4	**886**	7.29	57.1	32.8	5.28	**4480**
HA17	005	40-50	13-Sep-10	0.010	<0.2	0.007	18	5.58	5.57	15.6	12.9	7.97	121
HA18	002	10-20	13-Sep-10	0.039	<0.2	0.014	13	2.94	6.32	14.1	12.4	18.9	112

				Secondary COPCs									
				Barium	Beryllium	Boron	Cadmium	Mercury	Molybdenum	Selenium	Silver	Vanadium	Zinc
				(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)
				PHAI Clean-up Criteria									
BH / HA #	Sample #	Depth (cm)	Date of Analysis	*750/1000*	-	1.5/120	12	10	40	10	*20/25*	200	*600/800*
				Background Value									
				210			1	0.23	2.5	1.9	0.42	91	160
BH01	002	10-20	05-Aug-10	694	1.99	36.6	0.73	0.415	1.3	2.74	1.67	75.2	318
	004	30-40	05-Aug-10	586	1.69	27.7	0.425	0.236	0.92	2.06	1.18	67.6	199
	005	40-50	03-Sep-10	607	1.76	29.2	0.3	0.181	1	0.997	0.432	75.6	131
BH02	002	10-20	05-Aug-10	**763**	6.5	56.7	1.52	0.241	4.2	3.67	3.21	129	**733**
	004	30-40	05-Aug-10	390	1.27	17.3	0.202	<0.05	0.662	<1	8.87	65.8	60.2
BH03	002	10-20	05-Aug-10	533	2.86	30	0.592	1.19	2.25	1.61	0.891	97.7	238
	004	30-40	05-Aug-10	375	1.47	20.5	0.147	0.06	1.08	<1	0.212	116	88
BH04	002	10-20	05-Aug-10	659	2.22	35	0.67	0.407	1.43	2.23	11.7	82.1	290
	004	30-40	05-Aug-10	551	5.99	35.1	0.316	0.251	2.47	1.63	0.944	128	168
BH05	002	10-20	17-Aug-10	332	0.889	16.1	0.36	0.073	0.697	<1	0.499	47.2	115
	003	20-30	03-Sep-10	518	1.86	26.9	0.365	0.1	0.849	0.757	0.463	77.2	142
BH06	002	10-20	17-Aug-10	250	0.755	20.7	0.394	0.161	0.68	1.14	1.95	47.3	186
	004	30-40	03-Sep-10	585	2.2	24.6	0.248	0.075	0.682	0.602	0.277	88.2	110
BH07	002	10-20	19-Aug-10	586	1.37	31.4	0.43	0.134	1.03	1.27	0.366	86.1	214
BH08	001	0-10	17-Aug-10	222	0.527	12.5	0.368	<0.05	0.49	<1	0.113	19.9	82
	003	30-40	03-Sep-10	370	1.3	37	0.124	<0.05	0.944	<0.5	0.182	75.5	79.8
BH09	007	70-80	17-Aug-10	401	0.612	45.9	0.413	0.067	2.92	<1	1.28	46.8	383
HA10	003	20-30	13-Sep-10	528	1.36	21.1	0.771	0.148	0.83	1.31	0.849	62.7	354
HA11	003	20-30	13-Sep-10	330	0.74	11.9	<0.05	<0.05	0.212	<1	0.084	30	23.9
HA12	002	10-20	13-Sep-10	**792**	1.71	26.6	0.602	0.267	1.31	2.22	1.77	72.8	357
HA13	002	10-20	13-Sep-10	530	1.89	27.4	0.845	0.26	1.48	1.3	1.38	66	478
HA14	004	30-40	13-Sep-10	488	1.92	24.3	0.355	0.268	1.16	1.27	0.581	74.8	175
HA15	004	30-40	13-Sep-10	477	1.39	30.2	0.324	0.067	0.894	1.06	0.313	68.8	169
HA16	005	40-50	13-Sep-10	**2370**	0.604	374	0.341	<0.05	4.58	<1	0.334	45.7	**2620**
HA17	005	40-50	13-Sep-10	310	0.902	17.9	0.145	<0.05	0.401	<1	0.226	40.9	89.6
HA18	002	10-20	13-Sep-10	452	1.17	17.8	0.229	<0.05	0.478	<1	0.304	52.4	91.4

Notes:

1. COPCs: Contaminants of Potential Concern and background values are defined by Port Hope Area Initiative Clean-up Criteria (see EcoMetrix 2006).
2. ^{226}Ra values measured by LLRWMO gamma spectrometry and all other parameters by Kinectrics ICP-MS.
3. *Insufficient sample for analysis.
4. Boron standards for all surface soils are 1.5 µg/g for hot water soluble extract. For subsurface soils the standards are 120 µg/g for total boron (mixed strong acid digest), as ecological criteria are not considered.
5. Italicized values apply to medium and fine-grained soils only. Those not in italics apply to either all soils (where italicized values are absent) or to coarse soils.
6. Bold and highlighted values exceed PHAI CC.

In addition to the comparison to the PHAI CC, the analytical results were also compared to the "background" soil quality values (shown in Table 5-3). These concentration levels were also determined by EcoMetrix (December 2006), and are discussed in Section 4.3 of the *Port Hope Area Initiative Clean-up Criteria*.

Twenty-six (26) soil samples were analyzed and all other samples were stored for future analysis, if required. Of the total eighteen (18) boreholes and hand-augered holes, fourteen (14) had one or more exceedance of the COPCs and all were above background levels for one or more of the COPCs.

Three (3) of the signature parameters of LLRW exceeded the PHAI CC; radium, arsenic and uranium. Radium exceeded its PHAI CC in BH02 from 0.10 m to 0.20 m. Radium was also above background concentrations in nine (9) others samples, three (3) of which were within 50% of the PHAI CC. Arsenic exceeded the PHAI CC in twelve (12) boreholes and hand-augered holes. BH01 to BH06, HA12 and HA13 showed an exceedance of arsenic between 0.10 and 0.20 m. BH05 and HA10 showed an exceedance between 0.20 and 0.30 m. BH01, BH04, BH08 and HA14 showed an exceedance between 0.30 and 0.40 m. BH09 showed an exceedance of arsenic between 0.70 and 0.80 m. Arsenic was above background concentrations in three (3) additional samples, all of which were within 50% of the PHAI CC. Uranium exceeded the PHAI CC in BH1 to BH03, BH05 and BH06 between 0.10 and 0.20 m, in the surface sample of BH08 and in HA10 between 0.20 and 0.30 m. Uranium was above background concentrations in all samples analyzed, only six (6) of which were within 50% of the PHAI CC. The presence of radium, arsenic and uranium above the PHAI CC indicates that LLRW is present on the site.

Exceedances of PHAI CC for non-signature Primary COPC were observed for antimony and lead. Antimony was exceeded in HA16 between 0.40 to 0.50 m. Antimony exceeded background concentrations in all but five (5) samples. Elevated lead levels were identified in numerous boreholes and are as follows:

- Between 0.10 to 0.20 m in BH01, BH02, BH03, BH04, BH06, HA12 and HA13;
- Between 0.20 to 0.30 m in HA10;
- Between 0.30 to 0.40 m in BH01, BH04, HA14 and HA15;
- Between 0.40 to 0.50 m in BH01 and HA16;
- Between 0.70 to 0.80 m BH09.

Two (2) additional samples from BH05 and HA17 were above the background concentration for lead.

Exceedances PHAI CC for Secondary COPC were observed for barium and zinc. Barium exceeded the PHAI CC in BH02 and HA12 between 0.10 and 0.20 m, and in HA16 between 0.40 and 0.50 m. Barium was above background concentrations in all samples. Exceedances for zinc were observed in BH02 between 0.10 and 0.20 m and HA16 between 0.40 and 0.50 m. Thirteen (13) additional samples were above the background concentration for zinc.

5.3.4 Verification Process

The MMM Group developed (May 2010) the *Remediation Verification Standard Operating Procedure* (RVSOP) for use in the PHAI (including the SRCA project) that describes a field-applicable verification procedure for soil to confirm that:

- If soil contamination is suspected, the PHAI CC (as presented in the *Port Hope Area Initiative Cleanup Criteria*, Ecometrix, 2006) have been achieved following soil remediation; or

- If soil contamination is not suspected, the PHAI CC is satisfied following the Final Verification Process for soil based on initial site characterization activities conducted during each property survey.

In the RVSOP, Figure 6.1 provides a general overview of the soil verification process. If soil results are less than the signature parameter criteria, then the Final Verification Process is undertaken.

For Site , soil contamination with LLRW is likely, due to the confirmed presence of signature parameters above the PHAI CC. Therefore, further investigation and remediation are required before the Final Verification Process as detailed in the RVSOP can be applied.

5.4 Assessment of Elevated Non-Signature COPCs

In Section 6.3.1.3 of the RVSOP, the remediation verification procedure states that, "If the composite sample exceeds criterion for any COPC, while the signature parameters for ^{226}Ra, U, ^{230}Th and As are met, then contamination by materials other than LLRW is suspected". The RVSOP then outlines a statistical method to be applied to determine whether the exceedance in the composite remediation verification sample is evidence of LLRW. All verification samples would be analyzed for the COPC that is above criterion. If the elevated parameter co-varies with any of the signature parameters, this is evidence of LLRW.

Although it is not required to apply statistical methods to determine if the COPCs for investigation samples co-vary, a correlation analysis was undertaken. The location of the exceedances of non-signature parameters, particularly lead, did not coincide with locations of exceedances of the signature parameters radium, uranium and arsenic. However, the exceedances of other non-signature parameters were observed in samples with elevated lead levels. Where lead is elevated, one or more of the other non-signature parameters were above PHAI CC and/or above background concentrations. A correlation coefficient was calculated using the following formula:

$$Correl(X,Y) = \frac{\sum (x-\bar{x})(y-\bar{y})}{\sqrt{\sum (x-\bar{x})^2 \sum (y-\bar{y})^2}}$$

A correlation coefficient value of 1.0 shows a direct positive relationship between the parameters, -1.0 a direct negative relationship, and a value of 0 shows there is no relationship. The Table 5-4 below shows the correlation coefficients of radium, uranium, arsenic and lead with the non-signature parameters that exceeded the PHAI CC.

Table 5-4: Site – Correlation Coefficients of Non-Signature COPCs to Radium, Uranium, Arsenic and Lead

	Radium	Uranium	Arsenic	Antimony	Lead	Barium	Zinc
Correlation Coefficient with Radium	1.00	0.72	0.96	-0.15	0.16	0.08	0.14
Correlation Coefficient with Uranium	0.72	1.00	0.62	-0.24	-0.04	-0.21	-0.07
Correlation Coefficient with Arsenic	0.96	0.62	1.00	-0.12	0.10	-0.02	0.11
Correlation Coefficient with Lead	0.16	-0.04	0.10	0.91	1.00	0.95	0.95

The correlation coefficients demonstrate that radium, uranium and arsenic concentrations have a moderate to strong positive relationship to each other, but are not strongly correlated to the non-signature parameters that exceeded the PHAI CC. However, lead concentrations are strongly related to antimony, barium and zinc concentrations. This indicates that the source of contamination contributing to the elevated levels of signature parameters is likely from a separate source than that of the lead related contamination.

The RVSOP also indicates that during verification this result is to be communicated to the PHAI MO, and a confirmation plan is to be prepared to determine if the contamination of other origin extends beyond the zone of the signature parameters for LLRW. This plan will need to be developed as a part of the verification sampling procedure for this site.

6.0 CONCLUSIONS

Site does not meet all PHAI CC. Specific aspects of this investigation are described below:

1. The PHAI CC for objects and materials was met for both total and loose radiation on tested surfaces.

2. The PHAI CC for radon was met on the main level of the house, but was exceeded in the basement.

3. The PHAI CC for COPCs in soil were exceeded for signature parameters in twelve (12) of the eighteen (18) boreholes on the site. These exceedances were in boreholes located in the area of the front of the house, the walkway to the backyard, south of the driveway, in the northern portion of the backyard and at the southwest property corner.

Elevated gamma radiation readings were observed in the front garden of the property (140 to 210 nSv/h) and near the walkway along the south side of the house (300 nSv/h). The localized areas of elevated gamma radiation identified in the resurvey (front garden and near the walkway along the side of the house) indicate the possible presence of shallow LLRW contamination.

Radon levels in the basement exceeding the PHAI CC may be an indication of LLRW adjacent to the house foundations. A second round of radon monitoring will be done in the winter of 2011 to verify these radon results. Three (3) boreholes (BH05, BH07 and BH08) and one (1) hand-augered hole (HA10) were drilled adjacent to the foundation on the west, north and south sides of the house. Exceedances of arsenic and uranium were found in BH05, BH08 and HA10. The source of the radon may be due to the presence of LLRW adjacent to the foundation.

Soil samples taken from boreholes in the area of the front of the house, the walkway to the backyard, south of the driveway and the northern portion of the backyard indicated the likely presence of LLRW at depths between 0 and 0.40 m based on exceedances of the signature parameters. BH09 located in the southwest corner of the property showed an exceedance of arsenic between 0.70 and 0.80 m. Remediation through the removal of soil is recommended to a minimum depth of 0.40 m in the area of the front of the house, the walkway to the backyard, south of the driveway and the northern portion of the backyard. Deeper excavation will be required in the area of the southwest property corner. Further investigation is required to determine the depths and extents of remediation in these areas.

7.0 ACKNOWLEDGEMENTS

SNC-Lavalin would like to acknowledge the LLRWMO for their assistance throughout the Small-Scale Sites Resurvey and Remediation Trials Cost Assessment project. The LLRWMO provided technical support in the planning and execution of the project based on their extensive knowledge in LLRW contamination resurvey and remediation work, as well as the direct input of their staff supporting operations in the field, calibrating resurvey equipment and providing radiological analysis of soil samples.

8.0 REFERENCES

1. EcoMetrix Incorporated. 2006. *Port Hope Area Initiative Clean-up Criteria*. LLRWMO-01611-TE-11004, Revision 5.
2. LLRWMO, 2008. *Port Hope Project Environment and Protection Program*. 509200-MAN-12001, Rev 2.
3. Marshall Macklin Monaghan, 2008. *Port Hope Area Long-term, Low-Level Radioactive Waste Management Project Design Description, Volume 3, Waste Excavation Management Plan for Remediation Sites*, LLRWMO-01340-DD0-12001.
4. EcoMetrix Incorporated. 2008. *Port Hope Area Initiative (PHAI) Remediation Verification Protocol Guideline*. LLRWMO-12257-GL-12001, Revision 2.
5. Marshall Macklin Monaghan, 2010. *Remediation Verification Standard Operating Procedure*, Port Hope Project, prepared for Atomic Energy of Canada Limited.

Small-Scale Sites Resurvey and Remediation Trials Costs Assessment Project Procedures:

6. SNC Lavalin, 2010. *Environmental Management Plan*, 503107-0000-4EPA-0002 Rev 00.
7. SNC Lavalin, 2010. *Project Health and Safety Plan*, 503107-0000-4EPA-0003 Rev 00.
8. Kinectrics, 2010. *Radiation Protection Plan*, K-015367-RPP-001 Revision 00.

LLRWMO Field Service Operating Procedures:

9. LLRWMO-FS-OP-002, *"Surficial Soil Sampling Using Oakfield Soil Sampler"*.
10. LLRWMO-FS-OP-006, "*Preparation of Composite Soil Samples for Chemical Radionuclide Analysis*".
11. LLRWMO-FS-OP-031, "*Contamination Check of Equipment and Personnel*".
12. LLRWMO-FS-OP-034, "*Chain of Custody for the Relinquishment of Environmental Samples*".
13. LLRWMO-FS-OP-050, *"Taking Measurements with a Contamination Meter"*.

DOCUMENT END

NOTICE TO READERS

1. The Property Survey work performed in this report was carried out in accordance with the terms and conditions made part of our proposal and/or contract pursuant to which the report was issued. The results and conclusions presented in this report are based solely upon the scope of services, governed by the time and budgetary considerations to which this work was subject.

2. The principles, procedures and standards applied in conducting a Property Survey are neither regulated nor universally the same. The work has been carried out in accordance with generally accepted practices and industry standards and regarding applicable environmental regulations for environmental studies/investigations. No other warranties, either expressed or implied, are made as to the professional services provided under the terms of our original contract and included in this report.

3. The bore hole and hand auger logs indicate the approximate subsurface stratigraphy and conditions only at the locations of the bore and hand auger holes. Soil and rock formations are variable to a greater or lesser extent. Boundaries between zones on the logs are often not distinct, but rather are transitional and have been interpreted. The precision with which subsurface stratigraphy and conditions are indicated depends on the method of boring, the frequency of sampling, the method of sampling and the uniformity of subsurface stratigraphy and conditions. Subsurface stratigraphy and conditions between bore and auger holes is inferred and may vary significantly from stratigraphy and conditions encountered at these holes.

4. The Property Survey presented in this report is based on interpretation of conditions determined at specific sampling locations and depths. The levels of contamination are determined based on the results of the radiological resurvey and chemical analyses on a given number of soil samples obtained at the place and time of observation/investigation noted in this report. The nature and degree of contamination between the points of sampling may vary significantly from conditions encountered at the test locations. These conditions may also vary seasonally or as a consequence of activities on the site or adjacent sites which are beyond the control of SNC-Lavalin Inc.. While the work carried out has been aimed at minimizing the risk of unidentified environmental problems or concerns, there is no assurance, nor does SNC-Lavalin Inc. warrant either expressly or by inference, that other occurrences of radiological contamination or contaminated soil do not exist on site.

5. Groundwater elevations and conditions described in this report refer only to those observed at the place and time of observation noted in the report. These elevations and conditions may vary seasonally or as a consequence of construction activities on the site or adjacent sites.

6. The list of parameters tested in the laboratory is based on the scope of work prescribed by the client. The fact that other parameters were not analyzed does not exclude the possibility that these contaminants may be present at a concentration above background level, or detection limit.

7. The conclusions reached by this report are based only on the locations investigated and cannot be extended to other parts of the site or other sites which might have been unavailable for inspection or investigation at the time of the work, whether by result of equipment access or hidden by coverings (natural or man-made) or existing structures.

8. The Property Survey report must be read as a whole, as sections taken out of context may be misleading. If discrepancies occur between the preliminary (draft) and final version of this report, it is the final version that takes precedence.

9. This Property Survey report does not form a legal opinion. The disclosure of any information contained in this report is the sole responsibility of the client. Any use, reliance or decisions made on the basis of this report by any third party are totally the responsibility of any third party. SNC-Lavalin Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions or actions based on this report.

Table T-1

Detailed Soil Analytical Results

Table T-1
Site I - Detailed Soil Analytical Results

Sample #	Sample Type	Depth (cm)	Soil Type	Date of Analysis	Primary COPCs										Secondary COPCs									
					^{226}Ra (Bq/g)	^{234}Th (Bq/g)	^{232}Th (Bq/g)	Arsenic (µg/g)	Antimony (µg/g)	Cobalt (µg/g)	Copper (µg/g)	Nickel (µg/g)	Uranium (µg/g)	Lead (µg/g)	Barium (µg/g)	Beryllium (µg/g)	Boron (µg/g)	Cadmium (µg/g)	Mercury (µg/g)	Molybdenum (µg/g)	Selenium (µg/g)	Silver (µg/g)	Vanadium (µg/g)	Zinc (µg/g)
			PHAI Clean-up Criteria		0.29	1.16	0.158	20	137	40/50	225/300	150/200	35	200	750/1000	-	1.5/120	12	10	40	10	20/25	200	600/800
			Background Value		0.048		0.055	17	1	21	85	43	1.9/2.1	120	210			1	0.23	2.5	1.9	0.42	91	160
			BH01 (30-Jul-2010)																					
001		0-10	Topsoil																					
002		10-20	Gravelly fill	05-Aug-10	0.271	<0.2	0.009	**74.7**	11.8	15.1	86.7	41.6	**35.9**	**835**	694	1.99	36.6	0.73	0.415	1.3	2.74	1.67	75.2	318
003		20-30	Gravelly fill																					
004		30-40	Silty sand with some gravel	05-Aug-10	0.063	<0.2	0.011	**26.7**	5.29	11.1	45.5	32.3	16.5	**588**	586	1.69	27.7	0.425	0.236	0.92	2.06	1.18	67.6	199
005		40-50	Silty sand with some gravel	03-Sep-10	0.021	<0.2	0.013	15.1	4.12	10.5	22.9	31.9	9.37	**271**	607	1.76	29.2	0.3	0.181	1	0.997	0.432	75.6	131
006		50-60	Silty sand with some gravel																					
007		70-80	Silty sand with some gravel																					
008		205-215	Wet, silty sand till																					
EOH		215																						
			BH02 (30-Jul-2010)																					
001		0-10	Topsoil																					
002		10-20	Topsoil	05-Aug-10	**0.388**	<0.2	0.005	**113**	15.6	36.7	217	87	**46.9**	**849**	**763**	6.5	56.7	1.52	0.241	4.2	3.67	3.21	129	**733**
003		20-30	Sandy fil with gravel																					
004		30-40	Sandy fill with gravel	05-Aug-10	0.025	<0.2	0.001	3.95	<0.5	6.39	6.35	22.8	2.34	17.7	390	1.27	17.3	0.202	<0.05	0.662	<1	8.87	65.8	60.2
005		50-60	Sandy fil with gravel																					
006		70-80	Silty sand till																					
007		95-105	Silty sand till																					
008		210-220	Silty sand till																					
EOH		220																						
			BH03 (30-Jul-2010)																					
001		0-10	Topsoil																					
002		10-20	Topsoil and gravelly fill	05-Aug-10	0.054	<0.2	0.011	**33.9**	5.66	20.8	67.8	55.4	**44.6**	**468**	533	2.66	30	0.592	1.19	2.25	1.61	0.891	97.7	238
003		20-30	Topsoil and gravelly fill																					
004		30-40	Sandy fill	05-Aug-10	*	<0.2	0.003	5.42	0.873	13.9	33.6	73.9	4.91	46.4	375	1.47	20.5	0.147	0.06	1.08	<1	0.212	116	98
005		40-50	Sandy fill																					
006		60-70	Sandy fil with gravel																					
007		120-130	Silty sand till																					
EOH		130																						
			BH04 (30-Jul-2010)																					
001		0-10	Topsoil																					
002		10-20	Sand and gravelly fill	05-Aug-10	0.124	<0.2	0.014	**44**	9.2	17	82.3	43.5	28.3	**662**	659	2.22	35	0.67	0.407	1.43	2.23	11.7	82.1	290
003		20-30	Sand and gravelly fill																					
004		30-40	Sandy fill with slag	05-Aug-10	0.122	<0.2	0.009	**26.5**	4.84	38.2	97.1	87.9	12.7	**684**	551	5.99	35.1	0.316	0.251	2.47	1.63	0.944	128	168
EOH		40																						
			BH05 (12-Aug-2010)																					
001		0-10	Topsoil																					
002		10-20	Sand and gravelly fill	17-Aug-10	*	<0.2	0.002	**44.3**	1.9	8.01	17.1	22.3	**38.3**	112	332	0.889	16.1	0.36	0.073	0.697	<1	0.499	47.2	115
003		20-30	Sand and gravelly fill	03-Sep-10	0.07	<0.2	0.015	**33.8**	2.09	10.5	17.9	35.4	28.7	121	518	1.86	26.9	0.365	0.1	0.849	0.757	0.463	77.2	142
004		30-40	Sand and gravelly fill																					
005		40-50	Sandy fill																					
006		50-60	Sandy fill																					
007		75-85	Silty sand with gravel																					
EOH		165																						

Table T-1
Site - Detailed Soil Analytical Results

Sample #	Sample Type	Depth (cm)	Soil Type	Date of Analysis	Primary COPCs										Secondary COPCs									
					^{226}Ra (Bq/g)	^{234}Th (Bq/g)	^{232}Th (Bq/g)	Arsenic (µg/g)	Antimony (µg/g)	Cobalt (µg/g)	Copper (µg/g)	Nickel (µg/g)	Uranium (µg/g)	Lead (µg/g)	Barium (µg/g)	Beryllium (µg/g)	Boron (µg/g)	Cadmium (µg/g)	Mercury (µg/g)	Molybdenum (µg/g)	Selenium (µg/g)	Silver (µg/g)	Vanadium (µg/g)	Zinc (µg/g)
			PHAI Clean-up Criteria		0.29	1.16	0.158	20	137	40/*50*	225/*300*	150/*200*	35	200	750/*1000*	-	1.5/120	12	10	40	10	20/*25*	200	600/*800*
			Background Value		0.048		0.055	17	1	21	85	43	1.9/2.1	120	210			1	0.23	2.5	1.9	0.42	91	160
BH06 (12-Aug-2010)																								
001		0-10	Topsoil																					
002		10-20	Sand and gravelly fill	17-Aug-10	*	0.383	0.011	**139**	7.67	14.9	68	30.5	**63.6**	**201**	250	0.755	20.7	0.394	0.161	0.68	1.14	1.95	47.3	186
003		20-30	Sand and gravelly fill																					
004		30-40	Sand and gravelly fill	03-Sep-10	0.025	<0.2	0.007	8.89	2.39	11.1	12.4	35.2	9.66	43.2	585	2.2	24.6	0.248	0.075	0.682	0.602	0.277	88.2	110
005		40-50	Sand with trace gravel																					
006		50-60	Sand with trace gravel																					
007		60-70	Sand with trace gravel																					
EOH		115																						
BH07 (13-Aug-2010)																								
001		0-10	Topsoil																					
002		10-20	Sand and gravelly fill	19-Aug-10	0.012	<0.2	0.013	16.5	1.34	10.2	20	39.7	5.83	106	586	1.37	31.4	0.43	0.134	1.03	1.27	0.366	86.1	214
003		20-30	Sand and gravelly fill																					
004		30-40	Sand and gravelly fill																					
005		40-50	Sand and gravelly fill																					
EOH		85																						
BH08 (13-Aug-2010)																								
001		0-10	Topsoil	17-Aug-10	*	<0.2	0.005	16.5	0.799	4.71	38.2	10.5	**79.4**	99.5	222	0.527	12.5	0.368	<0.05	0.49	<1	0.113	19.9	32
002		10-20	Sandy fill																					
003		30-40	Sand and gravelly fill	03-Sep-10	0.005	<0.2	0.004	**21.4**	<0.5	12.3	20.5	26.5	4.75	23	370	1.3	37	0.124	<0.05	0.944	<0.5	0.182	75.5	79.8
004		40-50	Sand and gravelly fill																					
005		50-60	Moist, silty sand till with gravel																					
006		60-70	Moist, silty sand till with gravel																					
EOH		70																						
BH09 (13-Aug-2010)																								
001		0-10	Topsoil																					
002		10-20	Topsoil																					
003		20-30	Sandy fill																					
004		40-50	Gravelly fill																					
005		50-60	Gravelly fill																					
006		60-70	Gravelly fill																					
007		70-80	Gravelly fill with slag	17-Aug-10	*	<0.2	0.007	**65**	28.3	9.52	54.4	36.5	22.1	**411**	401	0.612	45.9	0.413	0.067	2.92	<1	1.28	46.8	383
EOH		80																						
HA10 (02-Sep-2010)																								
001		0-10	Topsoil																					
002		10-20	Topsoil and gravelly fill																					
003		20-30	Topsoil and gravelly fill	13-Sep-10	0.068	<0.2	0.02	**31.2**	3.66	10.2	33	19.9	**40.3**	**931**	528	1.36	21.1	0.771	0.148	0.83	1.31	0.849	62.7	354
004		30-40	Topsoil and gravelly fill																					
005		40-50	Topsoil and gravelly fill																					
EOH		50																						
HA11 (02-Sep-2010)																								
001		0-10	Topsoil and sandy fill																					
002		10-20	Sandy fill																					
003		20-30	Sandy fill	13-Sep-10	0.016	<0.2	0.008	2.59	<0.5	3.7	3.54	8.6	3.15	9.87	330	0.74	11.9	<0.05	<0.05	0.212	<1	0.084	30	23.9

Table T-1
Site - Detailed Soil Analytical Results

Sample #	Sample Type	Depth (cm)	Soil Type	Date of Analysis	Primary COPCs										Secondary COPCs									
					^{226}Ra (Bq/g)	^{234}Th (Bq/g)	^{232}Th (Bq/g)	Arsenic (µg/g)	Antimony (µg/g)	Cobalt (µg/g)	Copper (µg/g)	Nickel (µg/g)	Uranium (µg/g)	Lead (µg/g)	Barium (µg/g)	Beryllium (µg/g)	Boron (µg/g)	Cadmium (µg/g)	Mercury (µg/g)	Molybdenum (µg/g)	Selenium (µg/g)	Silver (µg/g)	Vanadium (µg/g)	Zinc (µg/g)
PHAI Clean-up Criteria					0.29	1.16	0.158	20	137	40/*50*	225/*300*	150/*200*	35	200	750/*1000*	-	1.5/120	12	10	40	10	20/*25*	200	600/*800*
Background Value					0.048		0.055	17	1	21	85	43	1.9/2.1	120	210			1	0.23	2.5	1.9	0.42	91	160
004		30-40	Sandy fill																					
005		40-50	Sand and gravelly fill																					
EOH		50																						
HA12 (02-Sep-2010)																								
001		0-10	Topsoil																					
002		10-20	Topsoil and gravelly fill	13-Sep-10	0.175	<0.2	0.02	**65.6**	5.48	13.7	69.8	29.1	34.2	**1690**	**792**	1.71	26.6	0.602	0.267	1.31	2.22	1.77	72.8	357
003		20-30	Topsoil and gravelly fill																					
004		30-40	Topsoil and gravelly fill																					
005		40-50	Gravelly fill with slag and trace organics																					
EOH		50																						
HA13 (02-Sep-2010)																								
001		0-10	Topsoil																					
002		10-20	Topsoil and gravelly fill	13-Sep-10	0.266	<0.2	0.025	**65**	12.4	16.7	59.7	30.2	32.6	**671**	530	1.69	27.4	0.845	0.26	1.48	1.3	1.38	66	478
003		20-30	Topsoil and gravelly fill																					
004		30-40	Topsoil and gravelly fill																					
005		40-50	Gravelly fill with trace organics																					
EOH		50																						
HA14 (02-Sep-2010)																								
001		0-10	Topsoil																					
002		10-20	Topsoil and gravelly fill																					
003		20-30	Topsoil and gravelly fill																					
004		30-40	Topsoil and gravelly fill	13-Sep-10	0.045	<0.2	0.025	**24.3**	4.02	12.2	38.2	24.6	14.9	**531**	488	1.62	24.3	0.355	0.268	1.16	1.27	0.581	74.8	175
005		40-50	Gravelly fill with trace sand																					
EOH		50																						
HA15 (01-Sep-2010)																								
001		0-10	Topsoil																					
002		10-20	Topsoil and gravelly fill																					
003		20-30	Topsoil and gravelly fill																					
004		30-40	Topsoil and gravelly fill	13-Sep-10	0.043	<0.2	0.024	18.7	19.2	8.65	34.7	17.4	14.6	**207**	477	1.39	30.2	0.324	0.067	0.894	1.06	0.313	68.8	169
005		40-50	Sand																					
EOH		50																						
HA16 (02-Sep-2010)																								
001		0-10	Topsoil																					
002		10-20	Topsoil and gravelly fill																					
003		20-30	Topsoil and gravelly fill with trace slag																					
004		30-40	Topsoil and gravelly fill with trace slag																					
005		40-50	Gravelly fill	13-Sep-10	0.033	<0.2	0.008	18.4	**886**	7.29	57.1	32.8	5.28	**4480**	**2370**	0.604	374	0.341	<0.05	4.58	<1	0.334	45.7	**2520**
006		50-60	Gravelly fill																					
007		60-70	Gravelly fill																					
008		70-80	Gravelly fill, trace sand and white																					
EOH		80																						
HA17 (02-Sep-2010)																								
001		0-10	Topsoil																					
002		10-20	Topsoil and gravelly fill																					

Table T-1
Site - Detailed Soil Analytical Results

					Primary COPCs										Secondary COPCs									
					^{226}Ra	^{234}Th	^{232}Th	Arsenic	Antimony	Cobalt	Copper	Nickel	Uranium	Lead	Barium	Beryllium	Boron	Cadmium	Mercury	Molybdenum	Selenium	Silver	Vanadium	Zinc
					(Bq/g)	(Bq/g)	(Bq/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)
					PHAI Clean-up Criteria																			
Sample #	**Sample Type**	**Depth (cm)**	**Soil Type**	**Date of Analysis**	**0.29**	**1.16**	**0.158**	**20**	**137**	***40/50***	***225/300***	***150/200***	**35**	**200**	***750/1000***	**-**	**1.5/120**	**12**	**10**	**40**	**10**	***20/25***	**200**	***600/800***
					Background Value																			
					0.048		**0.055**	**17**	**1**	**21**	**85**	**43**	**1.9/2.1**	**120**	**210**			**1**	**0.23**	**2.5**	**1.9**	**0.42**	**91**	**160**
003		20-30	Topsoil and gravelly fill																					
004		30-40	Sand and gravelly fill																					
005		40-50	Sand and gravelly fill	13-Sep-10	0.01	<0.2	0.007	18	5.58	5.57	15.6	12.9	7.97	121	310	0.902	17.9	0.145	<0.05	0.401	<1	0.226	40.9	89.6
006		50-60	Sand and gravelly fill																					
EOH		60																						
HA18 (02-Sep-2010)																								
001		0-10	Topsoil																					
002		10-20	Gravelly fill with sand	13-Sep-10	0.039	<0.2	0.014	13	2.94	6.32	14.1	12.4	18.9	112	452	1.17	17.8	0.229	<0.05	0.478	<1	0.304	52.4	91.4
003		20-30	Sand																					
004		30-40	Sand																					
005		40-50	Silty sand with sand																					
EOH		50																						

Notes:

COPCs: Contaminants of Potential Concern and background values are defined by Port Hope Area Initiative Clean-up Criteria (see EcoMetrix 2006).

EOH: End of borehole.

Radium-226 values measured by LLRWMO gamma spectrometry and all other parameters by Kinectrics ICP-MS.

Boron standards for al surface soils are 1.5 µg/g for hot water soluble extract. For subsurface soils the standards are 120 µg/g for total boron (mixed strong acid digest), as ecological criteria are not considered.

Italicized values apply to medium and fine-grained soils only. Those not in italics apply to either all soils (where italicized values are absent) or to coarse soils.

* Insufficient sample for analysis

Bold and Highlighted values exceed COPC criteria.

Figures

LEGEND

- BOREHOLE LOCATION
- DELINEATION BOREHOLE LOCATION
- HAND AUGER LOCATION
- SITE PROPERTY BOUNDARY (APPROX.)

N

2 1 0 2 4
Metres

AIR PHOTOGRAPHY: 2006

No	DATE	REVISION	BY	CHK	APP.
00	11/04/25	ISSUED WITH FINAL REPORT			

SNC·LAVALIN

Client: AFCL FACI

Project: Small-Scale Sites Resurvey and Remediation Trials Cost Assessment (SRCA)

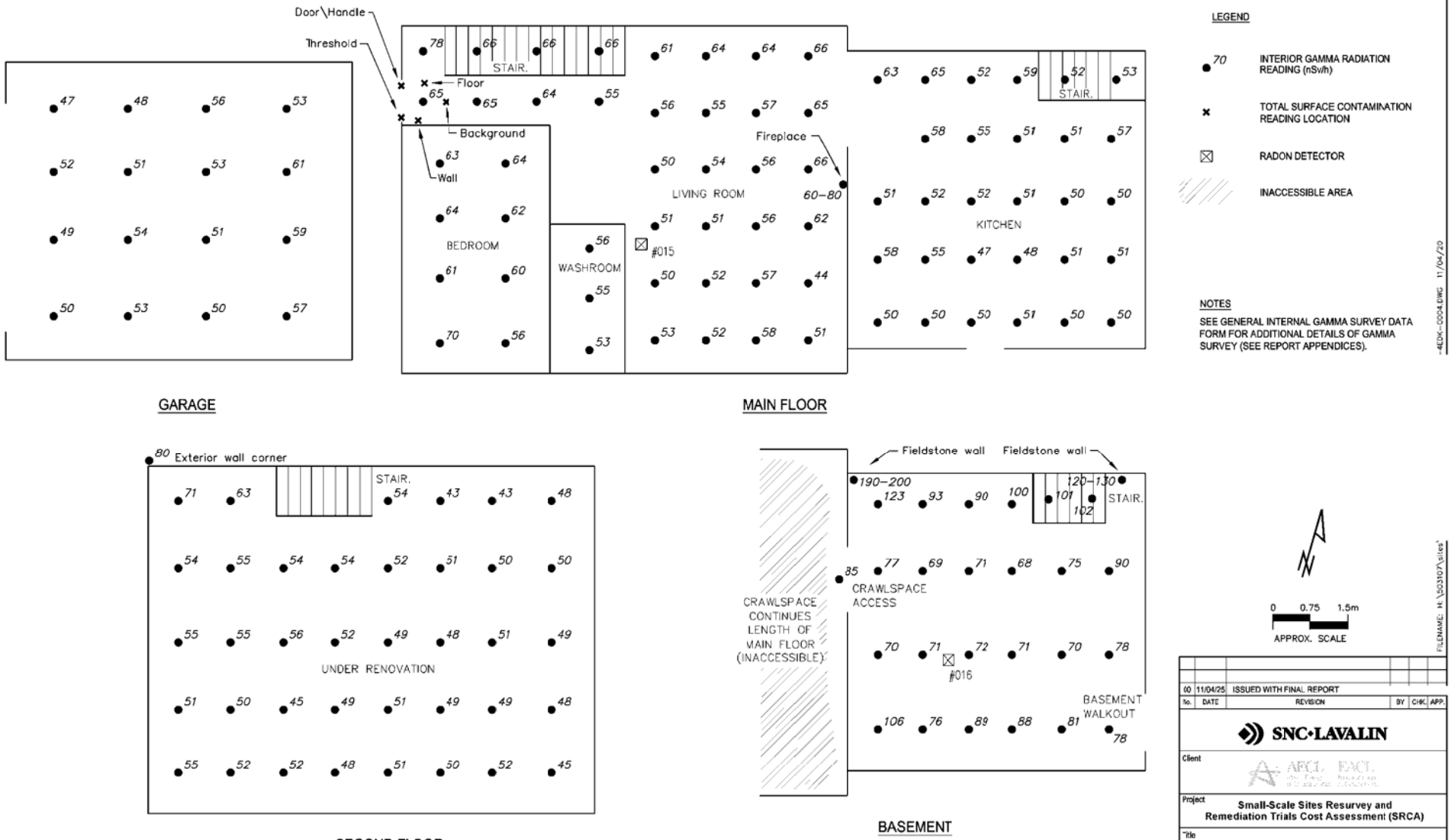
Title: BASE MAP WITH BOREHOLE LOCATIONS

Scale	1 : 200		Drawn	Date	APR, 2011
Approval	Int.	Date	Figure No.		Rev.
Designed		11/04/25	1		00
Checked		11/04/25			
Approved		11/04/25			

FILENAME: H:\35\07\dwg

Format: 11 x 17 Sheet Size

A0009693_35-000035



No.	DATE	REVISION	BY	CHK.	APP.
00	11/04/25	ISSUED WITH FINAL REPORT			

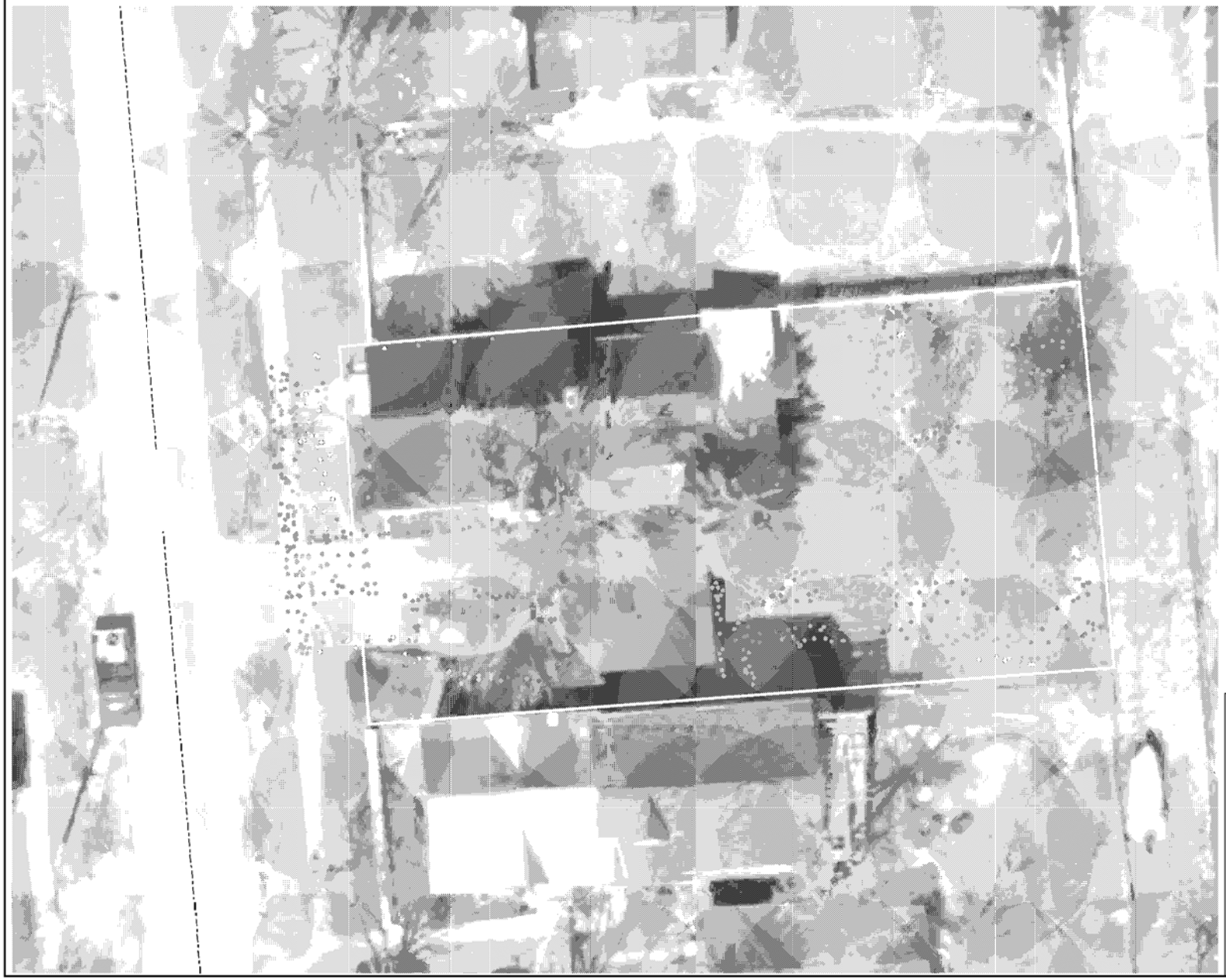
SNC·LAVALIN

Client

Project
Small-Scale Sites Resurvey and Remediation Trials Cost Assessment (SRCA)

Title
INTERIOR GAMMA RADIATION SURVEY READINGS

Scale	1 : 75 (approx.)		Drawn	Date	APR. 2011
Approval	Init.	Date	Figure No.		Rev.
Designed		11/04/25	2		00
Checked		11/04/25			
Approved		11/04/25			



Legend

GAMMA RADIATION READING (nSv/h)

- 0 - 70
- 71 - 140
- 141 - 210
- >210

SITE PROPERTY BOUNDARY (APPROX.)

N

2 1 0 2 4

Metres

AIR PHOTOGRAPHY: 2006

No	DATE	REVISION	BY	CHK	APP.
00	11/04/25	ISSUED WITH FINAL REPORT			

SNC·LAVALIN

Client

AECL EACL

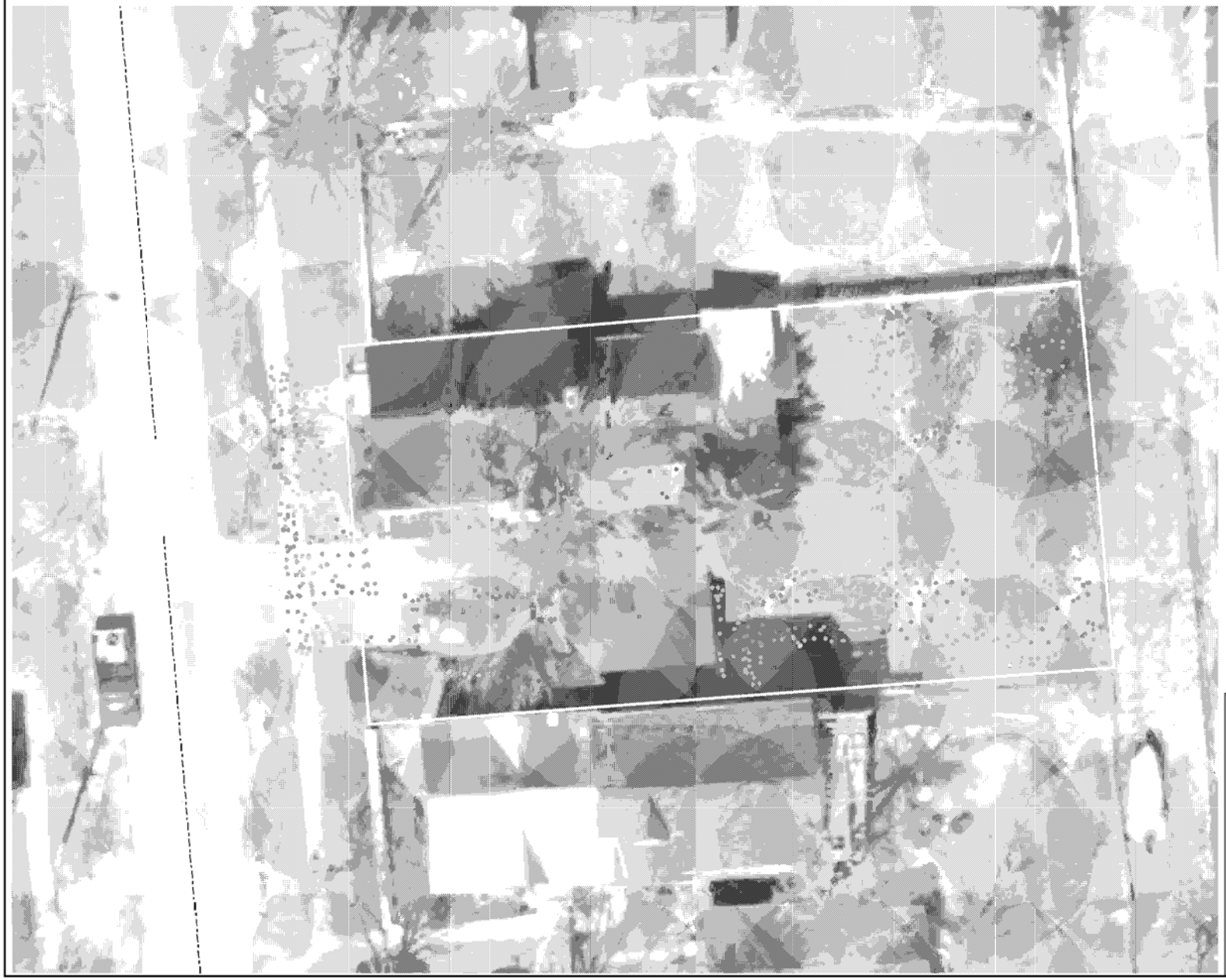
Project

Small-Scale Sites Resurvey and Remediation Trials Cost Assessment (SRCA)

Title

GAMMA RADIATION SURVEY READINGS AT GROUND SURFACE

Scale	1 : 200		Drawn		Date APR, 2011
Approval	Int.	Date	Figure No.	3	Rev. 00
Designed		11/04/25			
Checked		11/04/25			
Approved		11/04/25			



Legend

GAMMA RADIATION READING (nSv/h)

- 0 - 70
- 71 - 140
- 141 - 210

SITE PROPERTY BOUNDARY (APPROX.)

N

2 1 0 2 4

Metres

AIR PHOTOGRAPHY: 2006

No	DATE	REVISION	BY	CHK	APP.
00	11/04/25	ISSUED WITH FINAL REPORT			

SNC·LAVALIN

Client

AECL EACL

Project

Small-Scale Sites Resurvey and Remediation Trials Cost Assessment (SRCA)

Title

GAMMA RADIATION SURVEY READINGS AT 1m ABOVE GROUND

Scale	1 : 200		Drawn	Date	APR, 2011
Approval	Int.	Date	Figure No.		Rev.
Designed		11/04/25	4		00
Checked		11/04/25			
Approved		11/04/25			

Appendix A

Consent Form and Communication Notices

AECL – OFFICIAL USE ONLY

s.19(1)

AECL

Port Hope Area Initiative Management Office

Property Survey Access Consent Form

Port Hope Area Initiative Management Office
5 Mill Street South
Port Hope, Ontario, L1A 2S6
Ph: (905) 885-0291
Fax: (905) 885-9344

LLRWMO File No. 2185- K3.53 LLRWMO-121250-000-5838

PHAI File No. 4501-121250-110-000

Property Address			
Street Name & Number:			
Municipality:	Port Hope		
Province:	Ontario	Postal Code:	L1A

Property Owner's Name(s): Phone #:

Email Address:

Property Owner Mailing Address (if different from above)

Street Name & Number:			
Municipality:			
Province:		Postal Code:	

Please check the appropriate boxes.

- ☒ I am (we are) the Property Owner(s).
- ☒ I have ensured all residents and/or tenants are aware of this Access Agreement.
- ☒ I am acting on behalf of the Property Owner with the Owner's permission attached in writing.

I allow access to the property by AECL personnel or by authorized persons working on behalf of AECL for the purpose of conducting surveys and detailed investigations for the identification of contaminants that may require removal under the PHAI clean-up criteria. Such investigations may entail drilling exterior boreholes, collection of soil samples, interior/exterior contamination surveys and interior radon gas sample collection.

AECL will leave the property in the same state as it was prior to the survey, to the extent practicable.

Arrangements for access will be made verbally and in advance of any on-site investigations.

Owner's Name (Printed):	Owner's Name (Printed):
Signature:	Sign
Date: June 7	Date: June 7 2010
AECL Representative (Printed):	SUZANNE STICKLEY
Signature: Suzanne Stickley	Date: June 7 2010

Except for personal information, all information collected as part of the surveys/investigations will be the property of AECL. It is anticipated that the information will be available to third parties, as part of the PHAI Port Hope project.

Personal information collected on this form is protected under the federal *Privacy Act* and will be used to allow access to your property for the purpose of conducting surveys and investigations. Failure to provide the information may have an impact on the Property Resurvey project status. Please contact the Port Hope Area Initiative Management Office or the Coordinator, Access to Information and Privacy at AECL (www. aecl.ca/contact/access), in the event you would like access your personal information. Full details regarding this collection of information are available at Info Source (www.infosource.gc.ca/index-eng.asp) by referring to "Institute-Specific Personal Information Bank AECL PPU 007."

Signed document to be returned to:
Port Hope Area Initiative Management Office
5 Mill Street South, Port Hope, Ontario, L1A 2S6

SNC·LAVALIN

SNC·LAVALIN Inc.
400 Carlingview Drive
Toronto, Ontario
Canada M9W 6N9

Telephone: 416-679-6000
Fax: 416-231-5356

July 13, 2010

Port Hope Area Initiative Small Site Resurvey Program

Thank you for you participation in the Port Hope Area Initiative Small Sites Resurvey Program. The first stage of the resurvey of your home and property has been scheduled for:

TIME 1:00 PM **DATE** Monday, July 19, 2010

We request that a member of the household be present during the first stage of the resurvey, which should take approximately 4 hours. Personnel conducting surveys will be identified with Port Hope Area Initiative name tags. If you are unavailable for the scheduled appointment, please contact SNC Lavalin at 1-888-679-6291 as soon as possible to reschedule.

Indoor and outdoor radiation surveys will be performed, which will require access to all rooms of your home and areas of your property. Also, we will be installing radon monitors, which we will be returning to remove within 5 to 8 days after our initial visit. To assist us in completion of the resurvey work, we ask that you follow these guidelines:

- Outdoor surveys will involve the use of a wheeled trolley. Where possible, please clear yard of objects, or mow tall grass, which may impede use of this trolley.
- For the convenience of our staff, please keep pets and children away from areas and rooms being surveyed.
- Cars should be parked on the street to allow surveying of the driveway and garages/ carports.
- During the 5 to 8 days while the radon monitor is in place, normal house conditions should be maintained to the extent possible.
    - If you have a radon abatement system, please continue to operate normally during the measurement period.
    - Air conditioning systems that recycle interior air can operate normally during the measurement period.
- Detectors should not be touched, moved, or manipulated in any way as to interfere with their performance.

The second stage of the resurvey work will involve drilling one to three small boreholes in your yard to obtain soil samples. We will contact you to arrange for a convenient time for this work, although you will not be required to be present during the drilling.

If you have any concerns other than scheduling, the Port Hope Area Project Information Exchange can be contacted at (905) 885-0291 (Sue Stickley, Communications Officer).

PORT HOPE AREA INITIATIVE
(905) 885-0291

AECL Atomic Energy of Canada Limited
EACL Énergie atomique du Canada limitée

Information

PORT HOPE AREA INITIATIVE

July 2010

For your information

Subject: Local Site Visit Work in Support of the Port Hope Project

The Port Hope Area Initiative is responsible for the cleanup and safe management of historic low-level radioactive waste in Port Hope and Clarington for the long-term. Under the Port Hope Project waste will be removed from its current locations (remediated) and transferred to a new secure above-ground management facility to be constructed on the site of the current Welcome Waste Management Facility.

Property visits, radiological surveys and cleanup work in the Municipality of Port Hope are part of the Small Scale Site Resurvey and Remediation Trials Cost Assessment. This pilot project involves about 35 candidate sites at various locations in Port Hope. The firm of SNC Lavalin has been retained to undertake this work.

If you have any questions regarding this work in support of the Port Hope Area Initiative, please contact the Port Hope Project Information Exchange at 115 Toronto Road (905) 885-0291. For up-to-date project information, please visit our website at www.phai.ca

Thank you for your interest

Sue Stickley

Suzanne Stickley
Communications Officer

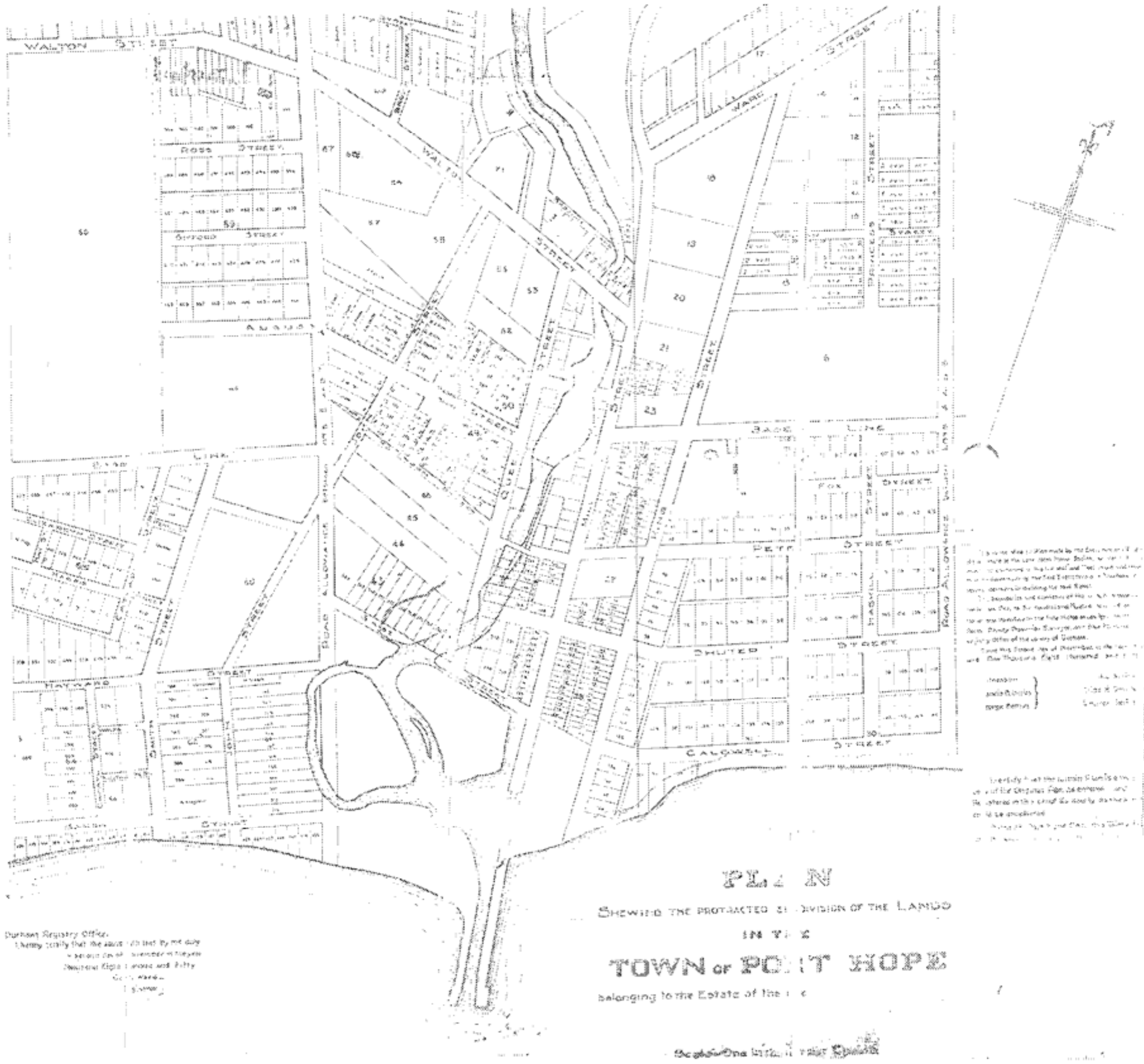
PORT HOPE AREA INITIATIVE MANAGEMENT OFFICE

P.S. IN YOUR NEIGHBOURHOOD ON
Monday, July 12, 2010

Canada

Appendix B

Legal Survey



WALTON STREET
ROSS STREET
GIFFORD STREET
WARD STREET
BACK LINE
FOX STREET
PETER STREET
SHUTER STREET
CALDWELL STREET
QUEEN STREET
PRINCESS STREET
ROAD ALLOWANCE
PL N
SHEWING THE PROTRACTED S DIVISION OF THE LANDS
TOWN OF PO T HOPE
belonging to the Estate of the
Durham Registry Office.

Appendix C

Historical File Review

File Review

June 23, 2010 s.19(1)

Recent construction monitoring has been done at this property, as the owners are currently undertaking a renovation of the home. **This information is not in the file. It should be reviewed before planning the site investigation work.**

Record of Radiation Survey June 22, 1976
Shows outdoor gamma readings; elevated near front of yard (0.020 – 0.030 mrem), and slightly elevated above background in back yard (0.014 – 0.018 mrem) throughout.

Radon samples March 23 1977
Basement by stairs 18 pCi/L
Basement by furnace 14 pCi/L
Dining room 14 pCi/L

Basement is not habitable, and part is crawl space.

Pre-Remedial Surface & Subsurface Gamma, Radon, WL and Contamination Survey by JFMcL, 18 May 1979 Plan
Shows exterior and interior survey results and boreholes drilled
Very good plan
Shows area for excavation in backyard, and in front of garage. Indicates other areas with elevated readings. Indicates boreholes and source contamination in boreholes. Indicated elevated readings along property line along north side of house; suggests contamination extends to property to north??.

PreRestoration Surface Gamma Survey by JFMcL, May 1980; shows area of extent of excavation around back portion of house.

May 4, 1995 CMP letter to owner re addition to east side of house.
Indicates that contaminated soils within 3 m of the foundation walls and the addition areas occur and should be removed to TSS, and that a passive sub-floor ventilation system be installed in the addition.
The addition was never built for this owner.

June 21, 1999 Request for Radiological Status report by owner, as owner uncovered slag material when digging in her yard.

June 5, 2007 Letter to Realtor
Summarizes the activities:
1976-79: surveys indicated remediation required (radon and gamma readings)
1979: Remediation included removal of 71 m3 of soil from around the perimeter of the home. A sump pump and weeper system, and a trap seal primer on floor drains within the basement were installed.

1979-83: Radon gas measured – two previously unknown floor drains were discovered and sealed with concrete. Subsequently, the radon readings were reduced.
1993: subsurface gamma investigation for a CMP determined above normal range of background, but below FPTFR criteria. This CMP was for the addition of a deck, but the deck was not installed at that time.

January 8, 2009 Letter
During Dec 2008, radon sampling was done by Jay Sherwin. The mean of the values was 3.4 pCi/L. The following average values were recorded:
Basement 4.0 pCi/L
Main floor living room 3.0 pCi/L
Second floor master bedroom 2.9 pCi/L

March 23-30/10 Kitchen Modification and expansion: Detailed maps are available.
Gamma readings observed over the proposed area of construction (rear of the dwelling) ranged 6-10 µR/h
During excavation, waste material readings from the kitchen ranged 5-6 µR/h.
Also, second addition proposed for the dwelling: a porch mounted on sono tubes at the front of the dwelling. Footprint of the porch gamma readings ranged: 10-25 µR/h. The contractor indicated that there is no plan to remove any soil from the porch location.
Two (2) Boreholes within the footprint of the porch and one (1) borehole within the footprint of the kitchen addition at the rear of the dwelling were completed to a depth of 45 cm. The gamma readings ranged from 11-40 µR/h.
The soil sample taken from 0-15 cm at the borehole 1 and 2 (taken within the footprint of the proposed porch) failed the criteria of 0.3 Bq/g for 226Ra. Results were 0.339 Bq/g and 0.255 Bq/g respectively for BH1 and BH2.

April 5/10
Deck removed for preparation for kitchen extension. Beneath the deck readings: 5-7 µR/h.

April 7/10
Two (2) BH completed to a depth of 60cm in area beneath the former deck. Gamma readings ranged: 6-10 µR/h.

Construction of west addition where contamination was found is expected in later summer 2010.

Issues to investigate:

Need new CMP results
Site is within the deposition plume
Contractor at site indicated they thought there was some issue with area of front garden that would be beneath new porch: Contamination was found in area of new porch within the first 15cm.
Need to clarify radon remedial measures that may be present in basement
Need to identify how to survey crawl space.
Need to identify Slag – investigate.

Notes from Site Visit to obtain Consent
Site visit conducted June 7, 2010

The house is undergoing a renovation at the moment.
The radon detectors could go in the basement and the main floor bedroom, as these would not be disrupted too much.
The front of the house is about 150 yrs old, and has only a crawl space below it – the house behind has a basement (though it is uninhabitable), and the new addition is attached to the original house.
s.19(1)
The neighbour

There was a "Drip" mechanism in basement for control of radon, that has since been removed – documentation doesn't say when this was done.

Appendix D

Kinectrics Field Data Collection Forms and Satisfaction Survey

s.19(1)

Site No.	RADON - DEPLOYMENT DATA FORM	KINECTRICS

TEST SITE

Name: _

Home Address: _____

City, Province: PORT HOPE, ON

phone # ~~690~~

Time in: 13:00

Time out: 15:30

Verified by: __

TEST DATES

Start Date: 19-July-2010 (dd-mmm-yyyy) Start Time: 13:50 (hr:mm)

Deployed By: _

DETECTOR INFORMATION

Electret #	Box #	Room Deployed	Location in Room	Background Gamma	Comments
SF1437 / SFI556	016	Basement	Wooden shelf	71 nSv/hr	House under major renovation -
SFI 415 / SFI 443	015	Living room	Bookcase/shelf	51 nSv/hr	new addition being built on the main floor and second level - all walls are being interior replaced.

Digital photograph taken of each detector (i.e. Box) location? (YES) or NO

*If **YES** - specify camera and file name for each Box below*

Box # 016

Camera #1, pic # 0254

*If **NO** - draw the sketch of each Box location below*

Box # 015

Camera #1, pic # 0257

TEST SITE INFORMATION

General House Information

House Type: detached, 2 storey (BASEMENT) or SLAB ON GRADE or (CRAWL SPACE) ↗ unaccessible

Finished or Unfinished Basement? FINISHED or (UNFINISHED)

Walkout Basement? YES or (NO) - used to be but

Central HVAC System YES or (NO) now concrete is sealed

Thermostat Set At: N/A

Protocols

Closed House Conditions During Testing Period? YES or NO or (NOT MONITORED)

Tamper Controls

Tamper Indicating Controls Used? (YES) or NO

Description of Tamper Controls: lock ties and tamper tape

pick up: Mon. morn. 11-12, call

K-015367-FORM-0002

GENERAL INTERNAL GAMMA SURVEY DATA FORM

Site No.

TEST SITE

Date (YY/MM/DD): 10-07-19

Time start: 13:00

Time finish: 15:00

Surveyor: _

EQUIPMENT

DETECTOR MODEL: FHZ 672 E-10 NBR

Serial Number of Detector (Circle One): 759 (760) 764

Serial Number of Rate Meter (Circle One): 23451 19425 23623 (23601)

α det: 0650

α rate meter: 23582

INSTRUMENT CHECK "Pass" if within required reading range.

SOURCE: **Co-60**

Required reading: **2 ± 0.5 uSv/h**

Actual reading: 1.80

Circle One: (**Pass**) **Fail**

Ra-226 35

130 ± 20 cps 4K

150

(pass) fail

PHOTOGRAPHS

Camera Number: (Circle One) (1) 2

File Start Number: 0254

Memory Card Number: (Circle One) (1) 2 3 4

File End Number: 0274

Verify Camera Date/Time: ☑

SURVEY

Minimum Coverage: 1m x 1m

	Complete	NA	Calculate # Survey Locations		Survey Complete	Identify High Values
Floor plan of basement:	☑	☐	☐	25	☑	☐
Floor plan of main floor:	☑	☐	☐	4K 8272	☑	☐
Floor plan of second floor:	☑	☐	☐	38	☑	☐
Floor plan of crawl space:	☐	☑	☐		☐	☐
Floor plan of _____:	☐	☐	☐		☐	☐

DUPLICATED AND SCANNED TO KINECTRICS INC (Date when complete)

A0009693_51-000061

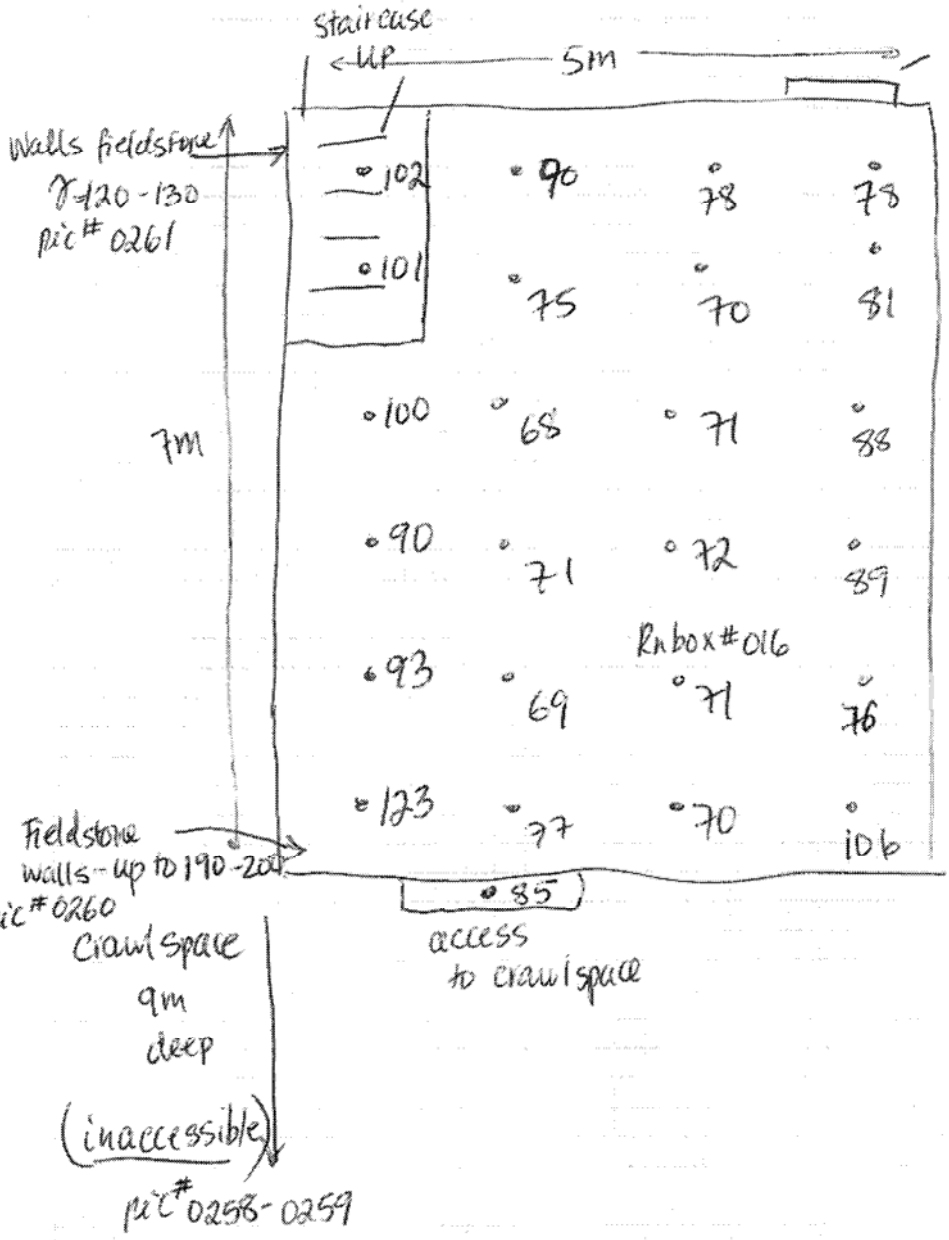
K-015367-FLRPN

Site No: B

Description Basement

Date (YY/MM/DD) 10-07-19

Surveyor



- Drawn not to scale
- Units: nSv/hr