

The Challenges Of Investigating And Remediating Port Hope's Small-Scale Urban Properties – 13115

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ABSTRACT

An important component of the Port Hope Project, the larger of the two projects comprising the Port Hope Area Initiative (PHAI), is the investigation of all 4,800 properties in the Municipality of Port Hope for low level radioactive waste (LLRW) and the remediation of approximately 10% of these. Although the majority of the individual properties are not expected to involve technically sophisticated remediation programs, the large number of property owners and individually unique properties are expected to present significant logistic challenges that will require a high degree of planning, organization and communication. The protocol and lessons learned described will be of interest to those considering similar programs.

Information presented herein is part of a series of papers presented by the PHAI Management Office (PHAI MO) at WM Symposium '13 describing the history of the Port Hope Project and current project status. Other papers prepared for WM Symposium '13 address the large-scale site cleanup and the construction of the long-term waste management facility (LTWMF) where all of the LLRW will be consolidated and managed within an engineered, above-ground mound.

INTRODUCTION

Large remediation projects are often characterized by large tracts of property, often in industrial settings, which involve the significant mobilization of construction equipment and supplies in relatively narrowly-focused programs. Although multiple owners, sub-sites and technologies are often involved in these large projects, few projects are like the Port Hope Project where almost 5,000 sites owned by an almost equal number of property owners, largely private citizens, will be investigated. Further, an estimated 400 to 500 of the sites will require the preparation and implementation of individual remediation plans.

The history of the distribution of LLRW onto the SSS properties in the community is varied. Near to the former Eldorado Nuclear Limited plant, there are properties that were impacted by airborne particulate emissions from the refinery stacks. A larger number of sites were impacted by uncontrolled backfilling of low-lying areas in the community using the structurally sound process wastes available from the plant site during the 1930s through the 1950s. A very small number of properties have materials – lumber and steel beams for example – that had been removed from the plant site during demolition operations, which were subsequently incorporated into the structures of homes and other buildings.

Port Hope has been the subject of investigations and interim cleanups since the 1970s. Between 1977 and 1981, every property in urban Port Hope (3,500 at the time) was radiologically tested using standards established by the 1977 Federal-Provincial Task Force on Radioactivity² and over 100,000 cubic metres of LLRW was removed from approximately 450 properties.

Since the late 1980s, all properties in the Municipality of Port Hope have been required to undergo testing under a Construction Monitoring Program whenever earthmoving, renovations or new construction occurs or a building permit issued. Additionally, whenever a house is sold, it is a requirement for the owner (seller) to declare the radiological status of the property – and at times this has prompted testing. As a result, an extensive library of records (files) of the radiological status of most properties in urban Port Hope has been generated and is maintained by AECL. Today, property files exist for about 4,600 of the 4,800 registered parcels of land in the community. Newer properties built in the past two decades are the ones least likely to have a file or to have LLRW. Older properties in Port Hope's core, and particularly those constructed between 1933 and 1955, are the most likely to contain LLRW since stack emissions from the Eldorado plant, and uncontrolled backfilling during construction of residential subdivisions, were the most common sources of LLRW. The property files are of varying volume and complexity, depending on the history of investigation and remediation on the property, ranging from a few pages to hundreds of pages.

The SSS survey and cleanup program undertaken by the PHAI will use new, more stringent criteria than those used by the Federal-Provincial Task Force on Radioactivity and employ broader testing protocols to identify the LLRW, as summarized in Table I. The current SSS program also incorporates a proactive and reactive public relations program and a highly standardized planning and testing regimen. This regimen will ensure that all properties of similar age, layout, and remediation history receive a uniform level of evaluation and remediation, regardless of the investigative team assigned to it.

The investigation of all 4,800 properties will occur between 2012 and 2016 and the remediation will take place between 2015 and 2019 when the mound at the Long Term Waste Management Facility is open to receive waste from major remediation sites and the SSS. The SSS program is, therefore, still in its early stages. To date, accomplishments include:

- Investigations of 35 properties and one trial remediation in 2010.
- Radon testing of approximately 450 homes in the summer of 2012.
- Award and initiate contract to investigate 450 properties for the presence of LLRW in 2012-13 (Campaign 1).
- Award and initiate contract to complete radon testing of approximately 1,100 homes/buildings in the winter/spring of 2013 (Campaign 2).

² The FPTFR standards are based on protection of human health: 0.02 Working Levels (148 Bq/m³) for radon and 0.05 mR/hr (indoors) and 0.1 mR/hr (outdoors) 1m above centre of floor and bare ground, respectively, for gamma radiation.

Table I – Cleanup Criteria for Residential Properties

	Contaminant of Potential Concern	Residential Properties and Port Hope Sites Without Development Constraints²
Soil and Sediment - Primary COPC	²²⁶ Ra (Bq/g) ^{1,3}	0.24
	²³⁰ Th (Bq/g) ^{1,3}	1.11
	²³² Th (Bq/g) ^{1,3}	0.103
	Arsenic (ppm)	18
	Antimony (ppm)	7.5
	Cobalt (ppm)	22
	Copper (ppm)	140 (180)
	Nickel (ppm)	100 (130)
	Uranium (ppm)	23
	Lead (ppm)	120
Soil and Sediment - Secondary COPC	Barium (ppm)	390
	Beryllium (ppm)	4 (5)
	Boron Total (ppm)	120
	Boron Hot Water Soluble (ppm)	1.5
	Cadmium (ppm)	1.2 (1)
	Mercury (ppm)	0.27 (1.8)
	Molybdenum (ppm)	6.9
	Selenium (ppm)	2.4
	Silver (ppm)	20 (25)
	Vanadium (ppm)	86
Zinc (ppm)	340	
Surface Contamination	Removable loose contamination by swipe	0.4 Bq/cm ² beta / gamma, and 0.04 Bq/cm ² alpha
Air	Radon in buildings	125 Bq/m ³ averaged over summer and winter, if concentration of ²²⁶ Ra in surrounding soil exceeds background (0.048Bq/g)

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1. Criteria are expressed as incremental concentrations for radionuclides; total concentrations for other COPC.
 2. Lower values (in parentheses) represent MOE “Table 2” values for agricultural use in potable groundwater situations. Other values are applicable to residential land uses (where two values are listed) or to both residential and agricultural land uses (where only one value is given). Additional criteria exist for commercial / industrial and special circumstances.
 3. Summation rules apply to ^{226}Ra , ^{230}Th and ^{232}Th . Criteria used for these COPC represent incremental concentrations.

Over the next four years, four additional investigative campaigns will be implemented by the PHAI MO which will include approximately 1,100 properties each year (Campaigns 2, 3, 4 and 5). Lessons learned from the work completed to date have been helpful in planning the upcoming investigations and in identifying the challenges. The following sections presents these experiences and summarizes the more significant lessons learned. As the SSS program progresses, the PHAI MO will continue to document the lessons learned and share them with the remediation community.

TRIAL INVESTIGATIONS AND REMEDIATION – 2010

A trial investigation program involving 35 properties was undertaken in 2010 for the purposes of: i) developing cost estimates for the future larger investigations and remediation of small-scale sites; ii) developing and validating operating guidelines, procedures and plans for the various types of small-scale sites; and, iii) assessing the effectiveness of the communications applied during the trials program and its applicability for the next phase of the Project.

The scope of the trial investigations involved:

- Indoor radon measurements;
- Interior and exterior surface contamination (objects and materials);
- Interior and exterior gamma scanning;
- Core and down borehole gamma scanning;
- Swipe sampling for loose contamination; and,
- Contaminant concentrations in soil (radiological and non-radiological).

From a review of the property files on record, properties selected for the trial included a broad distribution of expected LLRW quantities, from none (termed Type A properties) to significant quantities, including those with complex impacts (building materials, termed Type E properties). The selection of properties for the trial survey was deliberately biased to those expected to be Types C and D properties (less than and more than 25% of their surface areas, respectively, impacted by LLRW) to test the trial program under more challenging conditions. The trial program also included properties expected to not contain LLRW, to confirm that assumption. The assignments of the property type classification were based a review of the historical property files.

Lessons Learned

Based on the trial survey and a subsequent remediation of one property (discussed in subsequent sections), there were a number of “lessons learned.” The following summarizes the most significant findings:

1. Better delineation of contaminated properties needs to be completed before remediation begins to confirm the depth and lateral extent of contamination. This will improve the likelihood of passing the verification procedure and ensuring that the remediation can be completed quickly, efficiently and within the allotted schedule. The single residential property remediated during the trial was investigated by 27 boreholes and 47 analytical samples, which proved to be insufficient during remediation to definitively delineate the cleanup area without the need to repeatedly re-excavate the property to a depth and area meeting the cleanup criteria.
2. Investigating and remediating properties in isolation of data and remediation of neighbouring properties proved to be challenging. During the investigation, the absence of information about a neighbouring complicated the interpretation of information, especially as related to the common property line. Remediation at the property line when the neighbouring property could not be remediated was also complex since excavation could not extend all the way to the property line without undermining it or the use of expensive shoring. In future investigation program will be performed on blocks of properties such that the absence of LLRW can be more reliably determined or the presence of LLRW more accurately delineated.
3. The testing program included 20 Contaminants of Potential Concern (COPCs, see Table I), although only four are considered “signature parameters”³ which can be used to reliably and indisputably identify the LLRW. The identification of the signature parameters was made in a clean-up criteria report in which the authors concluded that “*While the primary COPCs present in LLRW consist of ten elements (or 11 at Port Granby), analysis of the data on LLRW and contaminated soil shows that contamination by LLRW invariably includes elevated concentrations of ²²⁶Ra, ²³⁰Th, As and/or U above normal background concentrations. This signature is known based on analyses of thousands of samples of LLRW and MCS from small waste sites, the Port Hope Harbour, the Port Granby WMF and the Welcome WMF*” (1). Since the PHAI mandate is to only remediate properties containing LLRW, including other waste types co-mingled with LLRW, consideration should be given to reducing the list of analytes to be tested to the signature parameters so as not to raise expectations on the part of the property owners that the PHAI will remediate other waste types.
4. Down-hole and core gamma logging can be an effective tool for guiding sample collection and characterizing soils.
5. Use of an X-ray fluorescence device to field screen samples for testing should be considered to increase the confidence in the selection of samples for laboratory testing.
6. Thoroughly document the site with text, videos, pictures and an inventory of objects prior to remediation to ensure that it can be verifiably restored to its original condition. Lists of plants, structures and other features must be developed, agreed upon and signed to by property owners so no confusion develops during the restoration.

³ Signature parameters Ra-226, Th-230, uranium, and arsenic

7. It should be stressed to the property owners, that although the intention of the Project is to restore a property to its original condition, it may not always be possible to recreate their specific garden, yard or structure.
8. Some members of the public were concerned about their health being affected by the activities of the Project. It would be beneficial for the Communication's group to have access to all applicable monitoring data, to present to the public and to post on a project website.
9. The Community Observer Group established to provide a lay perspective of the trial remediation was positive in that it provided a means of obtaining community endorsement.

THE CURRENT SSS SURVEY CAMPAIGN

The investigation of SSS will be carried out in five campaigns. The current campaign (Campaign 1) steps up the scale of the investigation from the 35 properties looked at in the 2010 trial to 450 properties. Each of the campaigns consists of 4 phases: i) file review and investigation planning; ii) assessment and delineation of LLRW; iii) remediation design; and iv) remediation of LLRW and restoration of property.

The first phase of Campaign 1 has been completed and the second phase has started. Each of the first three phases involves separate engineering / environmental consultant services contracts, to be followed by a fourth remediation phase to be performed by remediation contractors. The following two sections describe the first two phases, to the level completed and provide lessons learned.

Phase 1 - File Review and Investigation Planning

Seven consultants were retained to examine all 4,600 property files which contained thousands of pages of information on the Port Hope SSS. Because of the number of firms and the many individual involved in this task, a protocol and templates were developed to conduct and document the file reviews, so that decisions resulting from the reviews would have a consistent basis and be easily read and understood. The main element of the protocol is a decision matrix which classifies the properties into one of 7 different letter grades or "Types", as defined in Table II. The majority of properties are expected to be Type A, indicating no or little expectation of LLRW. A higher letter grade indicates expectation of a larger volume of LLRW. The decision matrix considered the following factors in classifying a property:

- Absence or presence of a file on a property. Those without files are classified based on their geographic location in Port Hope and the history of remediation on nearby properties.
- Development history on the properties. Properties developed between the 1930s and 1950s are deemed to have a higher likelihood of containing LLRW.
- Geographic location in Port Hope. Those within a certain radius and direction from the Eldorado plant are more likely to have been impacted by deposition from stack emissions.
- Previous remediation work at the site. Those sites previously remediated require investigations targeted in these areas.

- Previous history of interior radon results at the property. Properties with previous radon readings exceeding 125 Bq/m³ (considered to be higher than 90% of properties in Canada) require additional boreholes at the building perimeter.
- Previous history of gamma radiation testing at the site. Properties with previous exterior gamma radiation exceeding 7 to 12 uR/hr (dependent on the instrument) requires focused testing in these areas.

Based on the “Type” classification determined for each site (Table II), a preliminary investigation program is developed, as the main outcome of the first phase. The testing regimen described in Table II presents the most basic form of the program, with additional testing required around and in former remediation areas, around building perimeters where radon has been measured and for other reasons. In all cases continuous sampling is performed at 150mm intervals. The program is deemed to be preliminary because the opportunity for revision exists based on the results obtained for radon and gamma radiation scanning obtained during the second phase. For example, if radon testing in 2012/13 indicates radon concentrations above 125 Bq/m³, even if previous testing on record in property files indicated lower radon levels, then the decision would be made to add additional boreholes on the building perimeter.

Table II: Classifications of Small-Scale Sites arising from File Review Process

Type	Borehole Testing Program
A	10 boreholes per hectare, minimum 2 boreholes per property. Two samples per borehole.
B	10 boreholes per hectare, minimum 2 boreholes per property. Three samples per borehole.
C	20 boreholes per hectare, minimum 6 boreholes per property. Three samples per borehole.
D	20 boreholes per hectare, minimum 10 boreholes per property. Three samples per borehole.

The large number of properties and investigation plans presents a logistical challenge in terms of data and document management. This has been addressed by developing an on-line portal where the investigative program for each property is uploaded into a database with Geographic Information System functionality. Borehole locations are plotted into the portal for review and reference by all interested parties. Thus the portal enables sharing of information and serves as a tool to confirm progress and quality of the investigations.

Lessons Learned

1. The rigorous decision matrix was very useful in developing uniform and consistent investigative programs between the different evaluators. Nevertheless a quality review of every plan by a third party was still found to be necessary to confirm consistency.
2. The effort to review the files and develop the plans was significant. Initially only three consultants were retained to review the files, however four additional consultants were retained when it was found that more effort and time was required to review the files within the project schedule. The labour to review each file has averaged five hours per property.
3. Uploading of the file review and the investigation plan information into a portal has proven beneficial, as it allows for easy access by the PHAI staff as well as consultants tasked with implementing the investigations. The portal includes standard reporting sheets, which also ensured that the communication of information between the various parties was unambiguous. Additional functionality to upload investigative information will be added.

PHASE II – INVESTIGATION AND DELINEATION

The investigation and delineation of LLRW on properties is a multi-stepped process. The activities include engaging with the community to obtain access agreements, scheduling visits with property owners, completing the investigation and following up with the delineation, as necessary. The following three sections discuss these steps and the lessons learned to date.

ENGAGING WITH THE COMMUNITY & OBTAINING ACCESS AGREEMENTS

The engagement of the community as a whole, and the property owners within the community, is partially done through well-established PHAI MO communications channels and partially through SSS-specific communication initiatives. This two-pronged approach enables PHAI MO communicators to take advantage of proven networks, distribution channels, relationships, and communications products as a base for SSS communications and to supplement this current infrastructure with that which will meet the more focused needs of the investigation.

For instance, news about the SSS survey has been incorporated within broader products and events concerning the Port Hope Project such as newsletters mailed to residents, open house story boards, PHAI website postings, presentations to municipal council and stakeholder groups and the annual public attitude survey. Further, established venues such as the Port Hope Fall Fair and the Project Information Exchange housed within the PHAI MO (where 40-60 people “drop in” every month) provide more casual atmospheres for discussion directly with staff.

Separately, many SSS targeted communications have been carried out in accordance with the SSS Communications Plan. Among the SSS-specific activities, the most important has been the direct communication with the owners of the properties to be surveyed with a request to sign consent forms to gain access to their properties. Other efforts have included newspaper advertisements, community information sessions, and invited Q&A sessions for those involved in the first SSS campaign who have hesitated to return their consent forms.

Intensive efforts to obtain access consent to conduct the investigation began with each property owner three months before access was actually needed. A list of property owners was initially obtained from the Municipality which included some of the required contact information, (some addresses and all telephone numbers were missing). The PHAI MO then employed the following tactics to obtain consents:

- Sent a personally addressed information package, with a cover letter, flyers, a personalized access agreement and a contact information form to 500 property owners⁴, the latter two to be returned in a stamped, self-addressed envelope;
- Held an evening and weekend information session in public venues;
- Made follow-up phone calls to all property owners who had not returned their consent forms to explain the work and need for access;
- Sent out reminder post cards; and,
- Visited every outstanding property, door-to-door, on three separate occasions.

The efforts noted above, combined with a concerted public awareness campaign, netted the PHAI MO a 93% (465 / 500) rate of return on the consent forms. The return rate was considered a great success and indicative of the very high public awareness and confidence ratings for the Port Hope Project (94% and 84%, respectively, in the 2011 public attitude survey).

In terms of the pattern of response to each of the tactics noted, the first action using the personally addressed information package resulted in approximately 50% of property owners returning the consent forms within six weeks of the letters having been issued. The subsequent efforts saw the agreements continue to slowly flow in, including an approximately 7% success rate (i.e. 35 / 500) during the door-to-door campaign. When visited at their homes, the majority of residents were entirely supportive of the investigation, and told PHAI MO staff that they had simply forgotten to mail in the forms. Of the 36 property owners who did not return their forms, the following reasons were identified:

- Property owners were selling their homes in the middle of the testing period and could not sign access agreements for the unknown future property owner;
- Property owners could never be contacted and/or reliable addresses (for properties owned by persons not living at the property) could not be found;
- Property owners had died and the estate was not yet in a position to manage the investigation; and
- Owners refused access for a variety reasons, including opposition to the project, fear, etc.

⁴ 500 owners were targeted in order to increase the likelihood that 450 consents would be obtained.

The possibility of experiencing difficulty in gaining access agreements was identified a few years ago. Accordingly, the PHAI MO and the Canadian Nuclear Safety Commission (CNSC) developed a protocol that would be employed in situations where access was refused, despite several attempts, and when it seemed likely that LLRW was present. The protocol provides for a presentation of evidence by the PHAI MO to the regulator who will then independently assess the data and make its own judgment on whether (or not) it will endorse access to the property under the authorities provided in the Nuclear Safety and Control Act.

Lessons Learned – Engaging the Community and Obtaining Access Agreements

1. Use of well-established and proven PHAI communication channels facilitated the communication efforts for the first SSS campaign.
2. Considerable effort is required to obtain complete contact information. Although the list from the municipality was a good first step, the absence of phone numbers and a few missing owner addresses required extensive effort to obtain. Once access agreements were received, all contact information was available.
3. The initial personalized mailing of the access agreement was considered important in conveying the importance of the request. Future mailings will use business envelopes with address windows to elevate the importance of the request.
4. Although a three-month period to obtain access agreements is reasonable, a portion of property owners with the best intentions may require several prompts to respond.

SCHEDULING VISITS

Although the PHAI MO is responsible for seeking and managing the access agreements with the property owners, the task of scheduling visits to the properties to implement the investigation is the responsibility of the consultant retained to complete the investigation. The consultant is provided with data from the access agreements and the contact information forms, along with the data base. Up to seven visits are to be scheduled with limited opportunity for overlap between visits, which include the following:

1. Install summer radon monitor
2. Remove summer radon monitor
3. Conduct exterior gamma scan
4. Conduct internal investigation
5. Install winter radon monitor
6. Remove winter radon monitor
7. Conduct external borehole investigation

To date, only the first two steps have been implemented on the first 450 properties, and the remaining steps will be implemented in late 2012 and early 2013. Given the high number of properties to be investigated, the consultant is using high production techniques such as specialized teams to implement the investigation, therefore there is limited opportunity for

overlapping visits. For the work completed already, visits were scheduled by telephone, which personalized the investigation and allowed for questions, but also may have been a source of difficulty in contacting some property owners. The implementation of this task was relatively straightforward, with three exceptions:

- Scheduled visits at which the property owner did not show up, this increased PHAI MO costs and effort;
- Inability to contact the property owner to schedule the visit, despite repeated attempts. The scheduling of visits and the visits themselves occurred during the summer, when some were on vacation, in some cases apparently for the entire summer; and,
- Of the 465 property owners who signed access agreements, only 392 property owners, provided access plus another 19 properties did not have buildings. Therefore there was an 88% success in obtaining access for those properties where the owners had initially agreed to provide access and 82% of those to who requests were sent (i.e. 411/500). Most properties which could not be accessed were the result of not being able to contact the owner to schedule a visit or agree on a time, but for approximately 7% of those who initially agreed to access, the property owner changed his/her mind about allowing access. It is expected some of those not accessed during the current campaign will be accessed during future campaigns.

Lessons Learned - Scheduling Visits

1. If possible, document the visits scheduled over the phone by written correspondence. Schedules documented by emails, text messages or letters, with responses by the recipient, if time permits, would ensure that all parties have the same understanding.
2. Implementing visits during the summer can be very challenging due to summer vacations.
3. Considerable effort was put into obtaining the access agreements; however significant attrition can be expected to occur during the implementation of the visits.

IMPLEMENTING THE INVESTIGATION

The radiological investigation of properties to assess the presence of historic LLRW includes five testing procedures:

1. Interior radon testing (summer and winter); spanning two seasons
2. Exterior gamma scanning;
3. Borehole soil sampling and analysis;
4. Interior gamma radiation scanning; and
5. Swipe testing.

Of the five procedures, only the first, third and fifth yield results comparable to criteria that can trigger remediation. The remaining two procedures provide information that triggers additional analyses. Testing is generally done in the order listed, the first two informing the nature and

degree of the third. The fourth procedure is applied largely independent of the first three and is used to identify contamination of interior building materials.

Radon testing is performed using the Radiation Safety Services Inc. (RSSI) Alpha Track radon detector. The RSSI radon detector, similar to several others on the market, is capable of measuring radon levels in the range of interest for the Project over a period of 30 days. During Campaign 1 the PHAI elected to test radon inside homes over a period of 30 days in each of the summer and winter, in two living areas (basement and living room normally) during each period, and then to average the results for each living area. Results over 125 Bq/m³ are a trigger for additional boreholes around the building perimeter to check for the presence of LLRW. As noted in Table I, a radon concentration over 125 Bq/m³ can also trigger soil remediation when the concentration of ²²⁶Ra in soils surrounding a building exceeds the established background concentration.

As noted previously, to date only the summer radon testing has been completed. In the first campaign, the consultants engaged by the PHAI MO placed the units in the properties and returned to pick up the devices a month later. To date 396 homes in the current 2012 campaign have been tested for summer radon. Property owners provided feedback that they found the devices innocuous and there was a 99.9% return rate from the properties. Preliminary data indicates that radon levels within Port Hope homes are statistically similar to the rest of Canada (i.e. approximately 6.9% exceed 200 Bq/m³). Analyses of blanks identified that “noise” related to crossing the international border or some other source resulted in a downward adjustment of approximately 30 Bq/m³ being required for all sample results.

Lessons Learned – Interior Radon Measurements

1. Although the original intent was to use two seasons of data to determine the need to do building perimeter borehole sampling, schedule pressures caused the Project to use the first summer season of data alone to make decisions. The winter season data will still be collected and used to make decisions on additional drilling if necessary.
2. The radon program has an intended purpose of identifying the potential presence of LLRW around the building and as such informing the degree of the borehole drilling program, however the data can also be used to identify levels exceeding the Health Canada criterion of 200 Bq/m³ measured over a 3-month period. Since statistically 6.9% of Canadian homes exceed that criterion based on emissions from natural sources (2), testing in any community, including Port Hope, will invariably identify radon levels exceeding this level even when LLRW is not present. Clear communication with property owners, prior to testing, on naturally occurring radon is important. Rapidly distinguishing it from LLRW-sourced radon by drilling perimeter boreholes is important to ensure that the responsibility for remediation can be promptly attributed so the property owner can choose to take remedial actions, independent of the PHAI.
3. The PHAI protocol of leaving the radon monitors in properties for two 1-month periods poses challenges in terms of communicating the results of the first 1-month test to the owners. The 1-month test on its own is not sufficient to evaluate long-term radon concentrations in

buildings, and as such is difficult to interpret against Health Canada criteria which require a 3-month test. Although the PHAI program is not specifically linked to Health Canada criteria, it is difficult to communicate the information in the absence of considering the criteria.

4. Based on the previous two Lessons Learned, the PHAI MO in future will implement a single six-month radon test spanning three seasons (e.g. February to July, or August to January). This testing protocol is more cost effective since only two detectors (one for each of two areas in the building) and one drop-off and pick-up are required. The results are also consistent with the Health Canada criterion so they can be used by the PHAI MO, where LLRW is detected, or by the property owners, where LLRW is not detected, to make immediate remediation decisions.
5. Obtaining data well before remediation starts (2016) poses special communication challenges for the PHAI MO. Development of strategies to address acute risks is important to ensuring that the public feels its needs are being met. Based on Health Canada information, radon readings exceeding 600 Bq/m³ should trigger remediation within 1 year. The PHAI MO selected this level as requiring immediate contact with the property owner even prior to receiving information from the remainder of the testing program.
6. It is possible that noise resulting from crossing of the international border or some other source resulted in the need to adjust the sample results for all properties. Use of blanks proved to be very valuable and their use will be refined for future work.

CONCLUSION

The Port Hope Project is in the early stages of the testing of 4,800 private properties in the Municipality of Port Hope. Beginning in 2012 and extending through 2016, the SSS survey program will be implemented over five campaigns. The PHAI has and will continually look for and document lesson learned as campaigns continue. Starting with the trial survey and remediation conducted in 2010 and continued during the historical file reviews and first survey campaign involving 450 properties, the PHAI is growing its experience, resources and applying adaptive management to shape and inform the plans for subsequent work. As the SSS work is conducted, the PHAI MO will continue to share its experiences with the remediation industry to assist others who may be considering similar investigation, design and remediation projects.

REFERENCES

1. EcoMetrix Incorporated, Port Hope Area Initiative Cleanup Criteria, December 2006.
2. Health Canada, Cross Canada Survey of Radon Concentrations in Homes, Final Report, Cat.: H144-2/2012E, ISBN: 978-1-100-20115-3, 2012.