

**Port Radium Canada's Original Radium/Uranium Mine, The Complete Story of Canada's Historic Radium/Uranium Mine, 1932 to 2012 – 13159**

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**ABSTRACT**

This paper provides the life story of Canada's original radium/uranium mine. In addition to the history of operations, it discusses the unique and successful approach used to identify the key issues and concerns associated with the former radium, uranium and silver mining property and the activities undertaken to define the remedial actions and subsequent remedial plan.

The Port Radium Mine site, situated approximately 275 km north of Yellowknife on the east shore of Great Bear Lake, Northwest Territories, was discovered in 1930 and underground mining began in 1932. The mine operated almost continuously from 1932 to 1982, initially for recovery of radium, then uranium and finally, for recovery of silver. Tailings production totaled an estimated 900,000 tons and 800,000 tons from uranium and silver processing operations respectively.

In the early days of mining, Port Radium miners were exposed to radon and associated decay product levels (in Working Level Months of exposure - WLM) hundreds of times greater than modern standards. The experience of the Port Radium miners provides important contribution to understanding the risks from radon.

While the uranium mine was originally decommissioned in the early 1960's, to the standards of the day, the community of Déline (formerly Fort Franklin) had concerns about residual contamination at the mine site and the potential effects arising from use of traditional lands. The Déline people were also concerned about the possible risks to Déline Dene arising from their work as ore carriers.

In the late 1990s, the community of Déline brought these concerns to national attention and consequently, the Government of Canada and the community of Déline agreed to move forward in a collaborative manner to address these concerns. The approach agreed to was to establish the Canada-Déline Uranium Table (CDUT) to provide a joint process by which the people of Déline could have their concerns expressed and addressed.

A great deal of work was done through the CDUT, including efforts to assess site environment and safety issues in the context of modern reclamation standards. In addition to the environmental and remediation studies, an assessment of historic exposures of Déline ore carriers to radiation and a follow-up epidemiological feasibility study were performed.

SENES Consultants Limited (SENES) carried out the dose reconstruction for the Port Radium miners in the 1990s, was the environmental consultant to the CDUT from 2000 to 2005, developed the Remedial

Action Plan (RAP), engineering plans and specifications for decommissioning the Port Radium mine and vicinity sites in 2005/6, supervised the remedial works in 2007 and carried out the long term post closure monitoring from 2008 to 2012. Our firsthand experience from working cooperatively with the CDUT provides insights into effective decommissioning of historic contaminated sites.

## INTRODUCTION

### Location and History

The “Port Radium” mine site is located just below the Arctic Circle, on the eastern shores of Great Bear Lake in the Northwest Territories. The nearest major city, Yellowknife, is approximately 440 km south of the site, while the closest community Déline is located about 265 km west of the site (see Fig. 1).



Fig. 1: Location Map

The Port Radium mine has a long history extending back to 1930 with the discovery of pitchblende, silver, and cobalt ores. Underground mining (for radium) started in 1932, while mining for uranium began in 1942 and continued to 1960, when the mine was shut down. Mining for silver started in 1964 at the beginning of Echo Bay’s mining operations and continued until 1982.

The Déline Dene had a long association with activities at the Port radium mine. The Dene people of the region, while not directly involved in the development or operation of the mine, nonetheless played an active part in assisting in its development. During the early years of the mine, Dene people performed a variety of activities that included the harvesting of lumber from around the region for underground cribbing, as well as the provision of manual labour in support of the early transportation of ore from the mine along a transportation route along the Mackenzie and Great Bear Rivers (“ore carriers”). More recently, some men from Déline worked at the Echo Bay silver mine.

Over the life of its mining operations, the Port Radium mine produced about 13.7 million pounds uranium; 37 million oz silver and 10.5 million pounds copper. Total mill tailings were 900,000 tons from Eldorado Mines and 800,000 tons from Echo Bay Mines operations.

In the early days of radium and uranium mining, ore was transported by plane, then by boat and barge across the waterways, while in later years, ore/concentrate was transported off-site via barge to Sawmill Bay and transported to southern Canada by air transport (see Fig. 2,3,4). [2,6]



Fig. 2: Early Transportation of Concentrate



Fig. 3: Carrying Concentrate

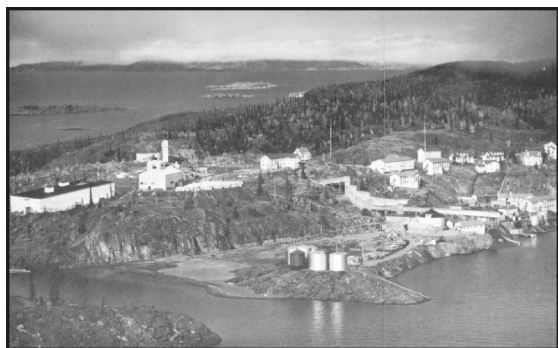


Fig. 4: Port Radium in the 1950s



Fig. 5: Hand Sorting

### Past Decommissioning

Prior to recent activities, the Port Radium mine site had undergone two prior decommissioning programs. The first was completed in 1962 by Eldorado Mining and Refining, and included the decommissioning of the underground mines and removal of some of the major equipment but the mill and camp site were not decommissioned at the time.

The second program was carried out by Echo Bay (silver) Mines Ltd. in 1982, at which time most of the mine site structures were demolished, equipment removed, shafts and adits secured, and some areas with elevated gamma radiation were covered with waste rock.

In both cases, the decommissioning was carried out to the standard of the day. The remaining structures included several small sheds and cabins at Port Radium and Echo Bay and a headframe and cabins at Cross Fault Lake.

After cessation of Echo Bay operations, the site had returned to the Government of Canada, which had custodial responsibility for the site and any residual environmental liabilities on the property. The Contaminants and Remediation Directorate (CARD) of Indian and Northern Affairs Canada (INAC) currently manages activities at the site and holds a Waste Nuclear Substance License (WNSL) for the portion of the site where radium and uranium mining occurred and radiological materials remain.

### Studies of Miners

The Port Radium mine produced uranium from the 1940's through the early 1960's. In the early years, ore grades were very high and sorting was done by hand (see Fig. 5).

The early miners were exposed to very high levels of radon and its radioactive decay products at levels 100's of times higher than levels in modern mines. There was no mechanical ventilation in the mine until 1949 and the miners worked in close proximity to the ore (see Fig. 5, 6).



Fig. 6: Hand Trimming

As a result of such very high exposures, the Port Radium miners experienced a higher than background risk of lung cancer. The experience of the Port Radium miners in this regard provides an important contribution to the understanding of the risks from exposure to radon. It may be of historical note that Port Radium was the first mine in Canada where radon/radon decay product sampling was performed. [1]. SENES [2] performed detailed exposure and dose reconstruction in support of epidemiology studies of Port Radium miners.

The epidemiology of the Port radium miners has been well studied, as for example, reported by [3], and [4].

### **Community Concerns**

As a result of past activities, both at the site and in association with ore/concentrate transportation, the community of Déline expressed concerns about any existing or potential environmental contamination. In particular the community had concerns with respect to past, present or potential future exposure to radiation as well as other sources of contamination related to the operation of the mines.

In the late 1990s, the community of Déline brought these concerns to national attention in Parliament. As a result of Déline's petition, the Government of Canada and Déline agreed to move forward in a collaborative manner to address these concerns. The approach agreed to was to establish the Canada Déline Uranium Table (CDUT) to provide a joint process by which the people of Déline could have their concerns expressed and addressed. As part of this agreement, the Crown formed an interdepartmental committee between Indian and Northern Affairs (INAC), Health Canada, Natural Resources Canada, as well as the Government of the North West Territories (GNWT) Health and Social Services with INAC taking the lead. The CDUT was formed to carry out studies under the advice of the Déline Chief and Council and the interdepartmental committee

The CDUT operated from 2000 to 2005 and made twenty-six recommendations which were accepted by the Déline Chief and Council and INAC. Under the direction of the CDUT, a three year action plan was developed, which laid out the framework and objectives for subsequent site assessments, the development of potential remedial options, and the interactive process for selecting the preferred options for remediation at the site.

The ensuing remedial action plan (RAP) was thus the outcome of a unique, wide ranging, and intensive co-operative effort between Canada and Déline, that consolidated the results of five years of efforts including environmental site investigations, human health and ecological risk assessments, iterative presentations of potential remedial options, and integrated these scientific principles with traditional knowledge and community values.

The remedial action plan for the site comprised the following physical works; closure of the vertical and horizontal mine openings present at the three mine sites; installation of an engineered cap over the former Silver Point Tailings Containment Area; demolition of the structures remaining on-site; management of designated substances such as asbestos applications; construction of a landfill to contain the demolition debris; placement of a cover over areas identified as having elevated gamma radiation levels, recovery and management of petroleum impacted soils encountered on-site and undertaking a verification program to confirm that the concerns associated with radioactive and petroleum hydrocarbon impacts had been appropriately mitigated.

### **SENES' Role**

SENES Consultants Limited (SENES) has been involved with studies of Port Radium miners since the early 1990's and with environmental studies and remedial actions since 2000. Initial efforts included undertaking various environmental assessments under the direction of the Canada-Déline Uranium Table (CDUT) a co-operative initiative to ensure that environmental conditions at the site were defined and characterized and that appropriate remedial plans were developed for the site. Following five years of site assessment and remedial planning, that included consultation with chief and council, as well as extensive community engagement, a final Remedial Action Plan (RAP) was prepared [5]. This document formed the basis for the remedial engineering designs, contract and specifications, as well as project cost

estimates for the work. SENES was subsequently retained by Public Works and Government Services Canada (PWGSC) on behalf of INAC, to provide engineering supervision services for the remedial site works. SENES was also retained to carry out the long term monitoring program for the remediated site.

## **DOSE RECONSTRUCTION AND EPIDEMIOLOGICAL FEASIBILITY**

Among other initiatives, the CDUT proposed an epidemiological feasibility study of the Déline who worked as ore carriers. SENES [6] working closely with the Deline traditional knowledge team, performed the dose reconstruction and subsequently performed an epidemiological feasibility study of the ore carriers [7].

A pilot dose reconstruction although challenging and requiring numerous assumptions, including information from oral histories, concluded that a dose reconstruction could be performed. A wide range of information was available including, reports on historical site activities and production records, data on the transportation system, as well as community supplied information including oral histories with respect to specific individual activities of Déline Dene band members and their families. The review of this information confirmed that the exposures of the Déline were limited to those activities associated with the handling of ore and (gravity) concentrate along the transportation route. The feasibility study developed (annual) dose estimates for the Déline Dene who transported ore and concentrate (ore carriers). The highest annual dose rates were estimated to be for the deckhands who traveled from Port Radium to Great Bear River during the 1930s and early 1940s.



Fig. 7: Barging ore and concentrate

The epidemiological feasibility study focused on the group of Déline Dene ore carriers who received the highest exposures to radiation and as a consequence, were assumed to have the highest potential cancer risk. This study used the radiation doses previously calculated in the dose reconstruction study and lifetable methods to predict the number of cancers that would be expected to occur in a study group with the same number of individuals after accounting for the radiation doses from the dose reconstruction study, reference baseline cancer rates that are plausible for the uranium concentrate workers, and dose-response models that relate radiation doses to increased risks.

While the epidemiological feasibility study predicted a small increase in the risk of cancer, the study also concluded that given the low risk of excess cancer, an epidemiological study would have little chance of detecting an association that was based on less than one excess cancer case and further epidemiological studies of radiation risks to ore carriers was not recommended.

## **DEVELOPMENT OF THE REMEDIAL ACTION PLAN**

A key objective was the desire of the Déline and the Crown to ensure that the Port Radium site was decommissioned in a manner that minimizes its potential impact on animals, the environment and human health and safety. To this end, the remedial program was undertaken in eight stages similar to any other civil or remediation project, namely:

1. define existing or potential concerns through site assessment and investigation;
2. develop remedial options, evaluate preliminary engineering plans and costs, and present the preferred action plan;
3. develop cost estimates based on the preferred remedial option;
4. prepare final remedial engineering and tender documents;

5. commence bidding process, evaluate the submitted bids, and award the work to the most qualified bid;
6. undertake the remedial works;
7. prepare “closure” documentation and presentation of findings to stakeholders at completion of the works; and,
8. Implement post remedial short and long term monitoring as identified in the RAP and outlined in licensing requirements.

The first three stages of the Port Radium remedial project were completed by SENES under the direction of the CDUT commencing in 2001 through to 2005. The site characterization work focused on the aforementioned issues and the results can be found in a series of SENES reports [8, 9, 10, 11, 12] while the RAP, which was prepared on the basis of these investigations, can be read in more detail in reference SENES/CDUT 2005 [5]. Stages 4 to 7 were undertaken under the direction of PWGSC who retained SENES to oversee the preparation of the Class A remedial cost estimate, the remedial tender documentation, assist with the tendering process [13], and provide contract supervisory services for the duration of the remedial program. The final stage of the project is the post remedial long term monitoring program the first 5 years of which were carried out from 2008 to 2012. A more detailed discussion of the work items involved under the various stages of the project is presented in the following sections.

## **DETAILS ON RESPECTIVE STAGES OF THE WORK**

### **Stage 1 – Site Assessment and Characterization**

As part of the CDUT’s mandate, it oversaw the necessary site investigation programs to determine the extent of the environmental concerns that pertain to the Port Radium mine. The 2001 and 2003 site investigations were used to develop the human health and ecological risk assessments and remedial options [5, 8, 9, 10]. Information on the findings of these programs was provided to the Chief and Council through various forums including public meetings and CDUT presentations commencing in 2002 through to 2005.

In summary, the results of the investigation work showed that while minor risks existed, additional remedial work could be carried out, in keeping with the As Low As Reasonably Achievable - Economic Factors Considered principal, to reduce potential site risks and reduce site hazards in keeping with today’s decommissioning standards with respect to radiological, chemical, and hazard exposures associated with soil impacted by poly-halogenated compounds, designated substances, remnant structures, horizontal and vertical mine openings, and cleanup of residual debris.

### **Stage 2 – Remedial Action Plan**

Further to the findings of the site assessments, SENES prepared a remedial options discussion report that reviewed a range of remedial options available to address the environmental and physical concerns identified. The results of the dialogue between all the stakeholders was captured in the document entitled *Port Radium Mine Remediation Plan* [5]. The details of the remedial action plan can be found in the aforementioned report.

### **Stages 3 & 4 – Preparation of Engineering and Tender Package and Class A Cost Estimate**

Once the detailed scope of work was agreed to by the project stakeholders, the technical aspects of the work assessed and the detailed design completed, the preparation of the technical specifications in the National Master Specification (NMS) format was relatively straight forward. A copy of the project Table of Contents can be found in the project tender documents [13].



As with most projects, the specifications were developed over a period of time with milestones set for review periods. Some of the challenges faced in completing the submissions included: the lack of detailed topographic mapping for baseline engineering site plans for some of the work areas; as well as the uncertainty surrounding site potential mobilization/demobilization approaches and how to include this in the specification (e.g. should a winter road specification be included or not). The complexity of the multiple interests, access to this remote site and weather resulted in significant challenges to the project team.

Cost estimates for mobilization and demobilization were considered explicitly as separate line items that could be used in the estimate as appropriate. Weather related aspects were accounted for in the cost estimate by applying a multiplier to the work. The other major uncertainty was related to winterization costs for stranded major equipment components which are directly related to equipment inventory, the work schedule, and the manner in which the contractor would choose to mobilize/demobilize from the site.

### **Stage 5 – Tender Period Support**

It was initially anticipated that the remedial site works would be initiated by the winter of 2006 and as such, a site visit was coordinated by PWGSC in the fall of 2005 to allow potential bidders the opportunity to visit the site prior to bidding on the work. Subsequently, due to a variety of reasons, the release of the project tender package was delayed to the fall of 2006 for work in 2007 and a bidder's conference was held on 6 November 2006 in Yellowknife. This conference was hosted by INAC and PWGSC with SENES providing expert advice. Representatives from the Land Claimant Group which included the Chief of Déline First Nations and the President of the Déline Land Corporation were in attendance at the bidder's conference.

One of the objectives of the Contaminated Sites Management Policy (August 2002) is “to promote the social and economic benefits that may accrue to First Nations, Inuit and northerners when carrying out activities required by this policy”. At the conclusion of the bidder's meeting the President of the Déline Land Corporation gave a presentation stating the desire of the Déline community to see that the remedial works were carried out in accordance with the recommendations of the CDUT. The approach illustrates the commitment of project participants to ensure that the interests of the people of Déline in being part of the solution were clearly articulated during the contracting process.

The evaluation of the respective bids was undertaken by the Crown, who on the basis of the marks achieved by the respective contractors, selected Aboriginal Engineering Limited (AEL) as the prime contractor for the Port Radium contract.

During a separate and subsequent bidding process, SENES was selected as the Consultant to provide site supervisory services, on behalf of PWGSC, for the remediation contract.

### **Stage 6 – Implementation of the Work**

Prior to the contractor mobilizing their forces to the site, all the contract submissions required at this phase of the project were submitted to PWGSC. SENES staff, on behalf of PWGSC, completed a detailed review of the submittals and worked out any required changes with the prime contractor. This component of the work took upwards of three months to complete to the satisfaction of the project engineer (SENES).

Once the required submittals were provided the contractor's full attention was set upon mobilizing to the site. For the Port Radium project, the contractor selected the option of mobilizing their equipment and

materials via Déline to take advantage of the existing winter roads which are constructed for the community each year. The intent was to use lands within Déline as a staging area, prior to the next stage of the mobilization. From this staging area, rather than construct an expensive winter road across Great Bear Lake (the Lake) the contractor chose to bring a sectional barge to Déline by which large equipment and bulk materials would be shipped across the Lake once the ice had thawed.

The contractor also planned to contract a barge that already operated on the Lake by Plummer's Lodge. The concern with this approach from the outset of the work was how this method of mobilization would impact the schedule of work given the already short construction season in the north. The contractor had submitted a 120 day schedule as part of their bid, however, due to the concerns with when the ice might come off the lake, the contractor was asked to provide both a best case and worst case scenario schedule. As it turned out the ice did not come fully off the lake until mid-July and the barge mobilization did not commence until late July 2007.

The challenges that arose from this hurdle were related to the sequence of work and which pieces of equipment and materials were most critical to the completion of the work given the three to four day turn around for each barge trip. The contractor established their priorities and mobilized the materials accordingly.

In late May 2007, the contractor was on site setting up their soft camp and started the remedial works that could be done manually and through the use of small equipment that could be airlifted. This work included asbestos abatement work at Port Radium and Cross Fault Lake, general cleanup and demolition of the small structures. Once the airstrip at Glacier Lake was in good enough condition to allow a Buffalo Aircraft to land, a rubber tired backhoe (completely stripped down) was brought to site and reassembled. Mechanics were flown to the site to re-assemble the backhoe, requiring helicopter assistance for mounting the cab assembly. With this piece of equipment, the mine openings at the Port Radium and Echo Bay mine sites could be investigated and the design process for the respective mine caps started.

During the initial phases of the camp set up, the contractor working with SENES staff undertook the necessary material inventory and waste audit work required under the terms of the contract. The early mobilization allowed the contractor's initial labour force to carry out the designated substance removal prior to the bulk demolition and earthmoving works. ATV and ATV trailers were also airlifted to the site to permit transport to and from the 7 km to 10 km worksite. As the nature of the remaining onsite mine structures was mostly wooden, including the Cross Fault Lake headframe, the structure demolition was carried out largely by the initial labour force

In parallel to the initial mobilization and field work, in early June 2007, the contractor conducted a 6-week Heavy Equipment Operator (HEO) training program in Déline. The training program, partially funded by INAC, was undertaken to provide suitable operators from the Déline community. Trainees were instructed on the operation of the heavy equipment being staged in Déline. As a part of the training program beautification projects were completed for the community.

The first barge run arrived at the site on 26 July 2007. The arrival of the heavy equipment signaled the start of the bulk remedial works including:

- placement of the radiation cover;
- demolition of the remaining structures;
- construction of mine openings;
- installation of engineered cover at Silver Pt.;
- mitigation of the PHC impacts; and,
- fencing of the crown pillar areas of concern.



Throughout the course of work the contractor's workforce was comprised mostly of individuals from the local community of Déline. Typically, the workforce composition included the contractor's field engineer, superintendents, mechanic, site medic and surveyor whom were non-aboriginal northern workers, and the remaining workers including foremen, HEO trainees, laborers, camp staff and wildlife monitors were Déline First Nations people from Déline. The overall social and economic benefit to the community of Déline was understood to be very positive. Younger workers received valuable training in construction/site-remediation projects and the process allowed members of the community first hand participation in the reclamation of the storied land. The project provided the Déline residents with job opportunities and a chance to gain some training in remedial works and as such this was a significant benefit to the local community.

Logistical and physical challenges associated with the remoteness of the remedial site were observed throughout the duration of the project work. The harsh northern winter conditions did not permit cost-effective remedial work beyond the short summer months. As seen during the Port Radium Remedial Program, the late ice break-up on Great Bear Lake delayed the mobilization of the full equipment fleet via barge until July 2007 thus reducing the effective work schedule further to only eleven weeks. Given the shortened construction season and the prohibitive mobilization costs it was imperative that sufficient resources be allocated to the work in order to ensure the completion of the remedial work in one field season. In order to achieve this timeline, additional equipment and parts were mobilized to the site so as to minimize equipment down time during the course of the field program; however, this effectively increased the project costs. Throughout the duration of the Port Radium Remedial Program equipment breakdowns and associated down time due to the limited supply of spare equipment parts resulted in the work sequence having to be rearranged thus introducing inefficiencies to the work program and project schedule.

### **Stage 7 – Construction “Closure” Reporting**

The closure reporting for the Port Radium Remediation Contract included a combination of regulatory submissions required for INAC to close out permits such as the land use permits and quarry permit and completion of a report that summarizes the work undertaken on site with reference to the requirements of the technical specifications for the work which were developed with a mind to address the concerns outlined in the project RAP.

The summary report for the project also addressed contract issues such as aboriginal content and material quantities and identified where the work completed differed from the technical specifications with an explanation as to why these changes were necessary. In completing the contract work the contractor prepared As-Built drawings for the site using site surveys to provide the necessary level of detail on the site drawings. These As-Built drawings were included in the report. Quality Control and Quality Assurance documents were also discussed and appended to the report. The summary report also included the radiation survey confirming that areas of elevated gamma radiation had been appropriately covered with soil and/or rock meeting the remedial requirements for the site.

### **Stage 8 - Monitoring Program:**

As with most projects, whether construction or remedial in nature, there is typically a warrantee or monitoring period during which the site is monitored to ensure that the works are performing as intended. For the Port Radium mine a specific post closure Long Term Monitoring (LTM) program had been developed by SENES for INAC in support of INAC's application for a Waste Nuclear Substance License (WNSL) from the Canadian Nuclear Safety Commission (CNSC) for long term monitoring of the site. The LTM program involves assessing the state of the remedial works through periodic inspections of the

site as well as water sampling in and around the site area, to ensure that the remedial works are providing the level of protection expected from the design.

Other areas outside the limits of the WNSL are also inspected and sampled as part of the LTM to confirm that the closure works have addressed the issues of concern in these areas. An example of this is the monitoring of the crown pillars in the Port Radium area. The condition of the crown pillar at the Echo Bay mine site as well as the Dumpy Lake area of the Port Radium mine site which have been fenced off, will require continued monitoring as the costs involved in decommissioning these parts of the abandoned mines are prohibitively expensive given the limited potential for harm to human or wildlife in the area.

## **ABORIGINAL CONSIDERATIONS**

The Port Radium mine site has long been a legacy site in the Sahtu settlement lands. As a result of the past mining and associated industrial activities and with concerns brought to the forefront by the Sahtu aboriginal communities, as discussed in the earlier sections, the formation of the CDUT was intended to provide a collaborative means of identifying issues and developing paths forward to address these issues. The concerns raised by the community were articulated through the CDUT process, which identified both human health and ecological concerns and the desire of the community to actively participate in the planning and implementation of remediation action associated with the site. The RAP was developed under the guidance of the CDUT with the inclusion of traditional knowledge and risk based ecological and human health assessment. Significant community consultation was carried out and documented in the INAC Mine Remediation Plan.

As discussed earlier, INAC policy for northern work mandates social and economic benefit to local communities. The participation of Déline workers during the course of the site investigations, as well as during the remedial program has gone a long way in providing the residents with valuable experience in site remediation projects and help with the overall day-to-day understanding and acceptance of the remediation program for the Port Radium site.

## **SUMMARY COMMENTS AND CONCLUSIONS**

The Port Radium Mine site was Canada's start into the recovery of radioactive materials. It operated for almost 50 years, under either private or public ownership and provided enormous wealth, through production of 900,000 tons uranium ore and 800,000 tons silver. The development and operation of the mine was carried out with significant effort due to its location and setting in Canada's far north. Similarly decommissioning of the mine posed unique challenges for site investigations and closure works.

In the early days of mining, that Port Radium miners were exposed to radon and associated decay product levels (in Working Level Months of exposure - WLM) hundreds of times greater than modern standards. The experience of the Port Radium miners provides an important contribution to understanding the risks from radon.

In accordance with license conditions and best practices of the day (the 60's and 80's), the site was formerly closed twice by previous operators. Nonetheless, despite these actions, concerns were expressed by residents of the community of Déline about the impact of past practices, remaining contamination at the site, and the potential for future exposures.

The residents of Déline, as traditional land users wanted an active part in the assessment of existing or potential environmental and safety issues based on current closure standards. Assessment of past radiation exposures of worker based on past practices associated with ore handling and concentrate shipping was also addressed.

The formation of the Canada-Déline Uranium Table (CDUT) provided a unique co-operative framework to ensure that the all stakeholders could participate in an appropriate and effective positive manner. The CDUT framework facilitated development of the overall strategy for identifying and addressing community concerns which in turn facilitated the development of an effective and appropriate risk based remediation plan that was implemented for the subsequent site remedial works in 2007.

In 2012, the site entered its fifth year of long term monitoring (inspections, gamma measurements, and water sampling) to ensure that the state of remedial work continue to function as implemented. A state-of-the-environment review was conducted to confirm that the radiological risks associated with the site have been managed in an appropriate and safe manner.

In all of the activities associated with the site, efforts have been made to include the people of Déline in an appropriate manner. This has included strategy and planning meetings with Chief and Council, community open houses and update meetings, technical meetings with the community technical committee, meetings with elders and elder tours, as well as the hiring of community members both in staff and contract positions throughout the program. In addition, the Déline Uranium team was formed which had a special role in assisting the community carry out its action plan initiatives and helping community members in their understanding of issues related to radioactivity. Through all of these initiatives, the community was able to engage in the process of remediation and work towards healing its relationship with Canada's first radium/uranium mine – Port Radium.

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