# REMEDIATION OF THE GUNNAR URANIUM MINE SITE, NORTHERN SASKATCHEWAN

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## ABSTRACT

The Gunnar uranium mine, located in northern Saskatchewan, operated from 1955 to 1963. When the mine was closed, the site was not remediated to the standards that are in place for today's uranium mines. Waste rock and mill tailings were left un-covered and water quality issues were not addressed. As a result, the current state of the site impacts the local environment.

The company that operated the Gunnar Mine no longer exists. In 2006, the Government of Saskatchewan and the Government of Canada entered into an agreement to share the costs for remediating the site. An environment assessment of the project to remediate the site is currently underway. This paper provides an update of the issues and the progress being made.

## 1. INTRODUCTION

### 1.1 Canada's First Uranium Mines

Canada's uranium industry has its origins in Port Radium, Northwest Territories where mining of uranium ore began in 1933 to extract radium. The Port Radium mine closed in 1940, due to declining markets for radium, but the mine was re-opened in 1943 to produce uranium. Demand for uranium increased, and during the late 1940s and early 1950s, additional uranium deposits were discovered and developed, first in the Beaverlodge area of northern Saskatchewan, and later in the Elliot Lake and Bancroft regions of Ontario.

For Canada's earliest uranium mines, tailings management practices were not as stringent as those used today. Tailings were placed in natural containment areas such as lakes or valleys, placed in engineered surface containment areas, or disposed as backfill in underground mines.

### 1.2 History of the Gunnar Uranium Mine

The Gunnar mine site is located on the north shore of Lake Athabasca in northern Saskatchewan (Figure 1). Uranium production began in 1955 and was completed in 1963. The open pit mine was in operation from 1955 to 1961 and the underground mine operated from 1958 to 1963. Details on the development and operation of the Gunnar Mine are provided in "The Gunnar Story" which was published in 1963 [1].

As was typical for mines of that era, closure requirements for the Gunnar Mine were minimal. The open pit mine was flooded and the shaft for the underground mine was capped. The site was then abandoned without any demolition of the buildings and structures. There were no efforts to address the mill tailings or waste rock.

The current state of the Gunnar site poses a safety risk and has impacts on the local environment The company that operated the mine no longer exists, and as a result, cleanup of the site has

become a government responsibility. In 2006, the Government of Canada and the Government of Saskatchewan entered into a cost-sharing agreement to remediate the Gunnar site.


**Figure 1. Location of the Gunnar Mine.**

## 2. CURRENT SITE CONDITIONS

### 2.1 Previous Work

The locations of the main features of the Gunnar mine site are shown in Figure 2. Investigations into the condition of the Gunnar site began in the 1980s as part of the National Uranium Tailings Program [2,3,4,5]. The following provides an overview of the results of these studies as well as more recent investigations which are being conducted to remediate the site.

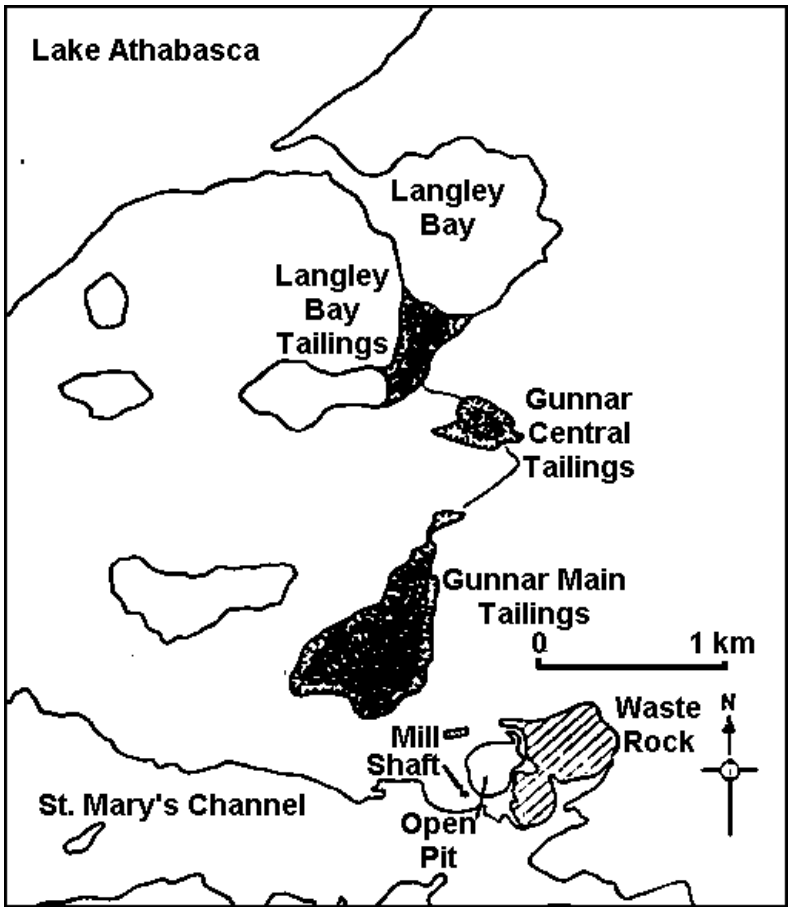


**Figure 2. Features of the Gunnar Mine site [2].**

## 2.2 Uranium Tailings

Approximately 4.4 million tonnes of tailings were discharged from the Gunnar mill. At first, tailings were deposited into a large lake located immediately north of the mill. When this tailings area, referred to as Gunnar Main, became full, tailings were directed into an adjacent catchment which flows to Langley Bay on Lake Athabasca. When this tailings area, referred to as Gunnar Central, became full, the tailings entered Langley Bay. Although some of the tailings have been covered naturally by vegetation or water, large areas of the tailings are uncovered and subject to wind and water erosion.

## 2.3 Gunnar Open Pit

The Gunnar open pit averages 300 m in diameter and has a maximum depth of 116 m deep. A large open stope from the underground mine is connected to bottom of the pit. The pit contains approximately 3.2 million $m^3$ of water and drains to Lake Athabasca through a rock-filled channel. The water has elevated concentrations of uranium and radium-226 in the order of 900 ug/L and 0.34 Bq/L respectively.

### 2.4 Waste Rock Piles

The open pit generated approximately 2.7 million $m^3$ of waste rock, some of which was used as backfill in the underground mine and for other purposes around the mine site. The majority of the waste rock, with an estimated volume of 2 million $m^3$, is located in two large piles located east and south of the open pit. Seepage from the eastern waste rock pile has been found to contain high levels of uranium. In addition, some areas of the waste rock piles exhibit elevated gamma radiation levels (> 1 uSv/hr).

### 2.5 Buildings and Structures

The Gunnar mine was a large self-contained operation and included a mill, two sulfuric acid plants, support facilities and a town site. The structural integrity of the buildings has deteriorated since they were abandoned nearly 50 years ago and most are now unsafe. In addition, some of the buildings contain asbestos. All of the structurally unsound wood-framed buildings were demolished in 2010. Many of the larger steel-structure buildings, such as the mill, head-frame and acid plant, are scheduled to be demolished in 2011.

## 3. SITE REMEDIATION

### 3.1 Remediation Challenges

Remediation of the Gunnar site poses several challenges. The location is remote and only accessible by boat, light aircraft or winter road. Construction equipment would have to be transported to the site by winter road or by barge. There are no services, such as electricity, near the site. The remediation options chosen for the mill tailings, open pit and waste rock will have to take into account the limited access to the site and availability of cover material. The options also need to consider the limited work season and lack of supporting infrastructure.

### 3.2 Tailings Remediation

For the remediation of the tailings areas, cover with waste rock and/or borrow material is anticipated. If waste rock is used, some radiometric sorting may be required to remove waste rock which has high uranium content. Placement of cover on water-saturated tailings or permafrost may also be an issue in some areas.

### 3.3 Remediation of the Open Pit

For the open pit, remediation options range from addressing hazards around the perimeter of the pit to filling the pit completely with waste rock and other material. The latter option will be difficult given the large volume and structural integrity of the pit. Short-term and/or long-term water treatment may be required.

### 3.4 Remediation of Waste Rock Piles

Remediation options for the waste rock piles range from re-contouring and covering to complete removal of the waste rock. Diversion and treatment of seepage from the waste rock is also being considered.

### 3.5 Environmental Assessment

The project to implement these options is subject to an environmental assessment (EA) under the *Canadian Environment Assessment Act* and requires a licence from the Canadian Nuclear Safety Commission (CNSC). As part of the EA process, which is currently underway, the environmental effects of the remediation options will be considered. In addition, the CNSC licence for the project may set additional requirement for site remediation.

## 4. CONCLUSION

The project to clean up the Gunnar mine site has some unique challenges due to its remote location. Detailed site characterization and thorough options analysis are key to ensuring that proper approach to remediating the site is selected.

## 5. REFERENCES

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