

UPDATE ON THE RECLAMATION OF THE YANKEE GIRL TAILINGS SITE, YMIR, B.C.

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ABSTRACT

The Yankee Girl Tailings site is comprised of mineral ore process tailings that were placed adjacent to the Salmo River near Ymir BC. Environmental assessment work was initiated in 2004 by the Ministry of Agriculture and Lands to address an Inspector's Direction issued by Fisheries and Oceans Canada. Metal contamination was identified that presented potential risks to human health and the environment. The results, along with conceptual remediation options, were presented at a series of public meetings from 2004 to 2007.

A preferred remedial design was selected and construction initiated in September 2007. The remedial activities included consolidating reactive and non-reactive materials under a bentonite clay amended dry cover and constructing a passive treatment system (i.e. engineered wetland bioreactor) to polish groundwater seepage. To protect the site from erosion and to compensate for lost habitat, erosion control barriers were installed, including bio-engineered fish habitat structures. Final revegetation of the site was undertaken in June 2009.

Added value was found by incorporating the community's desires for a final land use through contouring the repository into an amphitheater and incorporating tree islands to mimic a 'park-like' setting. Local community members participated in the site revegetation to encourage stewardship of the site.

KEY WORDS

tailings, mine, remediation, reclamation, passive treatment, Ministry of Agriculture and Lands

INTRODUCTION

Site Description

The subject site is approximately 6 ha area in size, located east of the Salmo River, and west of Wild Horse Creek Road near Ymir, BC. Photograph 1 illustrates the key features of the site, which includes the following:

- Upper Tailings Area;
- Lower Tailings Area;
- Southeast Lobe Tailings Area;
- Northwest Tailings Area;
- Northeast Tailings Area;
- Old Mill Area;
- Old Side Channel; and
- New Side Channel.



Photograph 1: Site Overview

Site History and Previous Environmental Assessment Work

Beginning in 1935, ore obtained from the Dundee/Yankee Girl mine workings located above the river valley was aurally trammed down for processing at the lower elevation mill located across from the Village of Ymir. Tailings generated from the mill processing were deposited in and adjacent the Salmo River until 1942 when the mill was shut down. Following closure, responsibility for the site eventually reverted to the Crown, represented by the Ministry of Agriculture and Lands (MAL). Detailed investigations identified metal contamination within the tailings and surrounding soil, and in the process fines around the former mill site. These metals were found in soil, sediments, surface water and groundwater. A Human Health and Ecological Risk assessment identified potential risks related to the site and a conceptual remediation plan was developed to address the risks as summarized in Table A.

TABLE A: Preferred Solutions to Address Identified Risk

Identified Risks	Conceptual Remediation Plan
Erosion of tailings into/by Salmo River and Ymir Creek.	Extend erosion control along Ymir Creek. Construct the main erosion control barrier to withstand a 1:200 year flood event.
Leaching of metals and acidic discharge into the existing side channel from lower tailings area.	Excavate lower tailings area and consolidate into containment cell within the upper tailing area.
Existing side channel currently not functioning as habitat or flood relief.	Excavate and re-create side channel.
Spilled concentrates in surface soil at mill area present potential human health risk and ability to leach into groundwater.	Excavate the surface soil and place the soil into the upper tailings area containment cell.
Exposed upper tailings area is eroding from surface runoff and presents potential human health risk.	Place an engineered cover over the upper tailings area following placement of the excavated site soil materials.

Stakeholders were consulted through a series of public meetings from 2004-2007 where findings and conceptual remedial options were presented. The assessment work and findings were previously presented at the 2007 BC Mine Reclamation Symposium in Squamish, BC.

REGULATORY FRAMEWORK

MAL and their consultants worked with regulators to ensure the project was carried out within applicable regulations, which involved the following:

- *Notification of Independent Remediation* to Ministry of Environment (MOE), Land Remediation Section;
- *Notification of Work on a Mine Site* to Ministry of Energy and Mines and Petroleum Resources;
- *Notification under the Code of Practice for Soil Amendments* to MOE Environmental Protection to use waste lime mud to neutralize acidic tailings ;
- *Environmental Management Act Approval* from MOE Waste Management Section to use composted pulp mill residuals on the site;
- *Section 52, Forest Act, Tree Removal Authorization* from Ministry of Forests for removal of trees to facilitate the remediation;
- *Section 9 Water Act Approval* from MOE Water Stewardship Division for in-stream works; and
- *Section 8 Water Act Approval* from MOE Water Stewardship Division to withdraw water from Salmo river for irrigation use.

REMEDICATION ACTIVITIES

Selection and Initiation of Preferred Remedial Design

A preferred remedial design was selected in 2007. The preferred solution was to leave the Upper Tailings in place and consolidate other reactive materials in a secure engineered containment system on top of the Upper Tailings. To protect the containment system and compensate for lost habitat, erosion control barriers, fish habitat structures, and revegetation was planned along Wildhorse (Ymir) Creek and the Salmo River.

The Province's remedial actions are being undertaken to ensure protection of human health and the environment. The community's desire was to use the lands for recreation. Incorporating the community's desires for final park land use into the remediation plan provided for added value beyond land reclamation only. Ongoing use of the rejuvenated lands and potential stewardship of the site by the community will help ensure sustainable land use of this former mine site. Based on feedback from the community at the public meetings, a park-like amphitheatre setting that is accessible by foot was desired. The repository on the Upper Tailings was to be shaped as a grassed amphitheatre with a gentle slope to a flat area that could be utilized as a stage.

MAL completed a competitive bidding process and awarded the following five contracts to carry out the remediation plan, with construction initiated in September 2007.

1. Remediation Project Manager/Owner's Representative, awarded to SNC-Lavalin Environment Inc (formerly Morrow Environmental Consultants).
2. Stream Channel, Erosion Control and Habitat Mitigation Design and Build, awarded to Interior Reforestation Ltd.

3. Instream Environmental Monitoring, awarded to Masse & Miller Consulting Ltd.
4. Tailings and Soil Excavation and Consolidation, Engineered Containment System Design and Build awarded to SRK Consulting (Canada) Ltd. and Quantum Murray LP.
5. Site Revegetation Design and Build, awarded to Masse & Miller Consulting Ltd.

2007 Activities:

Activities carried out in 2007 included flood control/erosion control work along Wildhorse/Ymir creek and the excavation and consolidation of contamination source materials.

1:200 Year Flood Protection Upgrade of Wildhorse (Ymir) Creek Rip-Rap Erosion Barrier

Residual tailings that were adjacent to Wildhorse (Ymir) Creek at the toe of the erosion barrier were excavated. The overall height of the erosion barrier was increased to provide 1:200 year flood event protection. Climate change and pine beetle implications were design considerations. Live tree cuttings and rooted trees salvaged from other areas of the site were placed at the toe of the erosion barrier to increase erosion protection and enhance ecological habitat.



Installation of bioengineering protection (upper left); Removal of tailings outside original barrier (upper right); and completed barrier (bottom)

Tailings/Soil Excavation and Relocation



Excavation of tailings (upper left); Upper tailings repository (upper); lime addition (lower left); sedimentation pond (lower right)

Approximately 14,000 cubic meters of tailings and metals contaminated soil was excavated from the former Mill area and Lower Tailings areas. The excavated soil was consolidated in a repository constructed on the Upper Tailings area. Lime was mixed into the tailings to neutralize their acidity. Drainage channels and a sedimentation pond were constructed to collect surface water and runoff until the final cover was placed on the repository in 2008. The excavated areas were backfilled with clean soil in preparation for final site restoration.

2008 Activities

Activities carried out in 2008 included both in-stream erosion control and habitat mitigation work as well as terrestrial work to cover and shape the repository. A passive water treatment system was installed.

In -stream Works

A portion of the Salmo River erosion barrier was re-aligned to increase the channel's flood carrying capacity. Bioengineering features were installed for erosion protection and to increase fish habitat, and the disturbed riparian areas were vegetated. The protection level of erosion barriers on Ymir Creek and Salmo River was increased to withstand a 1 in 200 year flood event.



Installation of bio-engineering structures using Spyder Hoe.

Terrestrial Works

An engineered cover was placed over the Upper Tailings Area repository. The cover material included a bentonite clay amended layer and a 1 m thick protective cover soil layer. The repository was shaped into an amphitheatre for future community use. Tree islands were incorporated into the cover to mimic a “park-like” setting. A passive treatment system (i.e., engineered wetland bioreactor), which utilized composted pulp mill residuals as an organic substrate, was constructed to polish residual groundwater seepage.



Aerial view of the site during 2008 construction activities.

2009 Activities

Activities carried out in 2009 included final site revegetation and the initiation of monitoring and maintenance activities.

Site Revegetation

A revegetation prescription was prepared and implemented. Native trees and shrubs were planted within the tree islands and other disturbed areas of the site. The repository cover/amphitheater area was hydro-seeded with grasses to facilitate human use of the site and protect the engineered cover from surface erosion. Local stewardship of the site was promoted through involving local Ymir area residents in a community planting event.



Local community members planting trees at the site.

Monitoring and Maintenance

A plan to fulfill the ongoing monitoring and maintenance requirements is being developed and will be implemented. Aspects of the monitoring and maintenance plan include:

Local Involvement

The success of this project has been greatly enhanced as a result of involvement from the residents of the Village of Ymir and the surrounding area.

Locals have contributed to many aspects of this project, ranging from the design phase to the onsite construction. The project team thanks the contributors for their participation, and for the community's patience during the construction work at the site.

- Inspection of vegetation success and irrigation until plants are established.
- Replacing monitoring wells, with an ongoing surface and groundwater sampling program.
- Geotechnical/engineering assessment of the repository cover and erosion control barrier performance.

CURRENT STATUS

Remediation work at the Yankee Girl Tailings site has transformed an industrial site to park land for use by the local community. Risks to human health and the environment have been mitigated. Ongoing monitoring and maintenance will be required to confirm the success of the project.

The Province is now in a position to arrange a tenure agreement to facilitate community use of the site. However, public use of the site will be discouraged until the re-vegetation is established and the terms of use are confirmed by the Province.



Yankee Girl Tailings in 2004 prior to remediation.



Yankee Girl Tailings in 2009 following remediation.



Lower Tailings Area before (left) and after (right) remediation.



Mill Area before (left) and after (right) remediation.



Old Side Channel before (left) and after (right) remediation.