Wolverine Project

SOLID WASTE MANAGEMENT PLAN

VERSION 2006-01

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Table of Contents

List of Figures

1 Introduction

This *Solid Waste Management Plan* provides details pertaining to the management of non-hazardous and hazardous wastes for the Wolverine Project during the construction and operation phases of the project.

The intent of this plan is to cover the process of handling, collection, storage, and disposal of solid waste for the various waste streams generated by the Wolverine Project. Waste streams covered in this plan include non-hazardous wastes, hazardous wastes, and mine wastes. In preparation of this *Solid Waste Management Plan* (SWMP), the Yukon *Environment Act*, *Solid Waste Regulations*, *Special Waste Regulations* and the *Fuel Storage and Handling Guidebook* (INAC, 2002) were reviewed.

Details pertaining to environmental characteristics of the facility locations and specific infrastructure design and facility operation and closure activities are contained within the *Wolverine Project Environmental Assessment Report* (YZC, 2005), *Wolverine Project Environmental Assessment Report Response to Public and Regulatory Reviews* (YZC, 2006a), and *Wolverine Project Reclamation and Closure Plan* (YZC, 2006b).

2 General Requirements

General requirements pertaining to the management, handling and storage of solid wastes including application of the waste hierarchy of reduction, reuse, recycling, treatment and disposal are provided below. Waste management strategies will be implemented to control solid waste on a daily basis.

The proposed waste management systems for non-hazardous waste include designated waste storage areas, an incinerator, and a landfill. The incinerator and landfill will be located to the north of the airstrip along the mine access road as shown on Figure 2-1, and will have controlled access and be attended by designated and trained workers.

Storage areas for hazardous waste materials will be established within the industrial complex. Mine wastes will either be stored underground, temporarily in the waste rock storage pad, or in the tailings facility. The surface facilities are also shown on Figure 2-1.

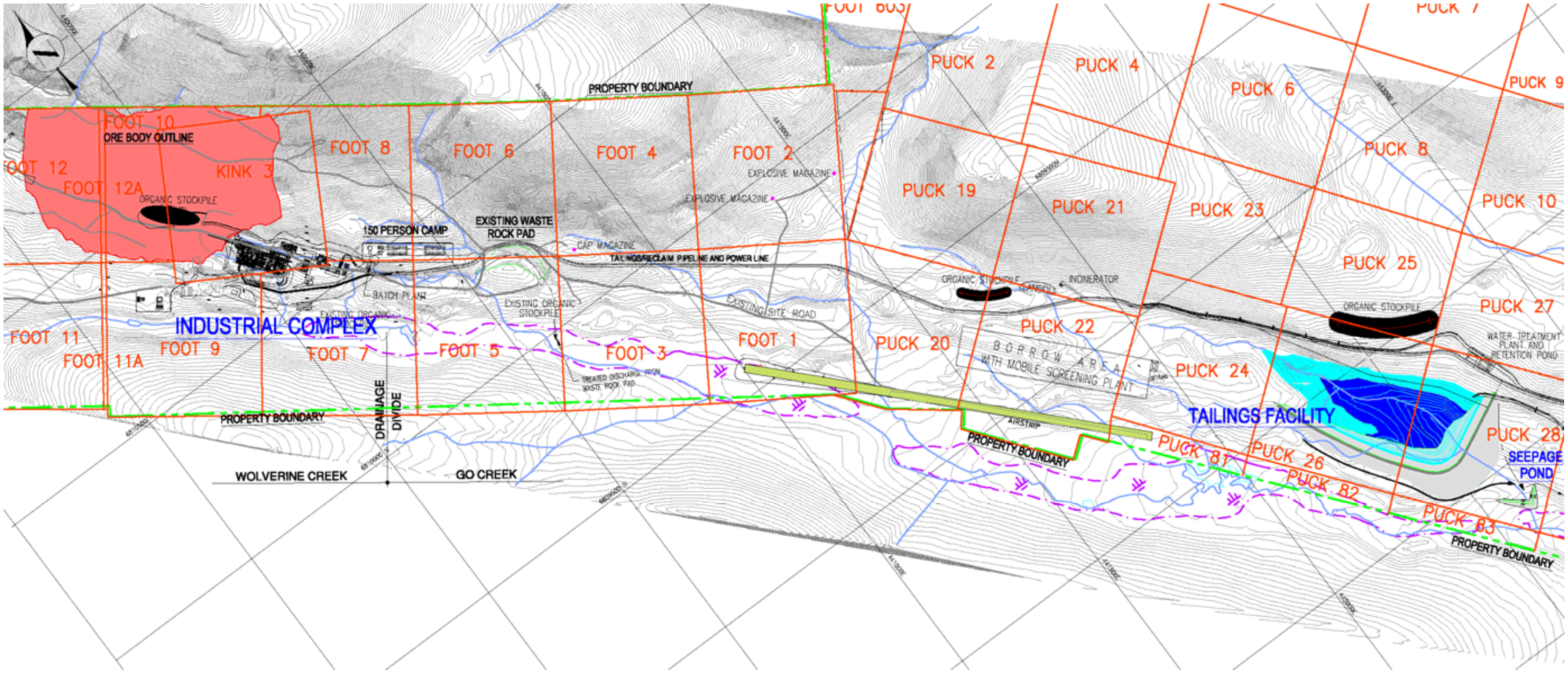


Figure 2-1. Wolverine Project Site Layout

With the level of construction activity expected to increase in 2007, there is a recognized need to implement a comprehensive waste management plan and waste handling facility to accommodate the increased volumes of solid wastes that will be generated. Therefore, upon completion of detailed engineering design, the SWMP will be revised to incorporate specific requirements of the facilities and process, and will also outline specific training requirements required for each facility and waste.

Construction phase waste materials include non-hazardous solid wastes, hazardous waste solvents and petroleum products. Operation phase waste materials include these materials plus mine wastes, which include tailings, waste rock, dense media separation (DMS) float and water treatment sludges.

3 Non-Hazardous Solid Waste

Non-hazardous waste will be segregated into the two streams - putrescible and non-petrescible wastes. Regular pick-up times and designated areas will be established for all burnable materials such as kitchen waste, paper, cardboard, and untreated/ unpreserved wood waste. An Air Emissions Permit under the Environment Act will be acquired as more than 5 kg of garbage will be incinerated on a daily basis.

3.1 Putrescible Kitchen Wastes

Organic food wastes from the kitchen facilities will be segregated, collected in closed bear-proof bins and incinerated daily to minimize wildlife attraction.

3.2 Non-Putrescible Waste

Burnable non-organic wastes will be incinerated. Non-burnable materials (such as cans, bottles, etc), used rubber products, scrap metal, and plastic packaging will be collected in designated recycling bins and removed from site periodically.

Non-hazardous solid wastes that cannot be recycled will be buried in a landfill, which will be established early in the construction phase and remain in use for the life of the mine. This material will be periodically buried under a layer of soil to prevent the loss of garbage through wind action.

The landfill will be designed to accommodate the waste volume and in a manner that will facilitate landfill closure. Surface water runoff from outside the facility will be diverted around the facility.

A sign at the entrance to the site will list conditions for use, emergency contacts and procedures. and items that may not be disposed of there such as: hazardous wastes, acids, corrosives, solvents, oily wastes, explosives, or unsterilized medical waste. YZC will ensure that the site is managed in such a way as to prevent wildlife from being attracted to the facility.

3.2.1 Used Tires

Used tires will be collected and those not used on site during the operation phase to provide vehicle protection barriers will be hauled off site and disposed of in accordance with the Yukon Used Tire Management Program.

To minimize the potential fire hazard created by tire stockpiles, the rules provide by the National Fire Code (1995) will be followed.

3.2.2 Sewage

During the early part of the construction phase the existing infrastructure at Wolverine Exploration Camp will be used. When the permanent camp is functional during the 2007 construction phase and during operations, sewage will be treated in a pre-packaged treatment plant located at the industrial complex. The sewage treatment plant (STP) will treat wastes generated from the mill building, the office building and the camp. The modularized STP will be a stand-alone fully enclosed treatment plant with no requirement for tanks or ponds. All the components of the system are factory assembled, inspected, tested and delivered into the site in major assemblies for final installation and commissioning on site.

The STP technology selected for the Wolverine Project will utilize a fixed growth bacteria process whereby bacteria are grown on a media surface that is rotated into and out of the wastewater. The treated wastewater flows through separate zones each with a progressively higher standard of treatment. The media on which bacteria grown is an engineered plastic disks made from grid extruded medium density polyethylene material with UV light inhibitors. The grid pattern promotes oxygen transfer into the wastewater. The system digests sludge efficiently as a result of the process design. The sludge remains in the primary settling tank during normal operation and may be pumped out every six to nine months depending on the influent total suspended solids level. The system is not prone to upsets and can be operated with varying flows.

Grey and black water will be collected via sanitary sewer systems and sent to a small in-ground concrete surge tank from where it will be pumped to the STP. The treated wastewater will be pumped to a holding pond and either recycled through the process plant or be discharged to the tailings facility via the tailings pipeline. Digested sludge from the facility will be disposed of in the tailings facility.

4 Hazardous Waste

Special or hazardous wastes are dangerous goods that are no longer used for their original purpose as defined in the federal Transportation of Dangerous Goods Act and Regulations. Special waste is regulated by the Special Waste Regulations under the Yukon *Environment Act*, and a special waste permit is required to generate, handle or dispose of a special waste. Special wastes generated, handled and stored at the Wolverine Mine may include used anti-freeze, used batteries, and leftover or used industrial reagents, leftover solvents, cleaners, paints, and petroleum products. Details pertaining to the source and management of these substances are provided below.

Hazardous waste will be segregated at the point of generation, placed into appropriate storage containers and then shipped off site to an acceptable disposal or recycling facility in either Whitehorse or south to BC. All wastes will be handled, stored and disposed of according to the appropriate regulations under the Yukon Environment Act, Contaminated Site Regulation, Special Waste Regulation, Solid Waste Regulation, and Storage Tank Regulation. In addition, unused or damaged explosives will be disposed of in a manner that complies with the Yukon Explosive Act.

The following general storage procedures will be followed to prevent special waste from endangering public health and the environment:

- Liquid special wastes will be stored in a tank if the volume is more than 205 L or in containers for smaller amounts. For transportation, flammable and combustible liquids will be stored in containers or tanks that meet the requirements of the federal Transportation of Dangerous Goods Regulations.

- When storing waste in tanks and containers, the National Fire Code guidelines will be followed with regard to distance from buildings and property lines, distance between tanks, dikes and drainage, and emergency access.

- Storage tanks containing more than 4,000 L, or more than twenty-four 45-gallon drums stored in one group will have secondary containment. Tanks will have a clay or plastic liner or a curbed concrete pad surrounding the container, and a spill containment device attached to the intake valve. When containing 45-gallon drums, a drip pan or similar container or two containers (with one placed inside the other) will be used.

- Records of the wastes being stored, including type, volume, origin and storage location will be kept and easily accessible to assist response teams if a spill or fire occur. Copies of waste manifests will be submitted to the Environmental Programs Branch.

- Containers stored outside will be covered to protect them from the weather. Containers will be stored in piles, with 1.5 m between the piles.

- Containers will be closed, except when waste is added or removed.

- The volume of waste will not exceed the limits set out in the National Fire Code for flammable and combustible liquids. For example, used oil stored in piles should not exceed 85,000 L in volume.

- If wastes with different flash points are stored together, the storage requirements for the liquid with the lowest flash point will be used.
- Containers will be labeled with the waste's identity, PIN no., class, and packing group as per the requirements of the Special Waste Permit, and in accordance with the federal Transportation of Dangerous Goods Regulations.
- Wastes will not be mixed or diluted with other wastes or water, as mixed products often cannot be recycled.

In the event of a temporary closure, all unused chemicals or reagents, with the exception of those required for water treatment plant and other incidental uses, that are deemed to have short shelf life will be returned to suppliers/manufacturers. Those chemicals that cannot be returned will be disposed of in a proper manner as per manufacture instructions. Fuel supplies for equipment will remain on site and diesel fuel tanks will remain in service during a temporary closure. YZC will comply with the requirements under the Yukon Environment Act pertaining to storage and handling of petroleum products. Additional details pertaining to decommissioning and closure are provided in the *Reclamation and Closure Plan* (YZC, 2006b).

4.1 Used Oil

The major sources of waste oil will be from the mobile equipment and power plant generators. The most common types of used oil are crank case oil, gear oil, transmission fluid, and hydraulic oil. Under the Special Waste Regulations, a special waste permit is required if more than 20 L of used oil is generated per month or stored. For tanks, a permit may be required under the Storage Tank Regulations.

Used oil will be collected in designated waste oil tanks located in the mobile equipment maintenance area and near the diesel gensets. The oil will be periodically shipped off site by authorized carriers and taken to permitted facilities for shipping, treatment or recycling.

For wastes contaminated with petroleum hydrocarbons, such as in the event of a spill, bioremediation will be used. A land farm will be constructed utilizing bioremediation to treat petroleum contaminated soil. The landfarm will be constructed near the proposed non-hazardous waste onsite landfill. The landfarm will be constructed on a compacted till or other suitable liner. Hydrocarbon contaminated soil will be transferred into the landfarm, spread out over the surface and regularly turned to promote remediation. The soils will be sampled to determine when hydrocarbon contamination has been reduced to acceptable standards, and subsequently stockpiled for use in reclamation projects. Water collected in the land farm will run through an oil-water separator and subsequently discharged into the tailings facility.

4.2 Waste Oil Filters

Before disposing of waste oil filters, as much oil as possible will be eliminated from them. Steps required to ensure proper disposal include puncturing the top of the filter, setting the filter in a tray and allowing the oil to drain for approximately 24 hours, and crushing the filter to increase waste oil recovery.

Once the oil is drained, the filter will be disposed of by recycling through a company interested in the filter's metal value, or through a disposal operator, or at a landfill site.

4.3 Used Batteries

Waste vehicle batteries will be collected for regular shipment to a licensed recycle or disposal facility. A Special Waste Permit is required for handling more than 5 kg of lead-acid batteries per month.

The steps outlined below for storing batteries will be followed to help prevent acid leaks and spills and to avoid contamination of the storage site:

- Batteries will be placed on wooden pallets in secondary containment (i.e. on a liner or berm) to prevent the escape of acid.
- Before putting waste batteries on the pallet, plastic sheeting will be placed on it to completely enclose all of the batteries in a continuous sheet of plastic. All sides will be wrapped to protect the batteries from the weather and to prevent any acid from being discharged into the environment.
- Batteries will not be stacked more than three layers thick and each layer will be separated with a sheet of plywood or other suitable material.

4.4 Antifreeze

A permit under the Special Waste Regulations is required if more than 5 L of waste antifreeze is generated within a 30 day period. Used antifreeze will be stored in good quality containers that are leak-free and have tight closures to prevent spills, then shipped to a licensed recycle or disposal facility.

4.5 Waste Solvents and Lubricants

Miscellaneous, small quantities of waste solvents and lubricants will be generated through routine maintenance and repair of equipment. Solvents are liquid substances that can dissolve other substances and can be recycled. Paint thinners and strippers, varsols, degreasing fluids, mineral spirits and petroleum distillates are common solvents. Most of these liquids are flammable and toxic. A Special Waste Permit must be obtained from the Environmental Programs Branch if more than 5 L of solvents per month, or more than 5 kg of solvent sludge per month is handled or stored.

Solvents and lubricants will be collected and stored in appropriate drums for regular shipment to a licensed recycle or disposal facility. Containers will be covered to protect them from precipitation and will be kept apart from other waste products. When transporting solvents, the container will be labeled according to the Transportation of Dangerous Goods Act.

4.6 Medical Wastes

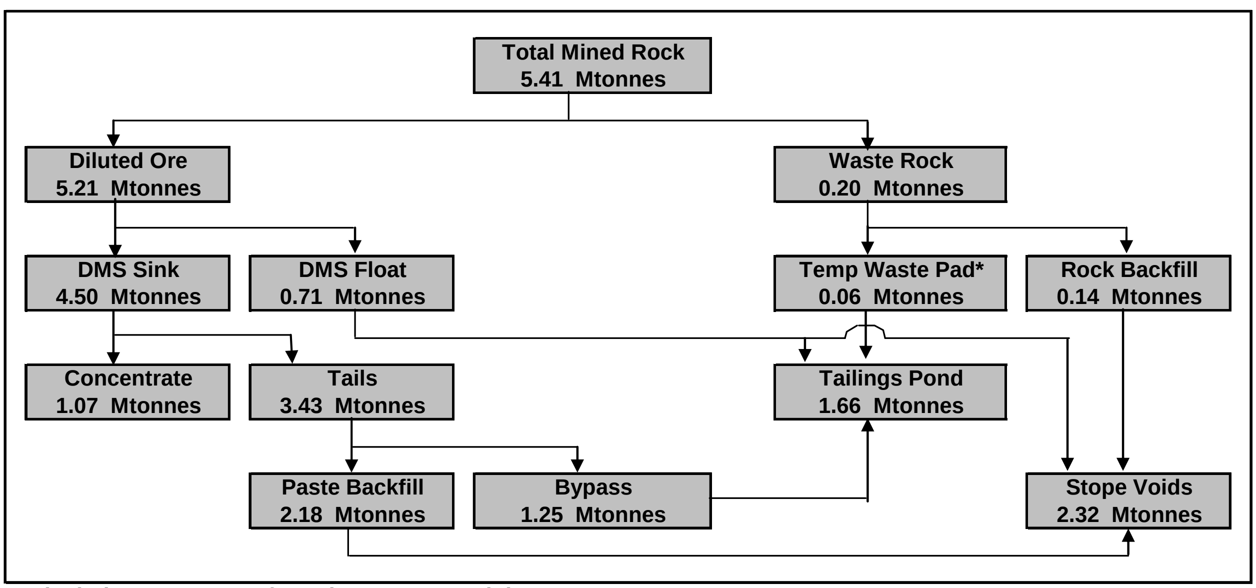
A small amount of hazardous waste (such as syringes, bandages etc.) will be generated at the first aid room. This waste will be collected in designated purpose-built containers and disposed of appropriately at an offsite facility.

5 Mine Generated Waste

The three types of mine waste generated during operations include waste rock, dense media separation (DMS) float rock and tailings. Disposal areas for these wastes include the tailings facility, the temporary waste rock storage pad, and underground. A materials balance flowsheet for these disposal sites is shown in Figure 5-1 for the life of the operation.

The tailings impoundment will store mill tailings, DMS float and waste rock. Additional details pertaining to the construction, operation and closure of the tailings facility are provided in the *Tailings and Infrastructure Design and Construction Report* (YZC, 2006c). The waste rock pad will temporarily store waste rock generated during ramp development, and will be subsequently placed in the tailings facility or underground. Tailings, loose waste rock from lateral stope development and DMS float will be consumed by paste backfill operations required to fill underground voids.

Figure 5-1. Material Balance for the Operation (Life of Mine)



*** includes 0.03 tonnes from the 2005 Test Mining Program**

5.1 Waste Rock Handling

The handling and storage of waste rock is based upon existing geochemical characterization, and as such, all waste rock will be treated as potentially acid-generating. Development waste rock from underground will be disposed of in the existing temporary waste rock storage facility and ultimately in the tailings facility or underground. Loose waste from the development headings will remain underground (See Section 5.1.1).

A waste pad was constructed during the 2005 test-mining program at a distance of approximately 1 km from the mine towards the airstrip, and is permitted under the existing Mining Land Use Permit (QZ01-051) and Type B Water Licence (LQ00140). Approximately 30,000 t of waste and 5000 of ore were added to the waste pad during in 2005. The waste pad will be expanded in 2007 to contain an additional 3900 t of ore and 63,700 t of waste from the pre-production mine development. The waste pad is a temporary facility. During the first few years of operations, the waste rock will be relocated to the tailings impoundment site for permanent disposal and the site will be reclaimed.

The waste pad is a temporary facility only. If the production decision in 2006 is favourable, the ore on the waste pad will be used to commission the mill on start-up. Once the tailings facility has been commissioned, all remaining waste rock on the pad (132,000 t) will be hauled to the tailings facility for permanent disposal. Upon the complete re-location of waste to the tailings pond, the waste pad site will be reclaimed. If the decision is not favourable, the waste rock pad will be capped, as described in the as-built report (YZC, 2005).

5.1.1 Loose Waste and DMS Float Rock

Most waste rock from development headings will be hauled into open stopes as fill (will not leave the underground), and DMS float rock will be hauled from surface to the mine. The material will be completely encapsulated by paste backfill. The DMS rock may be added to the paste backfill in the plant to increase strength or conversely reduce binder content.

On closure of the tailings facility, a 0.3 to 0.5 m thick layer of DMS material will be laid over the ice within the tailings area in winter. When the ice melts, it will provide a stable cover for the tailings and reduce the potential for remobilization and resuspension of tailings solids through wave action. Additional information is provided in YZC, 2006c.

5.2 Tailings Management

Approximately 56% of the tailings will be processed to paste for the backfill (see Section 5.3) and the remainder will be disposed in the tailings facility. The mill tailings, as well as waste rock, have high sulphide contents and if exposed for extended periods to atmospheric conditions will oxidize and result in acid rock drainage and higher metal concentrations. Accordingly, the operational and closure management plan is to store all of the materials below water to prevent sulphide oxidation. The tailings facility will be closed as a saturated deposit with minimum water cover of 0.5 m, and the mine will flood at closure.

5.3 Paste Backfill Plan

To promote overall mine stability, mining voids will be filled. Three types of backfill will be used: paste backfill with cement addition, loose waste generated by the lateral development, and DMS float product. YZC will utilize paste backfill as a strategy to provide underground support, manage tailings and reduce surface environmental impact from the operations.

Paste backfill is an engineered mixture of tailings solids, binder (cement) and water, with the required strength for backfilling the underground mine. The paste will be manufactured from unclassified tailings. Portland cement will be added to the paste to fully hydrate the water, causing the product to maintain its form as paste and add strength such that it can be exposed by adjacent mining.

Mine Systems Design, Inc. (MSD) was retained by Yukon Zinc Corporation to conduct testwork relative to the use of tailings for paste backfillin the mine. Paste testwork results and conclusions drawn by MDS are based on the assumption that the tailings produced in the laboratory are representative of the particle size distribution that will be achieved by a full-scale plant. The following results were obtained from the testwork:

- Specific gravity measurements of the minerals in the tailings sample were an average of 3.44.
- The bleed water or shrinkage of paste ranged from 2.2% to 5.0% of the initial paste volume and was mostly affected by slump.
- Particle size analysis confirmed sufficient ultrafine particles are present in the tailings to form a paste as 46.4% of the tailings pass 20 microns. Rheology tests (slump tests) also confirmed the tailings will form a stable paste.
- A 7-inch slump paste with 4.5% cement and made from 100% flotation tailings requires a pulp density of 74.1% solids. The addition of cement to tailings does not increase the viscosity of the paste.
- Low cement content cylinders (2.5% and 4.0%) of 100% flotation tailings were relatively weak after seven days of curing as compressive strengths were from 56 to 160 kPa. At least 5% portland cement will be required to produce adequate strengths after seven days of curing.
- The addition of DMS reject significantly increases the compressive strength of the paste.

- Permeability testing of paste backfill cylinders found the permeability ranged from 7.7 x 10^{-5} cm/s to 8.6 x 10^{-6} cm/s.
- A Meteoric Water Mobility Procedure did not find any constituents that would retard the strength development of portland cement.
- Mixing tests found no shear-thinning tendencies with the tailings.
- Based on the testwork results, conclusions relative to paste plant flowsheet design, relative to distribution of paste from the surface plant to the underground stopes, and relative to mechanized mining methods can be made.

Paste backfill will be passed to the mine through the main ramp via the 1345 Portal in 150 mm Schedule 40 or Schedule 80 steel pipe that will be rigidly mounted in the main ramp. The final 300 m of each paste line will be HDPE pipe that will be laid on the floor of the stope. As paste backfill is quite viscous, the head gained by the vertical drop will not be adequate to deliver the paste backfill to the stopes. A positive displacement pump will be used to move the paste through the line.

5.4 Water Treatment Sludges

As described in the EAR Response document (YZC, 2006a), all operational mine water will ultimately report to the tailings impoundment. YZC has been continuously evaluating and refining the treatment system planned for the Wolverine Project and has focused on ensuring adequate treatment of selenium. While additional site water treatment tests have shown success in treatment of Se from underground mine water using lime/ferric precipitation, YZC has continued to evaluate other proven alternatives for Se treatment. The proposed water treatment plant will consist of an high density sludge (HDS) water treatment plant followed by bioreactor treatment as shown in Figure 5.2.

The HDS sludge, an insignificant amount when compared to the mine wastes, will be placed within the tailings facility. The bioreactor treatment is designed to polish the HDS effluent by removing selenium. The bioreactor product is retained in the fluidized bed until the system undergoes maintenance and the frequency depends on selenium loads through the system. The bioreactor is essentially “back-flushed” and the elemental selenium is removed from the system as an approximately 95% pure Se^0 product in an organic matrix (Adams and Pickett, 1998; Macy *et al., 1993*; MSE, 2001).

If the system is being used to remove other metals (i.e., Zn, Cd), it will produce metal sulphides. The ultimate fate of this material depends on the quantity produced, which in turn depends on the concentration requiring treatment and the flows. It can be sold (in particular, there is a market for Se), or it could be buried in the tailings pond (both Se^0 and metal sulphides would be thermodynamically stable under the reducing conditions within the tailings pond). Given the existing market conditions, the current plan is to sell the selenium product.

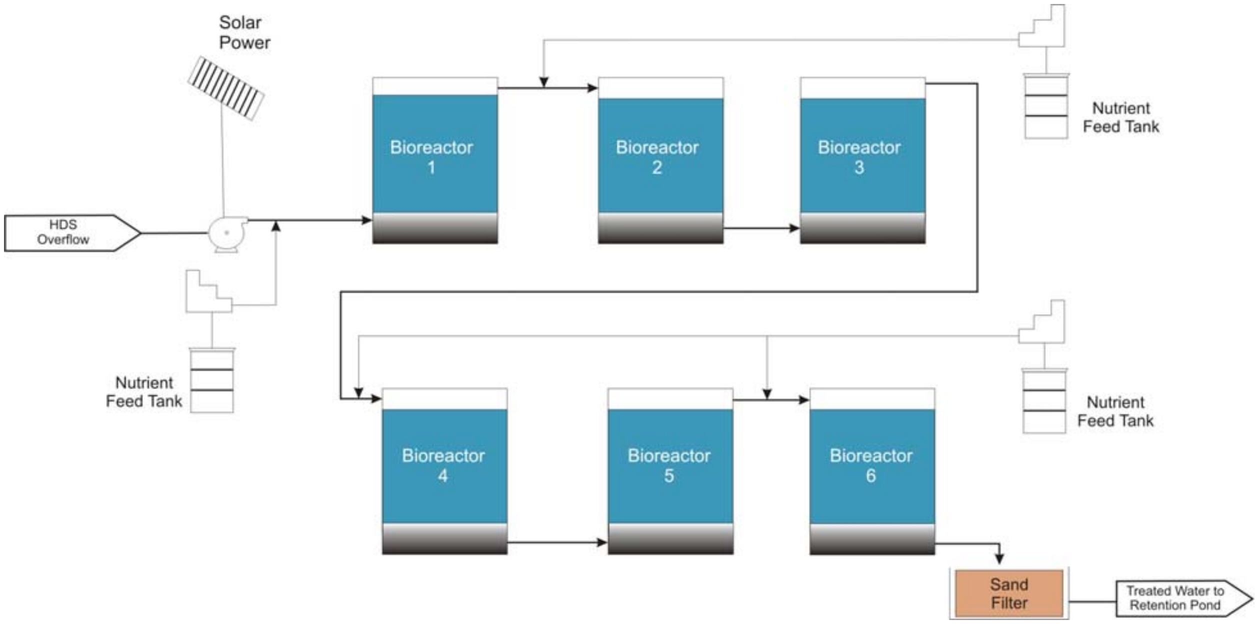


Figure 5-2. Schematic Design of the Bioreactor System for the Treatment of Selenium in Tailings Pond – High Density Sludge (HDS) Overflow Water.

6 Summary

This *Solid Waste Management Plan* is based on the best available information available at the time. The waste management plan will be revised during detailed engineering design to suit additional information.

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