8 Waste Rock Management

This section provides as-constructed details pertaining to the construction of the temporary waste rock and ore storage facility (the pad) for the Wolverine Project. The pad has been approved under Mining Land Use Approval LQ00140. Table 8-1 provides a summary of the reviewer comments and the location of the response.

The pad was constructed in July 2005 during the advanced exploration phase to contain all of the waste generated from the test mining program. It is located to the southeast of the portal at approximately 6810200N and 440650E, as shown in Figure 8-1. The pad contains approximately 27,000 t of waste rock and 4450 t of ore generated from the 2005 test mining program (Phase I), and has the capability of being expanded to contain waste rock and ore from preproduction underground development program (Phase II). Based on the rock geochemistry results received to date, all waste rock from the mine has and will be treated as potentially acid-generating.

Figure 8-1 Waste Rock Pad Plan and Cross-Section (Figures Section)

Table 8-1 Waste Rock Table of Conformance

Reviewer	EAR Section	Reviewer Comment	Response Report Section Where Addressed
8 Waste Rock Management			
SRK Consulting	Section 2.7	**Surface Water Diversions and Design Criteria** The EAR does not provide any discussion on the design criteria or drawings for the diversion ditch or the culverts.	Section 8.3.3, Figure 8.3
SRK Consulting	Section 2.7	**Pad Design and Construction** YZC should provide an as-built report on the Phase I construction.	Section 8
SRK Consulting	Section 2.7	**Collection Sump** YZC had previously provided a preliminary design for the seepage collection sump. YZC should explain how this flow will be treated and provide case histories for similar applications. YZC should also explain how the sump will be emptied.	Section 8.3.4
SRK Consulting	Section 2.7	**Waste Rock Sump Water Quality** This data will be very useful in assessing the geochemical behaviour of the lithologies stockpiled on the pad.	Section 6.3 and Appendix D
SRK Consulting	Section 2.7	**Closure – Capping of SPAG/PAG** YZC should provide more detail on the final configuration of the waste rock dump at closure and include details on final slope angle, water management and ditch removal.	Section 8.6
SRK Consulting	Figure 6.2.1	**Ore Stockpile** Figure 2.6-1 indicates there will be an emergency ore stockpile. If there will be a stockpile on site, details should be provided on its location, size, storage pad, operation and water management.	No stockpile on surface – Figure 1-2
Environment Canada	Section 2.7	**Waste Rock Disposal Plan** We also are not sure that contaminant contributions to the final tailings pond water and or to groundwater seepage, from what may be ARD materials in various states of oxidation, have been accounted for in subsequent tailings pond water quality predictions.	Sections 7.4 and 7.6; Appendix F3
Environment Canada		**Data Shortages** Geotechnical assessments, which included test pit studies and perhaps soil permeability testwork was undertaken on the waste rock pad foundation materials. This supporting information should be included with this document. Details of the groundwater monitoring wells (logs, monitoring installations, supporting information) needs to be presented.	Appendix F1

8.1 General Site and Structure Description

In July 2005, a 4900 m² waste rock pad was constructed on the lower slope of the northeast valley wall above Go Creek. Following subsurface geotechnical investigations (see below) and geotechnical test work, the pad location was selected in a bowl-shaped valley, rectangular-shaped on plan view. In the general area selected for pad, colluvial veneers with morainal blankets and colluviated moraine and rock cover the sloping surface.

The temporary waste rock pad contains stacked rock to an average height of 8 m with the edges sloped at the natural angle of repose of the broken rock (estimated at 38°) providing an approximate volume of 37,500 m^3 for the advanced exploration program (Phase I). The nominal maximum height of fill is 10 m. The pad will be extended an additional 3600 m² to the north to accommodate the additional 70,000 t of waste rock that will be generated during the pre-production development program (Phase II). This material will be stacked to a height of approximately 10 m, with a nominal maximum height of 13 m. At the end of the 2005 program, the height of the pile was approximately 9 m high (7 m of waste rock and 2 m of ore).

The site for the waste rock pad was chosen for its geotechnical properties and favourable topography. The side walls of the pad provide support for waste materials and the elongate bowl-shaped will contain any loose material. To minimize slope failure within the bowl-shaped area, the material will be graded at the angle of repose (38°). In the event of a slope failure, material would be limited to the outer banks of the bowl-shaped facility and would not extend beyond the pad itself.

The waste pad is a temporary facility only. If the production decision in early 2006 is favourable, the ore on the 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 area will be reclaimed. If the decision is not favourable, the waste rock pad will be capped and seeded.

Only Phase I material will be stored on the pad until the production decision is received. If YZC moves onto Phase II, then a slope stability analysis of the stored material will be considered.

8.2 Geotechnical Assessments

Six test pits (TP05-43 to -48) were excavated in the general footprint area of the constructed pad. These test pits were excavated using a 420D Cat backhoe down to a depth ranging from 3.5 to 3.9 m on May 22, 2005. The test pits were logged by Klohn Crippen, and representative samples were sent to the Klohn Crippen Vancouver laboratory for further visual classification and index property tests. In general, the pad area was found to have a low permeability layer underlying the pad with a minimum thickness of 3 m, sufficient thickness for the site to be developed as a temporary waste rock pad site. Appendix G1 contains the results of the test pitting. Laboratory soil test results, including grain-size analyses and water content, for samples retrieved from the pad area are presented in Appendix F1.

Two 2” diameter monitoring wells were installed downslope from the waste rock pad at location MW05-1 to monitor groundwater quality at two different depths. These

monitoring wells are located about 350 m southeast of the southeast corner of the pad. The test holes were logged using cuttings recovered from the drill holes, and falling head and packer permeability tests were carried out in the deep drill hole, MW05-1A. Due to problems with the removal of the casing, a monitoring well was not installed at this location and the casing was capped to prevent groundwater discharge. Figure 8-2 shows the location of the monitoring well and the test pits. The logs of these monitoring wells, including the permeability values and well installation details, are included in Appendix G1.

Figure 8-2 Plant Site and Waste Rock Pile Site Investigation Plan (Figures Section)

8.3 Pad Construction Details

8.3.1 Surface Preparation

In order to provide a base for the waste rock pad, the existing organic and topsoil layer was stripped to expose the underlying low permeability till-like layer and stockpiled for future reclamation activities. The exposed till-like surface was then graded, contoured and proof-rolled to facilitate the collection of water from the pad to the south end (Picture 8-1).

Picture 8-1 Grading, Contouring and Proof-Rolling the Till-Like Surface

8.3.2 Liner Installation

As site permeability with the clay layer could not achieve 10^{-6} cm/s, an area slightly larger than the footprint of the pad was lined with an impervious 30 mil Enviro Liner® encased in geotextile cloth for additional protection. The liner will minimize infiltration of water into the foundation subsoil. The Enviro Liner® is a proprietary polyolefin material designed by Layfield Environmental Systems Ltd. (Layfield) for outstanding durability, chemical resistance, and flexibility. The Enviro Liner® formulation includes a proprietary UV inhibitor/antioxidant additive that makes it the most durable thin film

geomembrane available on the market for exposed service applications. The 30 mil Enviro Liner® has been tested extensively and has been shown to provide the same exposed service life as can be expected from 60 mil high density polyethylene (HDPE) liner. Every step in the production of the Enviro Liner® geomembrane is completed according to Layfield's ISO 9002 Quality System to ensure that the liner adheres to stringent standards for all geomembrane applications. Every panel is produced as a custom panel and quality control reports are prepared for each panel produced.

The liner was supplied, placed and anchored by a specialist contractor in compliance with its quality control and assurance programs (Picture 8-2 and Picture 8-3). The preparation and excavation of the site was inspected and approved by a professional engineer licensed to practice in the Yukon and by the supplier before and after liner installation. To protect the installed liner from potential damage due to the waste rock placement, a layer of geotextile fabric and a 0.5 m thick protective layer of clay material were placed over the Enviro Liner®.

Picture 8-2 Installation of the Geotextile Layer and Enviro Liner®

Picture 8-3 Completion of Enviro Liner® Installation

8.3.3 Water Diversion

Runoff from most of the catchment area upslope of the waste pad is intercepted by the camp-airstrip road ditch located northeast of and upslope of the pad. The camp-airstrip road and collection ditch conform to the approximate shape of the pad. Ditches drain into vegetated areas thus mitigating sediment transport. There are two existing culverts under the camp-airstrip road west of the pad. The northern 600 mm culvert directs the majority of upslope runoff away from the camp-airstrip road and from entering the pad. The southern 400 mm culvert moves water under the back road, south of the pad, for discharge towards Go Creek.

The ditches upslope of the pad prevent surface water from entering the pad. Pad design incorporated maximum 50-year flow and catchment area data. The estimated catchment areas and the design flows for the various components of the drainage works are shown in Table 8-2. The run are maximum instantaneous 50-year flows based on a correlation plot of drainage area vs. surface runoff taken from the 2001 regional hydrology report (Gartner Lee, 2001).

Table 8-2 Temporary Waste Rock and Ore Facility - Catchment Areas and Design Flows

Location / Ditch	Catchment Area (ha)	50-year Runoff (L/s)
Collector Ditches (total all ditches)	1.7	5
Conveyance Ditch	1.5	4
Discharge Ditch	2.3	6
Stream Diversion Ditch	30	75

Berms are another measure used to divert surface runoff away from the pad. There is a large berm constructed at the pad entrance along the road's edge to keep water from flowing from the road into the pad. This berm extends to the east of the pad to direct water flow past the pad and eventually into Go Creek. Flooding of the west entrance from rainfall was a common occurrence in the summer of 2005. To minimize the pooling of water within the pad during spring 2006, a temporary berm has been constructed at the west entrance of the pad.

Subsequent transfers of waste to the pad will occur at the north east edge of the pad from the camp-airstrip road. Figure 8.1 shows the ditch, culvert and berm features surrounding the waste rock pad.

8.3.4 Collection Sump

The collection sump is located at the southern downslope end of the pad (Picture 8.4). All runoff from the waste rock pad is collected in the collection sump where it is treated. Once the water meets the applicable criteria to allow for discharge, it is discharged downslope to a vegetated area that eventually drains into Go Creek. The collection sump was constructed from compacted till and lined with a 40-mil Enviro Liner®. A second sump will be constructed in spring 2006 if the project moves towards production

The water in the sump is regularly tested as per the requirements of the Type B Water License. Once the water reaches discharge limits, the sump will be emptied by pumping the treated water directly from the sump into the headwaters of the Go Creek drainage.

The sump, with a capacity of 221 m^3, has been increased from the original proposed volume of 24 m^3. The sump volume is the capable of retaining water from a 24-hour rain event with additional melt waters.

Limited volumes of sediment have reached the collection sump. Based on the results of the 2005 monitoring program, the total suspended solids (TSS) within the sump water are low (Table 8-3). Sediment-laden road runoff has been diverted from entering the waste rock pad using ditches and berms and the waste rock on the pad acts as a filter. TSS was initially high immediately following liner installation and the initial rain event.

Table 8-3 2005 Waste Rock Pad Sump Monitoring

Waste Rock Sump WQ (mg/L)	WRS July 27	WRS Sept 7	WRS Sept 27	WRS Oct 26	Type B Water License Discharge Standard
Total Suspended Solids	**316**	2	4	4.4	*15*
Ammonia Nitrogen N	0.034	**11.8**	**6.38**	**9.06**	*2.50*
Total Arsenic As	0.0099	0.003	0.0014	0.00098	*0.10*
Total Cadmium Cd	0.000397	< 0.0002	0.0003	<0.010	*0.02*
Total Copper Cu	0.112	0.002	0.0027	<0.010	*0.20*
Total Lead Pb	0.0376	< 0.001	< 0.0002	<0.050	*0.20*
Total Nickel Ni	0.0564	0.007	0.0054	<0.050	*0.50*
Total Selenium Se	<0.0020	**0.066**	**0.041**	**0.0634**	*0.015*
Total Zinc Zn	0.095	< 0.005	0.051	0.0323	*0.50*

Picture 8-4 Water Collection Sump at the Southeast Corner of the Waste Rock Pad

8.4 Quality Assurance/Quality Control Plans and Testing Protocols

The Layfield Environmental Systems Ltd. Project Completion QA/QC Package is contained in Appendix G2. The following Layfield quality assurance/quality control plans and testing protocols are available upon request:

Process Control
Quality Control Plan Field QC. Plan
Shipping Instructions Field QC. Shipping. 01
Receiving Inspection Instructions Field QC. Receiving. 02
Site Inspection and Measurement Field QC. Site Inspection. 03
Deployment Instructions Field QC. Deploy. 01
Wedge Welding Instructions Field SI. Seams. 01
Extrusion Welding Instructions Field SI. Seams. 02
Bonded Seam Welding Instructions Field SI. Seams. 03
Qualification Welds & Testing Field QC. Testing. 01
Qualification Welds and Testing Field QC. Testing. 02
Film Tear Bond Test Instructions Field QC. Testing. 03
Air Lance Testing Instructions Field QC. Testing. 04
Point Stress Testing Instructions Field QC. Testing. 05
Vacuum Box Testing Instructions Field QC. Testing. 07
Repair Instructions Field QC. Repair. 01
Final Inspection Instructions Field QC. Final Inspection. 01
Operations and Maintenance Instructions Field QC. Ops. 01
Welding Trials Field LG-09-WI-030

Inspection and Testing
Field Geosynthetics Quality Control Recordkeeping Protocol
Geomembrane Deployment Log Field LS-10-SI-002
Geomembrane Trial Seam Log Field LS-10-SI-003
Geomembrane Seam Log Field LS-10-SI-004
Geomembrane Vacuum / Air Lance Test Log Field LS-10-SI-006
Geomembrane Defect / Repair Log Field LS-10-SI-007
Geomembrane Destructive Test Report Field LS-10-SI-009
Geosynthetics Inventory Log Field LS-10-SI-010

8.5 Operational Details

Waste rock and ore will continue to be hauled from the portal area to the waste rock pad at the onset of 2006 activities. Material hauled form the portal to the waste rock pad and dumped at the southeast end as shown in Picture 8-5 to Picture 8-7.

Picture 8-5 Haulage of Waste Rock on to the Waste Rock Pad

Picture 8-6 Waste Rock Pad, August 19, 2005

Picture 8-7 Waste Rock Pad, August 19, 2005

8.6 Closure Plans

The waste rock pad is a temporary storage structure that it is designed to accommodate mine waste until the tailings facility has been constructed. During preproduction in 2006 and 2007, muck from the underground will be brought to surface where it will be transferred to the waste rock pad.

The final closure configuration of the waste rock pad is dependent upon the production decision. If production proceeds then the waste and ore material would be stored at the pad for approximately eighteen months. Once the tailings facility has been completed, the waste will be hauled to the tailings facility and the ore would be processed through the mill. All remaining waste material and the Enviroliner® would be removed from the site. The slopes and organic stockpile would be re-graded to the natural contours existing before waste pad construction, and the sump would be back-filled. Ditch and culvert structures would remain as they maintain the integrity of the road. Later during the closure phase these structures would be decommissioned.

Additional details pertaining to the storage of waste rock at the tailings facility is provided in Sections 7. The small volume of material as well as the very small pore space of the waste material will have negligible effects on pore water quality of the tailings. On average the waste pad material pore water volume is 0.17 m^3/hr of the total 5.26 m^3/hr from all pore waters contributing to pore water volume.

If the project does not proceed to production, all ore and as much waste as possible will be returned to the underground workings. If any additional waste material remains at the pad it will remain on the impermeable liner and be contoured to conform to the natural topography. The pile will be compacted and capped and seeded to minimize infiltration. Sump water quality water monitoring will continue as required.