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## **8 MINE SITE CLOSURE AND REHABILITATION COSTS**

A preliminary Decommissioning and Closure Plan has been prepared for the Kalukundi site together with an estimate of the costs of implementation. These costs will form the basis for the calculation of the financial guarantee (Article 125 of the Mining Regulations).

Two years prior to closure, a detailed final closure plan will be submitted to the Ministry of Mines in Kinshasa.

### **8.1 Strategy and Objectives**

The mine site will be progressively rehabilitated throughout the life of the mine as areas become available. A more detailed closure plan with costs will be produced during the detailed design and construction phase i.e. pre-production during 2007-2008. This closure plan will be reviewed and updated every 6 months. The preliminary and final closure plans will satisfy the requirements of the DRC Environmental Regulations and World Bank procedures and guidelines where appropriate.

The overall objectives of the mine Decommissioning and Closure plan are to:

- (i) Protect future health and safety;
- (ii) Minimize or prevent environmental degradation, either physical or chemical;
- (iii) Return the land to the pre-mining land use (sustainable woodland) or an acceptable alternative; and
- (iv) Minimize any adverse socio-economic impacts.

These will be considered under the following site conditions; physical stability, chemical stability and land use.

#### **8.1.1 Physical Stability**

Mine structures that remain post closure e.g. TSF, WRDs and open pits should be physically stable such that they do not pose a hazard to public health and safety as a result of failure or gradual degradation. These structures should not erode and/or release solids into the environment during storm events or due to the long-term effect of natural forces.

#### **8.1.2 Chemical Stability**

The infiltration or run-off from the mine site or waste storage facilities should not endanger public health and safety or result in the pollution of surface or groundwater, or non compliance with DRC statutory limits or World Bank guidelines concerning the quality of effluent discharged to the environment. All mine waste materials stored on site should be chemically stable.

#### **8.1.3 Land Use**

Post closure, the mine site should be compatible with the surrounding land, to the extent that it is both practicable and economical to do so.

## **8.2 Open Pits**

The open pit will be designed with final pit slopes that will ensure the long term stability. The updating of the mine schedules and final decommissioning slopes will be carried out by RSG Global throughout the mine life.

During the operating life of the mine a perimeter bund wall will be constructed around the perimeter of the pits to prevent inadvertent access. At closure, all mining and dewatering equipment, and materials will be removed and the flooding by natural groundwater inflows and precipitation will occur. The pits do not cross any natural streams and overflowing from the pits is not thought likely. Access to the pits will be blocked with waste rock to prevent access by motor vehicles. Pictorial signs in French and Swahili will be erected along the pit perimeter bund to warn the public of the dangers of entering the pit.

## **8.3 Waste Rock Dump**

The proposed WRDs will be of stable terrace construction to an overall slope angle of 18 degrees with 20m lifts.

The results of geochemical characterization, mild leach testing and acid base accounting test work performed indicates a low risk of acid rock drainage occurrence. The dump will be constructed to ensure that any potentially acid forming (PAF) waste is encapsulated within non-acid forming (NAF).

The dumps will be progressively re-vegetated over the life of mine using stored topsoil and indigenous grasses and trees. The upper surface of the dumps will be re-vegetated at closure using agricultural methods i.e. discing, application of lime/fertilizer and planting of indigenous grasses and trees.

## **8.4 Tailings Storage Facility**

The tailings storage facility (TSF) will be constructed according to specifications provided by environmental and mining consultants Golder Associates Africa (Pty) Ltd and be of stable design.

At closure all decant structures will be sealed, and pipelines, equipment and materials will be removed. The supernatant pool will be allowed to evaporate. Future precipitation will collect in paddocks on the upper surface of the TSF and infiltrate the tailings and/or evaporate.

The results of geochemical characterization, mild leach testing and acid base accounting test work performed on samples of tailings indicates the tailings to be non-acid forming (NAF).

The side walls of the TSF will be progressively rehabilitated over the life of mine in order to establish a sustainable indigenous vegetation cover and minimize erosion. The upper surface of the TSF will be re-vegetated at closure using agricultural methods i.e. discing, application of lime/fertilizer and planting of indigenous grasses and trees.

## **8.5 Plant Infrastructure and Buildings**

At closure, the crusher and ore transfer section, mill and concentrator, associated steel and brick structures and foundations will be dismantled to 500 mm below ground level. Saleable items will be sold at market values. Redundant equipment will be sold as scrap or disposed of at waste dumps.

Equipment such as mining fleet, other mobile plant pumps, motors, valves pipes, transformers, electric cables, containers etc will be dismantled and/or removed to a secure storage area awaiting relocation to another mine site or sale to the local community, businesses and scrap metal dealers.

Certain of the mine buildings and plant structures (after removal of process plant and decontamination) could be adapted for sustainable use including small business enterprise, light industry and/or warehouse use. These buildings include offices, stores, workshops assay laboratory, dining hall etc. The local community and businesses will be consulted in this regard prior to closure. The Decommissioning and Closure Plan with Costs assumes that the whole mine site is dismantled and removed.

Potentially hazardous chemicals and substances onsite at closure will be sold, recycled or disposed of in an approved hazardous waste disposal site.

A soil contamination study will be conducted at closure. Contaminated soils will be managed on site or removed and disposed of off-site at an approved hazardous waste disposal site. Finally, the plant site will be leveled and re-profiled.

## 8.6 Mine Decommissioning & Closure Cost Estimate

The following costs have been derived from market knowledge, past costing development and experience. The costs cover mine site decommissioning and reclamation works, and post closure inspections and environmental monitoring at the Kalukundi mine site as outlined in Section 7.8.2 above. The estimated decommissioning and closure cost for Kalukundi Mine is US\$965,201.25, which includes US\$193,040.25 (25%) for closure management by an independent consultant. The costs assume rehabilitation work is carried out by a third party and no revenue from the sale of mine equipment to offset the decommissioning cost.

### 8.6.1 Estimated Cost of Mine Site Reclamation Tasks

#### Open Pit Decommissioning and Closure Cost

Open pit decommissioning activities for the four pits and costs are presented in Table 8.1. The total decommissioning cost estimate for the open pits is US\$42,500.

**Table 8.1 Open Pit Decommissioning Cost**

Activity/Task	Cost US\$
Removal of floating platform and dewatering pumps	\$7,000
Removal of dewatering pipelines	\$3,000
Removal of electrical equipment and cables	\$10,000
Removal of scrap materials	\$5,000
Blocking of pit ramps to prevent unauthorised access	\$1,500
Backfilling and profiling of sedimentation ponds	\$15,000
Erection of danger signs around open pits	\$1,000
<b>Total</b>	<b>US\$42,500</b>

#### Process Plant, Workshop and Re-fuelling Station

The Kalukundi process plant, workshop and re-fuelling station dismantling and disposal costs are summarised in Table 8.2 and estimated to be US\$305,000. This figure does not take into account any revenue generated from the sale of scrap materials and equipment, which will offset decommissioning costs.

**Table 8.2 Process Plant, Workshop and Re-fuelling Station Closure Costs**

Item No.	Mine Component	Decommissioning Cost US\$
1.	Ore crushing and transfer section	\$25,000
2.	Mill	\$30,000
3.	SX/EW plants	\$120,000
4.	Heavy equipment workshop	\$35,000
5.	Mechanical and electrical workshops	\$12,000
6.	Fuel storage area	\$8,000
7.	Stores and offices	\$15,000
8.	Other plant/infrastructure/cables/equipment	\$60,000
Total		US\$305,000

A soil contamination survey will be carried out after the process plant has been dismantled and disposed. A sum of US\$25,000 is included in the decommissioning and closure cost for the soil contamination study and removal or in-situ treatment of contaminated soils (if any).

The estimated unit rate for grading and re-profiling the plant site to re-establish natural drainage is US\$5,000/ha. This cost is based on local earthworks rates of US\$2.50/m<sup>3</sup> and an average re-profiling depth of 200mm. The cost of reprofiling the process plant, workshops and re-fuelling station is approximately US\$266,300.

The total rehabilitation cost estimate for the process plant, workshop and re-fuelling station is US\$571,300.

#### Tailings Disposal Facility

The main decommissioning activities and costs associated with the TSF are presented in Table 8.3. The total decommissioning cost estimate is US\$43,960.

**Table 8.3 TSF Decommissioning Cost**

Activity/Task	Cost US\$
Removal of tailings delivery pipelines approximately 5,000m @ \$2.66/m	\$13,300
Removal of return water pipeline approximately 1,000m @ \$2.66/m	\$2,660
Seal TSF decant towers and pipes	\$28,000
<b>Total Cost</b>	<b>US\$43,960</b>

#### Mine Site Re-vegetation Cost

The estimated cost to re-vegetate the mine site using agricultural methods (as outlined in Section 7.8.1) based on local input prices and labour rates is approximately US\$450/ha for the TSF and US\$233/ha for the plant site and WRDs. The cost breakdown is given in Table 8.4.

**Table 8.4 Mine Site Re-vegetation Costs per Hectare**

Agricultural Activity	Tailings Storage Facility	Plant Site and Dumps
Discing	\$15	\$15
Spreading fertilizer	\$6	\$6
Spreading limestone	\$13	\$13
Limestone cost	\$200	\$66

Agricultural Activity	Tailings Storage Facility	Plant Site and Dumps
Fertilizer cost	\$166	\$83
Plant native species	\$50	\$50
Total cost per hectare	US\$450/ha	US\$233/ha

The total mine site re-vegetation cost estimate is US\$94,401. Re-vegetation costs by mine component are summarised in Table 8.5.

**Table 8.5 Mine Site Re-vegetation Costs**

Mine Component	Area (ha)	Unit Rate (US\$)	Re-vegetation Cost (US\$)
Waste Rock Dumps	104	233	24,232
ROM Pad	2.98	233	694
Process plant site	48.26	233	11,245
Tailings Storage Facility	129.4	450	58,230
<b>Total Re-vegetation Cost</b>	<b>284.64</b>		<b>94,401</b>

Mine site re-vegetation should be completed within 3 years post closure.

#### General Site Clean-up

A sum of US\$20,000 has been included in the mine decommissioning and rehabilitation cost estimate for general site clean up.

#### Total Decommissioning and Closure Cost

The decommissioning and rehabilitation cost for the Kalukundi mine site is estimated at US\$772,161. A sum of US\$193,040.25 (25% of decommissioning and closure cost) has been added for supervision of decommissioning and closure activities by an external consultant. This brings the total cost to US\$965,201.25 (shown in Table 8.6).

**Table 8.6 Total Kalukundi Decommissioning & Closure Cost**

Item No.	Mine Component	Cost US\$
1.	Open Pits	\$42,500
2.	Process Plant, workshop and re-fuelling station	\$571,300
3.	Tailings Storage Facility	\$43,960
4.	Mine site Re-vegetation.	\$94,401
5.	General site clean-up	\$20,000
Sub Total		\$772,161
25% external management of closure		\$193,040.25
<b>Total Decommissioning and Rehabilitation Cost</b>		<b>US\$965,201.25</b>

#### **8.6.2 Post-closure Site Inspection and Environmental Monitoring Costs**

The Kalukundi post closure inspection and environmental monitoring cost estimate is US\$43,700. The cost breakdown for these activities is given in Table 8.7. These costs are developed from the assumptions of three site visits a year for a 5 year monitoring period post closure.

**Table 8.7 Post Closure Inspection and Environmental Monitoring Cost**

Item No.	Post-closure Environmental Activity	Qty	Unit	Rate US\$	Cost US\$
1.	Site Inspections x 5 Visits	15	days	\$600	\$9,000
	Mine site inspection to be carried out by independent consultant				
	Consultant's accommodation and transport	15	Days	\$250	\$3,750
Sub Total					\$12,750
2.	Environmental Monitoring x 5 Visits	15	days	\$350	\$5,250
	Technician to collect water samples				
	Water sampling consumables	-	l.s.	\$500	\$500
	Analysis of water samples	65	e.a.	\$120	\$7,800
	Technician's transport and accommodation	15	Days	\$200	\$3,000
Sub Total					\$16,550
3.	Post-closure Environmental Reporting				
	Preparation of 2 annual and final post closure environmental monitoring reports by independent consultant	24	Days	\$600	\$14,400
Sub Total					\$14,400
<b>Total Post Closure Environmental Inspection and Monitoring Cost</b>					<b>US\$43,700</b>