

Prepared for:



## SOIL AND EROSION MANAGEMENT PLAN

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Prepared by:



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## 1. SCOPE

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The Soil and Erosion Management Plan (SEMP) addresses soil management on and around the Kouilou Potash Project infrastructure. These include the plant area, the brine field, the port site, the pumping station, and all utilities corridors.

The SEMP also includes activities related to soil erosion control, which are strongly linked to the Water Management Plan (WMP) and the General Contractor's Erosion, Sediment Control Plan (ESCP).

The SEMP covers both the construction and operational phases of the Kouilou Potash Project. It constitutes the initial document which will be modified and updated as the Project unfolds.

## 2. PURPOSE AND ENVIRONMENTAL OBJECTIVES

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The SEMP aims to prevent adverse effects from the Project activities on soil quality and integrity and determines mitigation measures to minimise unavoidable degradation of soil conditions.

Soil management activities ensure that removed topsoil is not wasted and that as far as possible all residual organic matter from the Project activities are managed to favour reuse of topsoil.

In order to preserve the overall integrity of soil quality and maintain soil material in place, the SEMP also addresses erosion control and includes measures to mitigate soil degradation from erosion.

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### 3. DEFINITIONS AND ABBREVIATIONS

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#### **Definitions**

Soil: The naturally occurring, unconsolidated or loose material covering the Earth's surface. Soil is made up of broken rock particles which have been altered by chemical and environmental conditions, affected by processes such as weathering and erosion or modified by biological agents, and which can support plant roots.

Subsoil: Any soil horizons below topsoil.

Topsoil: The upper, outermost layer of soil, usually the top 5 to 20 cm. It has the highest concentration of organic matter and microorganisms, and is where most of the Earth's biological soil activity occurs. Plants generally concentrate their roots in this layer where they obtain most of their nutrients.

#### **Abbreviations**

BMP: Biodiversity Management Plan

CDP: Community Development Plan

CPAR: Corrective-Preventive Action Register

ESCP: Erosion, Sediment Control Plan

ESIA: Environmental and Social Impact Assessment

ESMS: Environmental and Social Management System

HSE: Health, Safety and Environment

HSEC: Health, Safety, Environment and Community

MTE: Ministry of Tourism and Environment

SEMP: Soil and Erosion Management Plan

SOP: Standard Operational Procedure

WMP: Water Management Plan

4R: Four Major Waste Management Principles: Reduce, Reuse, Recycle, Reclaim

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## 4. ACTIVITIES

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### 4.1 Context

The ESIA baseline reports that the soils in the Study Area are characteristic of the coastal sedimentary basin. In fact, regardless of the area sampled, they mainly consist of fine sand. They also have quite a high level of acidity and a relatively low humidity rate. They are poor soils with a low agricultural potential.

As MagMinerals promotes the 4R principles and wishes that local population benefits from the Project, topsoil is considered as a valued resource that should be managed to the benefit of the project and the environment. .

The fine sandy nature of the upper layers of the plateau favours the creation of gullies and the slopes are prone to erosion. The occurrence of soil erosion processes is confirmed by the presence of sediments in the water courses of the plateaus' sub-catchments, of rills on the rivers slopes and of gullies on the slopes around the plant site. Given that roads, embankments, retention walls and berms are mostly earthworks, these structures are prone to erosion if surface water management and erosion protection measures are absent or inappropriate.

Deforestation, vegetation removal, surface stripping, excavation, levelling and backfilling works, encroachment of machinery on the edge of the work areas, and the circulation of vehicles may result in soil erosion and sedimentary transport as a result of run-off.

Most of the soil disturbance will occur during the pre construction and construction periods. The General contractor will implement its own ESCP (Appendix 1) subject to approval by Mag HSE department. There also is the potential for disturbance to occur during ongoing development of the brine field.

### 4.2 Soil Removal

The first step of site preparation to construct any infrastructure is to clear surface vegetation, then grub and strip the land surface. Grubbing is defined as the action of removing stumps and large roots such as those of trees and shrubs. Stripping is defined as the removal of geotechnically unsuitable surface soils prior to construction. Combined grubbing and stripping is the action of removing vegetation, stumps, roots and geotechnically unsuitable surface soils prior to construction. In soil science terminology, 'unsuitable material', an engineering term, consists of the top soil and layers of subsoil which contain visible roots.

Surface soils will be removed from the plant site, the rail spur line and at the pumping station. This will be carried out by removal of vegetation and stumps, then stripping a layer of 150 to 200 mm thick with a bulldozer. The stumps will be reused as fill in gullies and large depressions as well as for barriers in erosion control measures. This topsoil will be stockpiled in piles no higher than 2 m in a designated area, as per drawings and specifications. Then, the subsoil will be removed according to construction plans and specifications, and will be transported to a location where it will be reused for backfilling, levelling or landfill cover.

No large quantity of soil is expected to be removed at the port and along the utilities corridors. Where underground utilities, pipelines and electrical poles are installed, removed subsoil will be stockpiled near the excavated areas and will all be used for the backfilling of trenches. This may create slight heaps that will settle with time. Topsoil will be stripped, stockpiled apart as a valuable asset and reused for reclamation of the area after completion of backfilling. Excess topsoil will be brought back to the plant site and kept stored for further revegetation purposes or given to the local communities. Any other soil removal will need to be authorised by the environment department officer as per SOP – Topsoil removal operations, transport and handling, and storage instructions.

Soil removal will also be carried out in the brine field to construct the drilling platforms as well as access and maintenance roads. The topsoil will be stripped and stockpiled near or along the cleared area. The subsoil will be used to create berms around the drilling platforms to control erosion during well operation and, after closure of the caverns and dismantlement of temporary pipelines, will be put back in place to recreate the original land profile. The topsoil will then be reused for reclamation of the stripped areas.

#### 4.3 Storing and Reuse of Topsoil

Topsoils are valuable and accordingly, they will be managed and stored apart from other soils. Their quality will be preserved by keeping the height of stockpiles to a maximum of 2 m to preserve aerobic conditions. The configuration of the stockpiles will account for the topography and natural drainage pattern as to minimise erosion. During the construction phase, shallow rooting grass such as *Cynodon dactylon* will also be planted to protect the stockpile against wind and rain erosion.

Stock piled topsoil will be reused as landscaping material. After completion of each Project infrastructure, residual topsoil stockpiles will be either given to the local communities or levelled and seeded as per the revegetation specialist recommendations for use in final closure.

#### 4.4 Subsoil Management

During construction, subsoil will be removed in several areas. Subsoil in the area is composed mainly of sand and silt, and will include frequent roots. It may not be geotechnically suitable for reuse and will be directed to backfilling and levelling operations in non load bearing zones.

Subsoil material will be stockpiled in locations to be determined. Final disposal of the stockpiled subsoil may involve:

- Landfill covering material;
- Site levelling;
- Filling of existing erosion gullies.

#### 4.5 Development of Topsoil

During the operating phase, trials will be considered to develop topsoil from compost, bentonite-based drilling mud and cuttings, and possibly residual removed subsoils.

Expected results of this program include:

- Creation of soils of good quality, usable for revegetation or agricultural purposes;
- Provision of technical assistance to local stakeholders for appropriate use, such as required soil amendments, appropriate planting densities and soil and water conservation practices.

The development of the program will include the following actions:

- Literature review of similar programs aimed at the development of topsoil;
- Physico-chemical analyses on soil samples;
- Identification of trial areas and conduct of agricultural and revegetation field tests;
- Monitoring of soil quality, yields and survival rates of crop plants in the trial plots;
- Assemblage of relevant agricultural and revegetation management practices in SOPs.

## 4.6 Erosion Control

### 4.6.1 Drainage during Construction

Most of the soil disturbances will occur during the pre construction and construction period. To limit erosion and the associated transport of sediments, the preventive practices to be implemented during construction, include:

- Minimisation of vegetation removal, excavation, surface stripping, levelling and backfilling works by thorough planning of these operations to the minimum required surfaces and volumes;
- Grading of temporary work areas to their original profile for revegetation and drainage purposes at end of use;
- Use of cranes on the banks of the watercourses for the installation of pipe bridges to avoid disturbances to water courses and stream beds;
- Carrying out construction works during the dry season, as far as possible.
- Use of silt fence, speed bumps and other energy dissipation/filtration measures to reduce run-off speed and contain sediments.

The implementation of these practices is supported further by the contractor's own ESCP (Appendix 1) subject to approval by MagMinerals.

#### ***Temporary Site Drainage:***

A temporary drainage system will be constructed on the plant area, immediately after the completion of vegetation grubbing and soil stripping operations. The ditches will be maintained until the general contractor starts its activities; then, the temporary ditches will be backfilled. This system is designed for a 24-hour rainfall event with a 25 years recurrence time period and will consist of:

- The areas developed for the construction phase are located to the north and west of the plant site. The ground is de-stumped and the holes filled to preserve the root structure of the ground cover plants which are important in holding the loose sandy surface soils and limiting gullyng. Leaving the soil in place will also simplify the process of rehabilitation after the construction phase;
- Run-off from these areas is not contaminated and is controlled by selective planting of Vetiver grass and hydroseeding to cut and fill slopes. Total run off is captured in a hard lined cut-off drain which is routed around the plant site to the Tienga river to the west of the plant by a new channel. The ground slopes at inclines from 1 in 40 near the hill crest to 1 in 6 close to the river. Calming measures such as cascades and hydraulic jumps are to be designed into the channel to reduce stream velocities and scour and allow a controlled entry to the river.

#### 4.6.2 Drainage during Operation

In the Project Area, soil erosion is essentially associated with surface runoff. Consequently, adequate surface water and storm water management will be implemented to limit the loss of soil particles into water courses.

Storm water management and infrastructure for the plant, the port and the pumping station are addressed in the Water Management Plan.

Design and specifications for the permanent drainage system are detailed in the Water Management Plan and in the engineering report entitled Stormwater Design & Management 6791-0000-d50-010.00 (EPC, 2009) which include the following elements:

- The plant site is laid out to a rectangular grid with roads used as storm water collectors designed with a cross fall to hard lined V drains;
- The road and drain system drains north to south and east to west with a large main collector on the southern side of the most southern plant road discharging into the storm water collection basin.

#### 4.6.3 Conservation of Vegetation Cover

Vegetation cover prevents soil particles from being lifted by wind and rainfall erosion and holds them in place, in spite of runoff. Also, the roots enhance soil structure and slope stability.

##### ***Minimisation of Vegetation Removal***

The measures to limit vegetation removal are embodied in the aforementioned construction procedures, which aim to minimise disturbances to the vegetation cover. Essentially, these measures consist of limiting deforestation, vegetation removal, surface stripping and excavation works to the minimum required surfaces and to restrict the movement of machinery and vehicles to the work areas. Wherever feasible, particularly in the footprint of temporary works, all efforts will be made to leave the stumps and roots of trees, young shoots of ligneous plants as well as herbaceous plants as far as possible. This will accelerate significantly the growth of the vegetation cover back to its initial state, and reduce the effort required to revegetate the affected areas.

A 20 m riparian strip of natural vegetation will be maintained on each side of water courses, as to minimise encroachment by vehicles and transportation of sediment in the water body.

### ***Revegetation Program***

In spite of the vegetation protection measures and practices to limit deforestation and earth works, the vegetation will be removed in several areas. Consequently, a revegetation program is presented in the Biodiversity Management Plan (BMP) to implement appropriate corrective measures, including the following:

- Revegetation of degraded forests and wetlands with indigenous species;
- Revegetation of areas particularly prone to erosion with Vetiver or similar deep rooted plant;
- Revegetation of degraded riparian strip of vegetation with indigenous species.

This revegetation program will be concurrently dedicated to soil stabilisation and erosion control, as the following revegetation elements will parallel the BMP's revegetation program:

- Temporary work areas will be revegetated as far as possible with indigenous vegetation as soon as work is completed;
- Bamboo or Vetiver grass will be planted on slopes located near cleared work areas and on drilling platform upon equipment demobilisation.

Revegetation activities are further detailed in the BMP and procedures are specified in the Revegetation SOP.

### ***Education Promoting Protection of Vegetation***

An education and awareness program addressing soil erosion control and vegetation conservation practices will be developed to educate communities on minimising the deterioration of their vegetated lands. The program will address tree cutting, clearance, charcoal making, slash and burn agricultural activities and shifting cultivation aspects as these have an impact on vegetation cover and exposed soil surfaces. Soil husbandry to maintain and improve fertility will increase the time during which crops can be grown on a cleared plot, which reduces the effort required to clear fallow land and has a knock on effect on vegetation clearance and soil maintenance. This program is specifically addressed in the Community Development Plan (CDP) and will be supported by technical assistance for intensive agriculture in gardens soils.

#### **4.6.4 Rehabilitation of Erosion Gullies**

Where existing and/or future erosion gullies may impact the project's infrastructures, they will be rehabilitated to stabilise steep slopes, and to prevent additional erosion

and transportation of sediment to existing water courses. The rehabilitation program may involve the following actions:

- Use of grubbing and stripping material, particularly unused subsoils, for backfilling;
- Divert water from erosion gullies into constructed ditches;
- Stabilise area, when needed, by using a boom/stick excavator to break side slopes;
- Revegetation works, including revegetating surfaces and seeding slopes with, as far as possible, indigenous cultivars, or planting vetiver and bamboo as appropriate.

#### **4.7 Subsidence Prevention**

To avoid surface subsidence above caverns, various measures will be implemented throughout mining operations.

- Safety pillars will be maintained between the caverns;
- Drill holes will be sealed with concrete;
- Caverns will be backfilled with solid NaCl and MgCl<sub>2</sub> brine slurry to provide physical support;
- Horizon 1 of the carnallite zone is left unexploited. To provide additional thickness of overburden before mining commences. The first mining horizon will be at 671 – 707 m below ground surface, making any caving to surface extremely unlikely.

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## 5. PERFORMANCE MONITORING

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### 5.1 Site Inspections

Sites inspections are performed by the Health, Safety and Environment (HSE) Department. Sites have been divided into sectors and are inspected on a continuous rotational basis. An official documented inspection is conducted each month. Inspection ensures that specific soil management activities are verified and that all commitments from this SEMP are implemented.

Results of inspection are compiled in the CPAR.

### 5.2 TopSoil Quality Monitoring

Soil quality will be monitored from the various sampling stations according to the SOP on Sampling Protocol, and Analysis Methodology.

The quality of topsoil for agriculture purposes will be determined from the following parameters:

- Physical characteristic including grain size distribution and silt/clay content, soil bulk density pH, and hydraulic conductivity;
- Nutrient content, particularly nitrogen, phosphorous, and potassium;
- Cation Exchange Capacity<sup>1</sup>;
- Organic content;
- Presence of trace metals.

### 5.3 Topsoil Inventory

In order to ensure the availability of topsoil material for rehabilitation, a register of available topsoil volume will be kept by earth works contractor and updated everytime there is soil movement.

There will be a register with:

- Volumes of removed topsoil;
- Location of topsoil stockpiles;
- Volumes of reused topsoil;

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<sup>1</sup> Measures ability of a soil to hold nutrients rather than being leached out by rainfall. It is usually linked to clay content.

- Planned use, including revegetation, research purposes, agriculture, and distribution to local communities;
- Topsoil quality data.

The goal is to optimise the reuse of topsoil by facilitating the management of the stockpiles and available quantities.

#### **5.4 Soil Erosion Monitoring**

The performance of erosion control measures will be evaluated during the site inspections, on the basis of expected results and performance indicators.

Erosion monitoring will cover soil surface, stream banks, drainage systems and permanent infrastructure during site inspections.

Environmental audits will also be conducted and will integrate the performance assessment of the erosion control activities.

When required, corrective measures will be implemented and registered in the CPAR.

#### **5.5 Subsidence monitoring and slope stability**

Even with the operational provisions which will be in place, a subsidence monitoring program will be implemented to detect any sign of land surface subsidence and initiate control measures if required.

- Sonar surveys of the caverns and geotechnical monitoring will be conducted as part of mining performance design, to detect enlargements of the caverns beyond the rock mechanical design and to ensure geotechnical stability;
- Land surface level over the undermined caverns will be surveyed prior to extraction operations, after operations are completed, and once every three years thereafter. These subsidence surveys will be performed from three reference points for each well area as per the subsidence prevention SOP;
- Visual Slope stability inspection will be included in the site inspection SOP.

## **6. PERFORMANCE INDICATORS**

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Measurement is an important tool in improving performance, and performance indicators help organisations to define and measure progress towards their goals. The results reflect current conditions and allow orientation and coordination of further actions towards sustainable exploitation.

### **6.1 ROC Government Notice of infraction**

Permits for vegetation removal are granted by the Ministry of Forestry. Inspectors may visit the site to confirm compliance with permit requirements. Excessive sediment washout into streams may also trigger Notices of infractions from the MTE.

The Project's goal is to maintain a track record without any notice of infraction. This indicator is not specific to the SEMP, but to all facets of the ESMS.

### **6.2 Environmental Audit Results**

Environmental auditing is a key process in the implementation of the ESMS. Internal and external auditing procedures are described in Section 11 of the ESMS main document. The findings of each audit are registered in the CPAR database, where corrective and/or preventive actions are prescribed, responsibilities assigned to people, deadlines established and necessary resources mobilised.

In compliance with the procedure, audit reports shall categorise the findings as being either "major", "minor" or "observation". The number of findings should decrease every year until the ultimate goal of zero major findings is achieved. This indicator is not specific to the SEMP, but to all facets of the ESMS.

### **6.3 Topsoil Research Program**

A Topsoil Research Program will be conducted to develop topsoil from organic waste compost, used bentonite-based drilling mud and cuttings, and residual removed soils.

A detailed action plan listing stages of project with activities, schedule, responsibilities and budget will be developed.

The objective being the development of high quality soils, the performance indicators could include:

- Water retention capacity;

- Silt vs sand content, and carbon:nitrogen ratio;
- Soil microbiological activity;
- Revegetation productivity index.

This action plan will be updated and progress reported on a biannual basis.

#### **6.4 Erosion Control**

Erosion control will be monitored by site inspection results. The aim is to avoid:

- Presence of rills on the side slopes of ditches;
- Presence of sediments in downstream water courses.

Performance indicators of the revegetation activities are addressed in the Biodiversity Management Plan.

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## 7. RESPONSIBILITIES

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The responsibilities of the SEMP interveners are presented herein (Table 1).

The HSE Department is responsible for:

- Site inspection and monitoring of stockpiles, including soil sampling, verification of stability and erosion;
- Soil analyses, either on site laboratory or through agreements with external laboratories;
- Definition and coordination of the Topsoil Research Program, and identification of revegetation areas;
- Monitoring of erosion and performance assessment of the erosion control measures.

The Construction/Engineering Department is responsible for:

- Decisions on location and management of topsoil stockpiles, screened subsoil stockpiles and other soil residues, with input from the Environmental Department;
- Implementation of the erosion control practices during construction activities.

The early earthworks contractor and General Contractor are responsible for:

- Implementation of the removal and stockpiling methodology;
- Submittal and implementation of an ESCP for its activities, which is consistent with this SEMP.

Table 1 Implementation Responsibilities for the Soil and Erosion Management Plan

Objective / Action	Activity	Intervener														
		Site General Manager	Risk & asset Protection Officer	Community Liaison Officer	HSEC Director	HSE Manager	Environmental Monitoring Coordinator	Environment Technicians	General services	Procurement Officer	Construction Manager	Drilling supervisor	Contractors	Compost Expert – Consultant	External Auditors	Revegetation Expert
<b>Removing soil</b>																
	Site preparation for construction									A		E				
<b>Topsoil management</b>																
	Location of stockpiles				P	P				A		E				
	Construction of stockpiles					P				A		E				
	Stockpile erosion control				P	E		P		A						E
	Topsoil inventory				A	P		E				P				
<b>Subsoil management</b>																
	Location of bulk stockpiles				P	P				A		E				
	Storage and reuse of subsoil material				P	P				A		E				
<b>Creation of new soil</b>																
	Design of research program				A	P								E		P
	Conduct of research program				A	E		P						P		P
<b>Soil monitoring</b>																
	Develop soil sampling procedure					A	E									
	Conduct site inspection					A		E								
<b>Erosion Control</b>																
	Erosion control practices during construction									A		E				
	Revegetation works	A			P	A				A		P				E
	Development of erosion control monitoring protocols					A	E									
	Conduct site inspections and erosion assessments					A		E								
<b>Subsidence measurement</b>																
	Measurements in mining field					A						E				

Legend:  
 E Executes  
 P Participates  
 A Approves

## 8. SCHEDULE AND BUDGET

An implementation schedule is defined for the various activities of the SEMP (Table 2). This provisional version will be updated and made available by the HSEC Director as the Plan evolves. Site preparation, construction of topsoil stockpiles and erosion control, topsoil inventory and subsoil stockpiling will be initiated at the onset of Project's construction activities. Site inspections will be carried continuously from the construction phase throughout the operational phase.

The budget is incorporated with overall budget of the ESMS presented in the ESMS main document.

Table 2 Implementation Schedule for the Soil and Erosion Management Plan.

Objective/ Actions	Prior to construction	During construction	Project start-up	During operations
<i>Removing soil</i>				
Site preparation for construction	X			
<i>Topsoil management</i>				
Location of stockpiles	X		X	
Construction of stockpiles		X		X
Stockpile erosion control		X		X
Topsoil inventory		X		X
<i>Subsoil management</i>				
Location of bulk stockpiles	X		X	
Storage and reuse of subsoil material		X		X
<i>Creation of new soil</i>				
Design of research program				X
Conduct of research program				X
<i>Soil Monitoring</i>				
Develop soil sampling procedure	X			
Conduct site inspection		X		X
<i>Erosion Control</i>				
Erosion control practices during construction		X		
Revegetation works		X		X
Development of erosion control monitoring protocols	X			
Conduct site inspections and erosion assessments		X		X

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## 9. LIST OF SOPs

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The Standard Operational Procedures which will be developed include:

- Site inspection;
- Topsoil removal operations, transport and handling, and storage instructions, including a soil removal authorisation form;
- Revegetation operations;
- Agricultural and revegetation management practices;
- Soil sampling protocol, calibration of devices and analysis methodology;
- Erosion control monitoring protocol;
- Subsidence and slope stability monitoring protocol.

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## 10. RECORDS KEEPING

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The records related to the SEMP will include:

- Audit reports;
- ROC government notices;
- Site inspection forms:
  - Plant;
  - Brine field and associated pipelines;
  - Pumping station;
  - Port facilities;
  - Waste management centre and landfill;
  - Electrical lines, pipelines and railway corridors.
- Topsoil inventory and quality analysis reports;
- Topsoil and subsoil stockpile inventories, *i.e.* location, quantities, intended uses, storage duration;
- Research program results.

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## 11. REFERENCES

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GENIVAR. 2009. Water Management Plan.

GENIVAR. 2009. Biodiversity Management Plan.

E+PC, 2009. STORMWATER DESIGN & MANAGEMENT  
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Appendix 1

CCC – Erosion, Sediment Control Plan

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# Project Procedure

## Erosion, Sediment Control Plan

MagMinerals  
 Kouilou Potash Project  
 Republic Of Congo (Congo-Brazzaville)

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			FBB	OR	BL
0	For review and comments	25-June-08	Feras albaqaen (FBB) Asst. HSE Coordinator	O.Reed (OR) Group HSE Manager	B. Kayyali (BK) Vice President Health, Safety and Environment
<b>Rev</b>	<b>Description</b>	<b>Date</b>	<b>Prepared By</b>	<b>Checked By</b>	<b>Approved By</b>

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## Section A: Background

### 1. Objectives and Purpose

Reinstatement of the Project's site is a key element in the success of the project. Fundamental to good reinstatement or site restoration is good site preparation and adherence to good construction practices. The ultimate aim of the Erosion, Sediment Control Plan (ESCP) is to re-establish areas disturbed by construction works to a state capable of supporting vegetation, and in keeping with the surrounding environment, within the time constraints dictated by specified erosion performance criteria and biorestation requirements.

CCIC will progressively improve this Plan as further relevant information is received during the project.

### 2. Scope

This ESCP describes the erosion control plan of the Sangaredi Development Project's construction site in addition to areas disturbed by construction works that are not required permanently by the project.

This ESCP establishes the minimum technical requirements for topographical replacement, erosion control and soil management. The methods described within are applicable to the stabilisation of the terrain both during construction and after it has been completed.

The ESCP describes the methods to be used for removing, storing and replacing excavated topsoil, subsoil and rock.

### 3. References

[References to be listed here](#)

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#### 4. CCIC Roles and Responsibilities

##### 4.1 The Project Manager (Construction) is responsible for:

- Coordinating the various construction crews and ensuring that work progresses in a systematic and efficient manner;
- Assisting with the selection of borrow pit locations;
- Ensuring that this ESCP is implemented, and that adequate resources are dedicated to this activity;
- Ensuring that all HSE requirements are met during the course of the project; and

##### 4.2 The Transport Manager is responsible to the Project Manager (Construction) for:

- Preparing Transport Management Plans for importing construction materials.

##### 4.3 The HSE Manager is responsible to the Project Manager for:

- Ensuring that HSE procedures are maintained, up to date and present in all Field Manuals;
- Developing HSE procedures and assuring compliance;
- Arranging periodic independent audits to assure the effective implementation of HSE procedures throughout the Project;
- Collating information and lessons learnt gained from field experiences, implementing the HSE procedures and initiating periodic reviews to identify opportunities for improvement; and
- Ensuring that the HSE Officer carries out his/her duties in accordance with this Plan.
- Development and periodic evaluation of the Plan;
- Informing the Project team of specific environmental requirements of the area(s) of activity

##### 4.4 The HSE Officers are responsible to the HSE Manager for:

- Monitoring Site preparation to ensure that topsoil is stored and maintained in accordance with the Company requirements; and
- Documenting (using checklists) various aspects of pre, during, and post-construction Erosion Control-related procedures.

##### 4.5 The Foreman is responsible to the Site Superintendent for:

- Implementing this Plan, and other procedures affecting Erosion Control measures;
- Supervising all erosion control crew personnel;
- Verifying their training and competency levels;
- Ensuring plant and equipment is inspected and maintained in good order;
- Ensuring existing services remain protected from damage during the erosion control activities;
- Ensuring erosion control is carried out safely, in accordance with environmental constraints; and
- Authorising permits in accordance with the Permit to Work System.

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## 5. Definitions and Abbreviations

### 5.1 Main Definitions

Aggregate stability	Wet strength of a soil particle. Synonymous with soil consistence, resistance to slaking.
Boulders	Rock larger than 10-inches (25.4 cm) diameter.
Cohesion	Force holding a solid or liquid together, owing to attraction between like molecules. In hydraulics - particles in the silt or clay size range (<0.06 mm in diameter) where there is an electrostatic attraction between particles (c.f. sands and gravels, where the force is absent).
Contract	Governing this scope of work.
Soil erosion class	Classification of soils according to the magnitude of soil erosion that has occurred, or the potential magnitude of soil erosion.
Soil structure	The combination or arrangement of primary soil particles into secondary particles, units or peds; secondary units are characterized and classified on the basis of size, shape, and degree of distinctness into classes, types and grades, respectively.
Soil texture	The relative proportions of the various soil separates (particle sizes) as described by the classes of soil texture: sand, loamy sand etc.
Topsoil	The top, fertile layer of material on the land surface, which is capable of supporting plant growth.
Turbidity	The percentage of suspended solids in a liquid, which affects the amount of light that the liquid can reflect.

### 5.2 Abbreviations

AGA	American Gas Association
ESCP	Erosion, Sediment Control Plan
EIA	Environmental Impact Assessment
HSE	Health, Safety & Environmental
PPE	Personal Protection Equipment
PTW	Permit to Work
WMP	Waste Management Plan

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## Section B: Health, Safety and Environment

### 6. Health, Safety and Environment

- 8.1 In implementing the ESCP, CCIC will fully comply with the requirements of the Health, Safety & Environmental Management Plan. All requirements for the protection of health, safety and the environment will apply to all Erosion Control works, in particular in relation to working on steep slopes.
- 8.2 ALL PERSONNEL HAVE AN OBLIGATION TO STOP WORK IF THEY CONSIDER AN ACTIVITY TO BE UNSAFE OR HAS THE POTENTIAL TO ADVERSELY AFFECT THE ENVIRONMENT. THEY MUST IMMEDIATELY REPORT THE SITUATION TO THEIR SUPERVISOR.
- 8.3 Prior to the commencement of erosion control activities, the Environmental Risk Assessment and the required mitigation measures will be reviewed jointly by the Construction and the HSE Department to ensure that all the risks are addressed and the required mitigation measures are in place.
- 8.4 The following conditions apply to all CCIC construction activities:
- All work will conform fully to the requirements of the EIA;
  - The erosion control crew will collect up all rubbish generated by erosion control activities and dispose of it in accordance with the approved WMP;
  - All surplus material will be cleaned up and disposed of in accordance with the WMP;
  - All archaeological sites will remain protected during activities. Should any unknown archaeological remains be discovered, work will immediately stop and the COMPANY informed as per the Cultural Heritage Protection Procedure;
  - Irrigation systems and field drains will be reinstated to the pre-construction condition or better;

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## Section C: Procedures

### 7. Overview

The following procedures for the ESCP have been prepared to comply with the requirements of the COMPANY. In general, this requires the following for erosion, sediment control.

- Erosion class 3 or better shall be achieved
- Protection of topsoil shall be ensured through separation from subsoil, and storage in a manner that retains the soil structure and seed base and minimises the risk of topsoil loss.
- Excess spoil shall be disposed of in an environmentally acceptable manner.
- Sensitive habitats outside of the construction site shall not be adversely impacted from construction activities.

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## Section C1: General Procedures

### 8. Soil Management

Generally all soil and rock will be returned to the excavated areas. In some locations however, there will be surplus subsoil or rock that cannot be returned and this will be disposed of safely in accordance with the environmental requirements of the Contract as stipulated in the WMP. Material remaining surplus after final reinstatement will be removed from the site as inert waste. CCIC will assume the same responsibilities for excess soil and rock as for any other waste material as specified in the WMP.

#### 8.1 Management of Waste Soil and Rock

##### 8.1.1 Select the Priorities for Managing Excess Soil and Rock

Priorities for managing excess soil and rock are as follows:

- **1st priority: Project Reuse**  
Where generated spoil is suitable for use as a construction material it will be first considered for reuse on the Project infrastructure works materials; stability, erosion control, construction camps, etc.
- **2nd priority: On Project Disposal**  
Where generated spoil is not suitable for reuse in the site or is in excess of what is required, it will be used for restoration purposes e.g. hillside contour blending.
- **3rd priority: Off Project Reuse**  
Transfer to third Party for reuse purposes as raw or semi-finished materials that may be suitable for road construction materials. CCIC will enter into negotiations and agreements with third parties regarding the feasibility, material specifications, terms and conditions for supplying spoil materials off the Project as materials acceptable for reuse. Notification of such agreements will be duly reported to COMPANY. The requirements of the WMP regarding waste transfer will apply.
- **4th priority: Off Project Disposal**  
All off Project disposal sites are to be agreed prior to use with COMPANY and are to be in accordance with the WMP. Detailed specifications and engineering design for such areas will be provided.

##### 8.1.2 Permanent Disposal of Excess Waste Soil and Rock

Sites for the disposal of waste soil and rock will, in general, comply with the requirements for 'Inert' waste disposal sites as specified in the WMP. However, provided the following conditions are met, a reduced specification for the design of the site may apply.

- Only completely natural materials are to be deposited. The following materials are excluded: contaminated soil; agricultural topsoil; worked stone (except natural stone that has been processed by crushing / screening); building materials;
- Vehicles used for transporting waste soil and rock will not be used to transport any other type of waste; and

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- The range of particle sizes in the majority of waste soil and rock material will mean the replaced spoil will be largely free draining.

If the above criteria are met, the 'reduced specification' for permanent disposal sites may be as follows:

- The design will maintain the integrity of the site stability, local hydrology, and landscape regime. Thus infiltration of rainfall over the site would continue to contribute water of acceptable quality to local surface-waters and ground waters. The design will also minimize impact on the local environment. Drainage will be provided if necessary.
- Impermeable barriers between the deposited material and the surrounding ground are not generally appropriate.
- To finish and close the site the exposed surface will be capped. The capping material will include surplus topsoil or a combination of subsoil, fertilizer and mulch.
- The site will be designed, operated and closed so that over time the site will blend with the landscape and become, as far as practicable, imperceptible.
- Notwithstanding the remarks about transmission of rainwater, all the water flowing from the deposit will be, if necessary, treated in order to remove suspended solids. In this case, CCIC will install appropriate erosion control and sediment removal measures and maintain them until handover of the works.

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**9. Erosion Control Measures**

The use of erosion control measures will be decided on a case-by-case basis. All measures will be agreed with COMPANY prior to being installed.

**9.1 Temporary Erosion Control Measures**

9.1.1 Sediment Interception

In areas where the construction activities intersect or are parallel to a watercourse, wetland, water body or other environmentally sensitive area, sediment interception measures will be installed to prevent sediment laden runoff from reaching them.

9.1.1.1 Silt Fence

A silt fence is composed of a synthetic filter fabric stretched across and attached to supporting posts. The fence is typically placed at the toe of a slope below disturbed areas that may be subject to erosion. Silt fences are used to decrease the velocity of sheet flows and to intercept and detain sediment disturbed during construction operations. The suspended sediment settles out as the water percolates through the silt fence, effectively retaining it on site.

The following requirements will apply to the use of silt fences:

- The drainage area will not exceed 0.1 hectares per 30 m of fence length;
- The maximum upslope grade perpendicular to the fence line will not exceed 1:1
- For slopes between 1:0.5 and 1:5 (Vertical: Horizontal) the maximum allowable upstream flow path will be 30 m;
- For slopes steeper than 1:5 the maximum allowable upstream flow path be 6 m; and
- Silt fences will not be used for channelised flow.

9.1.1.1.1 Material Specifications

Posts used to support the filter fabric will have the following minimum dimensions: 50 mm square by 1.2 m long. Posts will be a hardwood material, or metal in areas where water may pond against the fabric. Staples, wire, zip ties or nails will be used to attach the filter fabric to the posts. The synthetic filter fabric will contain ultraviolet inhibitors and stabilizers, to prevent it from breaking down / decomposing during the project. The filter fabric will be chosen so that it meets all of the performance criteria listed in Table 2 below, for the entire length of installation and within the environments encountered.

**Table 1: Filter Fabric Criteria**

Physical Property	Minimum Requirements
Filtering Efficiency	75% - 80%
Tensile Strength at 20% (maximum) elongation	90 kg / linear metre
Slurry Flow Rate	0.11 litres / m <sup>3</sup> / min

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#### 9.1.1.1.2 Placement and Installation


- Silt fences will be placed on level or near level ground, 1.5 m to 3 m away from the toe of the slope to provide adequate area for sediment to settle. Wherever practicable, they will be placed along natural contours to avoid concentration of flow, as this can lead to overtopping and deterioration of the fence.
- The silt fence will be dug into the ground by excavating a trench 150 mm deep by 100 mm wide.
- Similarly, fences constructed at ground level are ineffective as they allow water to flow underneath the barrier.
- A continuous length of filter fabric will be rolled out on the down slope side of the trench. The fabric will then be placed in the trench, starting at the top up-slope edge, taking care to ensure that all three sides of the trench are lined with fabric (approximately 300 mm). The trench will then be backfilled and compacted to firmly secure the filter fabric. Posts will be driven into the ground on the down slope side of the filter fabric to a depth of 600 mm, and placed not more than 1.2 m apart. The filter fabric will then be attached to the posts using staples, wire, zip ties or nails.

#### 9.1.1.1.3 Inspection and Maintenance

Once installed silt fences will be inspected regularly, and after a rainfall of 10 mm or more. During periods of prolonged rainfall fences will be inspected daily. All necessary repairs will be performed within 24 hours of identification. The Site Supervisor and HSE Officer will check the following items during each inspection:

- *Is water concentrating at any point along the silt fence?* Concentration of flow can drastically reduce the overall storage capacity of the fence and may ultimately cause it to fail. The silt fence or the affected sections will be reinstalled along contours so that it is level.
- *Does water flow underneath the silt fence?* Water may flow under the silt fence where the posts have been installed too far apart, the trench is too shallow or the trench has not been backfilled adequately. The silt fence will be reinstalled with the appropriate number and spacing of posts, and if necessary a deeper trench to firmly anchor the fabric.
- *Does the silt fence sag excessively?* Sagging of the silt fence is typically caused by excessive post spacing and / or overtopping of the fence. If the sagging is due to poor post spacing additional posts will be added to reduce the distance between each post. If the fence is regularly being overtopped then it will be removed and alternative erosion control measures will be installed.
- *Has the silt fence torn or become detached from the posts?* If the fabric has torn, the damaged section of the silt fence will be replaced. Additional staples will be used to reattach loose fabric to the posts.
- *Does sediment need to be removed from the silt fence?* Sediment will be removed prior to the sediment reaching 1/3 the height of the silt fence and disposed of in a manner approved by the COMPANY. Care will be taken during sediment removal to ensure the integrity of the fence is maintained.

Silt fences will not be removed until the upslope area has been permanently stabilized. After the removal of the fence any remaining sediment will be dressed to conform to the existing topography, prepared and seeded.

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### 9.1.1.2 Filter Berm

Filter berms are typically installed where there is a requirement to temporarily retain runoff water after a storm event, allowing sediment to settle. The retained water slowly filters through the berm removing the finer particles and water is prevented from ponding on slopes. Filter berms are constructed with gravel, stone or crushed rock covered with a synthetic filter fabric.

#### 9.1.1.2.1 Placement and Installation

Filter berms will be designed according to the drainage area under consideration and site-specific requirements. Filter berms will be a maximum of 1 m in height with no greater than 2:1 side slopes. A low point in the berm will be provided to serve as a spillway to prevent overtopping during extreme storm events. Berms will be spaced according to the steepness of the slope, with berms spaced closer together as the slope increases. Filter berms will only be constructed on stable slope surfaces.

#### 9.1.1.2.2 Inspection and Maintenance

After installation filter berms will be inspected bi-weekly and after each storm. All necessary repairs will be made immediately to ensure that the berm remains structurally sound. Regular cleaning and maintenance is necessary to ensure that the berm will function properly. Filter material will be replaced as needed.

Sediment will be removed prior to the sediment reaching 1/3 the height of the filter berm and disposed of in a manner approved by the COMPANY. Filter berms will not be removed until the upslope area has been permanently stabilized. After the removal of the berm any remaining sediment will be dressed to conform to the existing topography, prepared and re-vegetated.

### 9.1.1.3 Straw Bale Barrier

Straw bale barriers are used as a temporary measure to intercept and detain small amounts of sediment from disturbed land, for example when over-pumping water out of the trench. These barriers decrease the velocity of sheet flows, allowing the suspended sediment to settle against the straw / hay bales. Straw bale barriers are typically placed at the toe of a slope below disturbed areas that may be subject to erosion. Straw bale barriers should not be used where sediment control is required for periods greater than 3 months.

#### 9.1.1.3.1 Placement and Installation

Straw bale barriers will be placed on level or near level ground, 1.5 m to 3 m away from the toe of the slope to provide an adequate area for the sediment to settle. Wherever practicable, they will be placed along natural contours to avoid concentration of flow. Straw bale barriers will not be used in areas of rock or shallow soils, where full and uniform anchoring is prevented. The drainage area will be no greater than 0.1 hectares for each 30 m of barrier. The maximum slope length and gradient behind the barrier is shown in Table 3 below.

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**Table 2: Maximum Slope Length and Gradients for Straw Bale Barriers**

Slope	Slope Length (m)
1:2	7.5
1:3	25
1:4	30


- Straw bales will be placed lengthwise in a single row and will be bound together around the sides (horizontally) using wire or twine.
- A trench will be excavated along the contour the width of a bale and at least 150 mm deep.
- The bales will be placed in the trench tightly abutting one another, any gaps between the bales will be filled by wedging straw into them.
- Two stakes will be driven through each bale, at least 460 mm into the ground and approximately 150 mm to 200 mm in from the bale ends. The stakes will be a hardwood material with minimum dimensions of 50 mm square by 1.2 m long. The excavated soil will then be backfilled and compacted against the up-slope side of the barrier.

9.1.1.3.2 Inspection and Maintenance

Once installed straw bale barriers will be inspected regularly, and after a rainfall of 10 mm or more. During periods of prolonged rainfall barriers will be inspected daily. All necessary repairs will be performed immediately. Any accumulation of water behind the barrier will not be released without the appropriate treatment of the wastewater.

Site Supervisor and HSE Officer will check the following items during each inspection.

- *Are there any points along the straw bale barrier where water is concentrating?* Water will concentrate at low points of the barrier if it has been placed across the natural contours. Concentration of flow can drastically reduce the overall storage capacity of the barrier and may ultimately cause it to fail. Wherever possible barriers should be installed along the natural contours.
- *Does water flow under the straw bale barrier?* This is generally caused by not trenching the bales deep enough or by insufficient compaction of soil against the up-slope side of the barrier. If the problem is due to insufficient trench depth the entire straw bale barrier will be reinstalled with a deeper trench. If the problem is due to insufficient compaction, the soil on the up-slope side of the barrier will be re-compacted.
- *Does water flow through spaces between abutting bales?* Loose bale material will be stuffed into any spaces to solve this problem.
- *Have any bales become dislodged?* The maximum useful life of a straw bale under normal conditions is three months. Bales may deteriorate faster under extreme weather conditions. Bales will be inspected for any signs of decomposition and replaced as necessary.
- *Does sediment need to be removed from behind the straw bale barrier?* Large accumulations of sediment behind the barrier may drastically reduce its effectiveness. Sediment will be removed before it reaches 1/3 of the original exposed height of the bales.

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Straw bale barriers will not be removed until the upslope area has been permanently stabilized. After the removal of the barrier any remaining sediment will be dressed to conform with the existing topography, prepared and seeded.

#### 9.1.1.4 Sediment Traps

Sediment traps are used to detain sediment-laden runoff from small disturbed sites long enough to allow the majority of the sediment to settle out. Sediment traps are not designed to control concentrated flows or to store large volumes of sediment.

##### 9.1.1.4.1 Placement and Installation

- Sediment traps will be constructed and made functional before any upslope land disturbance takes place. Sediment traps will be installed as required in the following locations:
  - Outlets of Construction site drainage systems;
  - The outlet of any structure which concentrates sediment-laden runoff; and
  - Above a storm water drain that is in line to receive sediment-laden runoff.
- Traps will be designed specifically to meet the requirements of each site, taking into consideration topography, catchment area and the volume of sediment and water to be intercepted. The drainage area for sediment traps will not exceed 2 hectares of disturbed ground.
- Wherever practicable traps will be located as close as possible to the source of sediment in areas that will maximize the storage potential on the site, allow easy access for sediment removal and minimize damage should the structure be overtopped during high flow conditions. The trap site area will be kept free of debris including trees and brush.
- An earth dyke will be constructed in 150 mm layers and compacted by traversing with construction equipment. The fill material for the dyke will be free of wood, vegetation, roots and large stones.
- The dyke will then be covered with an erosion mat to ensure stabilization. The ponding area of the sediment trap will have at a minimum a 2:1 length to width ratio.
- The gravel outlet will be constructed using stones 100 mm to 300 mm in diameter, with the upstream face being lined with a 300 mm layer of 20 mm to 40 mm diameter washed gravel. The crest of the outlet should be at least 300 mm below the top of the dyke. Filter fabric will be placed at the soil – stone interface to act as a separator.

##### 9.1.1.4.2 Inspection and Maintenance

Once installed, sediment traps will be inspected bi-weekly, and after each significant storm to ensure structural integrity. Repairs will be performed as necessary to ensure good working order. The HSE Officers and Site Supervisors will check the following items during each inspection.

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- *Has the sediment trap been damaged by undercutting, bypassing, scouring or overtopping?* Undercutting, bypassing, scouring and overtopping of the sediment trap will eventually damage the structural integrity of the trap. This may lead to erosion problems and sediment-laden runoff affecting areas down slope. Repairs will be made as soon as possible after identification.
- *Does the gravel outlet effectively filter sediment?* The gravel filter will be regularly checked to ensure that filtration performance is maintained. If the sediment trap does not drain completely within 24 hours of a storm event the filter fabric and gravel outlet will be cleaned or replaced.
- *Does sediment need to be removed from the trap?* Sediment build up can lead to overtopping of the trap. Sediment will be removed before it reaches 1/3 of the original trap volume. Sediment collected will be disposed of in an approved manner.

Sediment traps will be removed once the sediment runoff has reached an acceptable level and the area is fully stabilized.

## 9.2 Permanent Erosion Control Measures

### 9.2.1 Diversion Berms

Diversion Berms or "Slope Breakers" are designed to intercept and collect runoff, diverting it down slope to an area that is less susceptible to erosion. They are commonly constructed on slope faces to intercept sheet flow. Diversion berms reduce runoff velocities, allowing sediments and soluble pollutants to settle out. It is not expected that diversion berms will be required, however they will be installed as per the specifications below should they prove necessary.

#### 9.2.1.1 Placement and Construction

- Diversion berms will be placed to intercept runoff and convey it to a safe outlet.
- Berms will be constructed by digging a trench 0.25 m to 0.30 m deep. Excavated material will be placed on the down slope side to form a ridge not less than 0.25 m high. The ridge will be compacted in not less than three layers.
- Berms will have a total width of 4.8 m, a minimum effective depth of 0.5 m, side slopes of 1:4 and an across slope grade of 1:100 (1/2°).
- Diversion berms will be provided at regular intervals, dependent on the width and gradients of the disturbed areas to be protected. Berm spacing will be optimised for specific sites, taking into account the soil erosion class and local conditions.

##### 9.2.1.1.1 Diversion Berm Outlets

Outlets will be installed at the end of each diversion berm to provide disposal of water. Outlets will be designed to effectively dissipate the energy of the runoff and take the water to a disposal point that is safe and avoids environmental impacts. Outlets will be stable and non erosive. Two types of outlets are detailed, soakaways and lined channels. The outlet selected for each Diversion will vary based upon the needs of the site.

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#### 9.2.1.1.2 Soakaways

Where soils are cohesive and erodible conditions are low, the berm will be extended by 2 m into the surrounding vegetated landform to create soakaways. Where soils are non-cohesive, and erodible conditions are higher, the berm will be extended by 6 m into the surrounding land.

#### 9.2.1.1.3 Lined Channels

Lined channels run along the slope, to take runoff at a safe velocity down slope to a suitable disposal point. The channel will be designed to carry a peak runoff for a 10-year return period. Channels will be no deeper than 0.4 m, and the width will be at least twice the depth. The following minimum requirements will apply to the construction of lined channels:

- Channel will be designed to give a bottom width of 0.7 m and an overall depth of 0.3 m;
- The channel will be lined with riprap (D50 = 75 mm) to a depth of 0.15 m; and
- For channels where the slope is > 50 m erosion matting will be installed as an additional liner beneath the riprap.

#### 9.2.1.2 Inspection and Maintenance

Diversion berms will be inspected weekly and after every storm event. The berm, flow channel and outlet will be checked for deficiencies or signs of erosion. Any breaches or damage of diversion berms will be reported to the COMPANY. Repairs will be made as required, and diversion berms will be stabilized as needed in order to maintain structural integrity. Repair work will be carried out within 14 days or less, depending on the severity of the breach.

### **9.3 Monitoring of Erosion Control Works**

All Erosion Control Measures will be monitored by an HSE Officer. In the field, monitoring records will be kept by the HSE Officer using the appropriate inspection Form.

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## Section C2: Pre-Construction and Construction Procedures

### 10. Land Clearing and Grading

All land clearing and grading activities will be limited to an area necessary to permit safe movement and operation of equipment. This section describes the general principles that CCIC will apply during land clearing and grading activities, the techniques to be employed, and the management processes and procedures governing the application of those techniques. The HSE Officer will be responsible for monitoring work activities and verifying compliance.

Erosion control measures will be a primary construction focus during land clearing and grading activities. Particular attention will be paid to sedimentation and erosion control measures during clearing and construction in order to ensure protection of water resources. Buffer zones near sensitive or special areas will be established, flagged/cordoned and protected during land clearing and grading activities.

Rubbish and debris collected prior to clearing and grading activities will be temporarily stored in a segregated manner at a Waste Collection Point and subsequently transferred to a construction camp. It will then be treated in accordance with the WMP. Vegetation removed from the cleared site may be managed for its use as mulch during site reclamation. Access control measures will be built into all clearing and grading operations to minimize the Project footprint.

#### 10.1 Description of Land Clearing and Grading Techniques to be Employed

CCIC will implement the least invasive land clearing and grading techniques practicable to facilitate land reclamation at any specific locality. CCIC will preserve the natural drainage, topography and vegetation that existed prior to construction as closely as is practicable and as documented in Project documents. To this end, the following practices will be implemented.

In most areas, topsoil will be removed and stockpiled in advance of other grading or trenching. Stripped topsoil will be stored separately from other graded material so that it can be used to enhance restoration of the site. Appropriate stockpiling methods (e.g., selective use of covering material, restricting heights of soil piles) will be used to reduce loss or degradation of the topsoil.

Grading will be conducted to a minimum extent required to accomplish work, but also to reduce disturbance and restoration requirements.

Strategies for reducing soil erosion on graded sites include the following actions:

- Installation of erosion control measures as necessary and in line with the guidelines provided by the COMPANY;
- Erosion control measures will be employed only for as long as necessary; and
- Special grading and erosion control precautions will be taken on work sites adjacent to streams or rivers.

Depending on the particular site conditions CCIC may elect to use one or more of the following precautions:

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- Generally grade soils away from the watercourse area;
- Installation of pre-construction drainage systems;
- Soils to be stockpiled at a safe distance away from the watercourse to avoid watercourse contamination;
- Installation of silt and sedimentation fencing as necessary;
- Installation of a solid barrier such as geotextile over stockpiled soils;
- Waiting 24 hours after significant precipitation before grading; and

The measures used will be decided on a case-by-case basis on completion of an environmental risk assessment. COMPANY approval will be sought prior to any measures being installed.

### **10.2 Procedures for Preserving Sensitive Areas Including Areas of Cultural Significance**

- CCIC will coordinate with COMPANY to identify and record cultural sites other than those already identified in the Project EIA, and sensitive areas located at or near work sites.
- CCIC will act in accordance with the Cultural Heritage Protection Procedure and take additional measures to ensure that all sensitive areas and cultural sites are properly identified, marked, and monitored during construction.
- CCIC will use temporary perimeter fencing and / or other means to barricade cultural sites or sensitive areas to prevent them from being disturbed.

### **10.3 Preparatory Works**

CCIC will undertake the following preparatory works:

- Identification of underground services;
- Liaison with and approvals from third party service owners / operators;
- Pre-entry environmental surveys;
- Soil barriers in steep side slope areas;
- Areas of special environmental significance identified and flagged off;
- Archaeological sites marked as per alignment sheets;
- Topsoil profiling survey ahead of any topsoil stripping activities;
- Pre-construction staking and flagging/cordoning; and
- Installation of pre-construction drainage.

### **10.4 Pre-construction topsoil profiling**

CCIC will investigate, record and log topsoil depths in advance of construction crew(s).

- Hand excavate an area approximately 300 x 300 x 300 mm, located at the site to be stripped.

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- Inspect and record the depth of topsoil with a box tape, if the depth is greater than 300 mm then indicate >300 mm, otherwise the actual depth will be recorded in millimetres;
- Record the location of the site.
- Backfill and compact the disturbed area.

The topsoil survey will be agreed with COMPANY Environmental Representatives prior to topsoil stripping.

### **10.5 Pre-construction Staking and Flagging**

Prior to construction, crews will stake and flag/cordon all areas intended to be used for construction activities.

In addition, all environmental or cultural features adjacent to the construction site will be flagged or cordoned off in order to protect them from damage during construction.

### **10.6 Topsoil Removal & Storage**

#### 10.6.1 Definition

Topsoil is defined as:

‘The top layer of soil on the surface, which is suitable for sustaining agriculture or natural vegetation growth.’

This soil horizon contains organic material, essential plant nutrients and the seed bank. The main objective in topsoil handling and storage is to maintain the fertility of the topsoil, in particular its structure and the integrity of the seed bank. Using topsoil during the restoration process improves the productivity and rate of re-vegetation, and thus helps to minimize soil erosion.


HSE Officers will hold regular toolbox talks stressing the importance of topsoil in light of its crucial role for effective reinstatement. Toolbox talks covering stripping, handling, and storage of topsoil will be scheduled to coincide with the respective construction activity.

#### 10.6.2 Topsoil Stripping

##### 10.6.2.1 Equipment / Machinery

All equipment used in the topsoil stripping and handling process will be in a safe and efficient working condition at all times. Machines will stop work if the subsoil ground conditions cannot support the weight of the equipment.

Equipment to be used for topsoil stripping will be selected based on the ground conditions, requirements for stripping and the topsoil characteristics in the specific location. However in wet conditions it is preferable to cease stripping activities.

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#### 10.6.2.2 Stripping Method(s)

- Stripping and handling methods can affect the quality / viability of topsoil restoration through severe soil deformation (e.g. compression and smearing) and mixing with the subsoil. One of the most significant causes of soil deformation is traffic movement, the effects of which increase with increasing soil moisture content.
- Topsoil will be stripped from the area of any installation and from any surrounding or adjacent areas to be used during construction to provide access or storage.
- Where the depth of topsoil is equal to or less than 300 mm, the topsoil shall be carefully stripped to its full depth and stored in a dedicated place. Where the depth of topsoil is greater than 300 mm, only the top 300 mm shall be similarly stripped and stored.
- CCIC may apply for modification to the requirements where the ground is solid rock (i.e. no soil at all) taking into consideration the local conditions. Any modification will be agreed in writing with COMPANY prior to works being carried out.

#### 10.6.3 Topsoil Storage

Stockpiling can have adverse effects on the physical and biological properties of topsoil, and excessive compaction of stockpiles can lead to anaerobic conditions. This results in reduced nutrient recycling and availability, which may have a negative impact on plant establishment during restoration. CCIC will ensure that there is careful management and monitoring of topsoil stockpiles.

The following requirements will apply to topsoil storage:

- Preparation of sites for topsoil stockpiles will include the removal of debris, roots, heavy clay, hard clods, weeds, trash and large stones;
- Stockpile locations will be selected to avoid slopes, natural drainage ways, contamination and traffic routes;
- Stockpiles will not be driven on, and will be protected from vehicle movements;
- Stockpiles will not extend through watercourses. Topsoil stacks will be at least 15 m from the edge of any watercourse or flood plain;
- Topsoil will be stockpiled on the uphill side of sloped installations;
- Topsoil will be stored in a stockpile not more than 2 m high with side slopes  $<45^\circ$ , drained with open ditches;
- Topsoil stacks will be placed to ensure that they are free draining and do not impound water;
- Diversion dikes may be used to divert storm water around storage piles;
- Erosion control measures will be installed as necessary to prevent loss of topsoil and surface water contamination;
- The surface of the stockpile will be lightly compacted to restrict rainfall penetration, with care taken not to create anaerobic conditions;
- Wooden and/or silt fences will be installed to retain stockpiled topsoil in areas of side slope and along steep ridges. The eroded materials will be trapped, recovered to the extent possible, and placed back on the piles.

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#### 10.6.4 Topsoil Maintenance

Topsoil will be stored for as short a time as possible, allowing for engineering constraints to prevent loss of fertility and degradation of seed bank. If topsoil needs to be stored for an extended period, stockpiles will be treated where appropriate to prevent weed growth, unless there is high risk of erosion of the stockpiles. Topsoil stripping will be monitored on a daily basis and inspection of topsoil stockpiles by the HSE Officers is included in their daily checks.

#### **10.7 Monitoring of Land Clearing and Grading Activities**

Land clearing, grading and pre-construction drainage activities will be monitored by an HSE Officer using the appropriate inspection Form.

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