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Soil, Land Capability and Land Use Assessment

Proposed Valencia Uranium Mine

Requested By

Digby Wells & Associates

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SUMMARY

The proposed Valencia Uranium Mine is situated south-east of the B2 road between Swakopmund and Usakos in Namibia. The proposed operation involves a north and south waste rock dump, a low grade stockpile, a tailings dump, an acid and leach plant, a crusher and an open pit.

The soil survey was conducted during January 2008. Soils were randomly assessed by means of hand auger observations at a predefined grid with a density of 150 x 150 meters. The total area surveyed covered 1,277.15 ha.

Most of the area surveyed consists of rocky outcrops with very shallow soils dominated by the Mispah and Glenrosa forms. In order to map these shallow soils in smaller, more sensible soil units, the units proposed were strongly based on lithology, topography and the amount of exposed surface rock within the unit. The lithology was broadly assessed during the soil assessment mainly based on extrusive rock. Ten soil units were identified and named Cg, Gra1, Gra2, Gra3, Qs. Sc1, Sc2, DZ, Col and E.

No high intensity land uses existed during the time of the field assessment. The total area was classified as barren i.e. not arable, due to the extremely arid conditions, the lack of soil and rocky nature of the area.

The stripping and stockpiling of topsoil will be very difficult. The lack of topsoil will hamper proper rehabilitation. The footprint of facilities and areas to be disturbed should therefore be contained as far as possible.

All possible efforts should be made to strip and stockpile all loose soil material on the surface at the open pit area and the footprint of permanent facilities in order to save a natural seed source for later rehabilitation of the area.

1 INTRODUCTION

Rehab Green Monitoring Consultants cc were requested by Digby Wells & Associates to conduct a soil, land capability and land use assessment of the proposed Valencia Mining Area situated south-east of the B2 road between Swakopmund and Usakos in Namibia.

The survey was conducted during January 2008. Soils were randomly assessed by means of hand auger observations at a predefined grid with a density of 150 x 150 meters.

This report describes the baseline soil condition, the physical and chemical characteristics, land capability and current land use, as well as survey and laboratory procedures.

Further soil issues related to the mining operation, mining impacts and management thereof are described in Appendix 1.

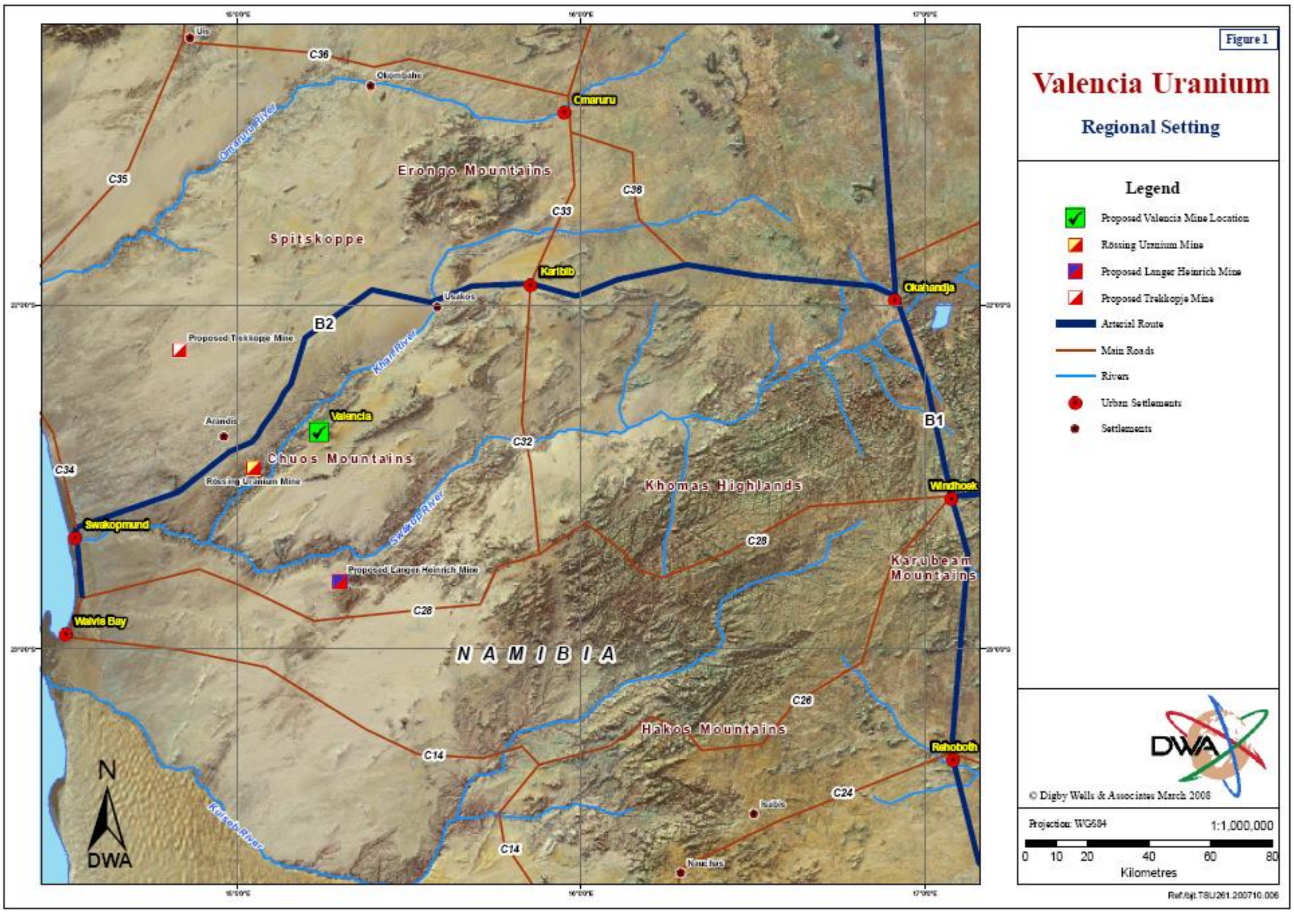

Figure 1: Valencia regional setting

2 METHODOLOGY

2.1 Field survey

To enable accurate surveying, a fixed point grid with a density of 150 x 150 meters was generated using ArcGIS 9.2 software. The coordinates of these points were loaded onto a Global Positioning System (GPS) to locate the positions of the points in the field. The soils were randomly investigated by hand auger observations at grid points. The soils were classified according to the Taxonomic System for South Africa (Soil Classification Working Group, 1991).

Approximately 200 physical soil observations were made at grid points and a further 35 observations were made randomly in-between grid points during the field assessment. Auger observations were made to the first restricting layer or to a maximum depth of 1,500 mm. However, due to the rocky and stony nature of most of the area, auger observations hardly exceeded a 100 mm depth throughout the surveyed area. In order to map these shallow soils in smaller, more sensible soil units, the units chosen for mapping were strongly based on lithology, topography and the amount of exposed surface rock within the unit. The lithology was broadly assessed during the soil assessment and it was mainly based on extrusive rock.

2.2 Soil sampling and analyses

The A-horizon (0-100) of the dominant soil types were sampled and analysed in the soil laboratories of the South African Institute for Soil, Climate and Water (ISCW). A large amount of the thin gravely soil layer was taken in order to have enough soil for analysis. The laboratory methods, which are currently in use for routine analyses in South Africa, as set out in the Handbook of Standard Testing for Advisory Purposes (Non-Affiliated Soil Analysis Working Committee, 1991), were used. A total of eight localities were sampled and the positions of the sampling points are shown in Figure 12; the coordinates are summarised in Table 4.

Soil acidity (pH) was determined in a 1:2.5 water solution. Cation exchange capacity (CEC), as well as extractable cations, sodium (Na), potassium (K), calcium (Ca) and magnesium (Mg) were determined by the ammonium acetate method. The S-value represents the sum of the extractable cations. The P status (phosphorus) was determined by the Bray 1 method.

2.3 Soil Map

The **Soil Map** (Figure 12), consisting of soil units was compiled by classifying and manually grouping areas displaying similar soil properties. The map was spatially referenced using the

Universal Transverse Mercator coordinate system, zone 33 south based on the WGS 1984 Datum.

The following attributes were recorded at each observation point:

- Soil form (Soil Classification Working Group, 1991);
- Soil depth;
- Estimated clay content of A and B-horizon (soil texture class);
- Soil structure;
- Soil colour;
- Underlying material;
- Derived land capability; and
- Current land use.

2.4 Land Capability

A Land Capability Map was not compiled because the total area surveyed can be classified as barren land i.e. land that is not suitable for agriculture.

Land capability was assessed according to the definitions of the Chamber of Mines of South Africa (1981).

Soil properties such as effective soil depth, mechanical limitation, internal drainage, soil texture, soil structure, erosion susceptibility and slope percentage were evaluated in order to classify the soil units in Figure 12, according to the above-mentioned guidelines, into four land capability classes namely arable land, grazing land, wetlands/riparian areas and barren.

2.5 Land Use

A Land Use Map was not compiled because no specific land use, apart from natural wildlife occurred in the total area surveyed.

2.6 Soil Utilisation Guide

A Soil Utilisation Guide Map was not compiled because the stripping of the thin gravelly soil layer, mostly within a soil-rock complex, appears to be impractical for most of the area.

3 SOIL

3.1 Surveyed area

The study area is situated south-east of the B2 road between Swakopmund and Usakos in Namibia (Figure 1: Regional setting).

The surveyed area comprises the Exclusive Prospecting License (EPL) area, as well as the footprints of the following proposed facilities: a north and south waste rock dump, a low grade stockpile, a tailings dump, a plant, a crusher and an open pit. The proposed footprints of the north and south waste rock dumps, the low grade stockpile and the crusher is situated partly outside of the EPL. The proposed plant and tailings dump is situated completely outside the EPL. The total area surveyed by Rehab Green cc covered 1,277.15 ha.

The topography consists mainly of mild to steep rolling, highly eroded rocky outcrops. The geology consists mainly of granite, quartzite and schist. No rivers occur in the area although a fine network of drainage lines occurs throughout the area.

The total area consists of very shallow soils dominated by the Mispah and Glenrosa soil forms and was classified as barren land due to extreme arid conditions, lack of soil material and the rocky nature of the area. In order to map these shallow soils in smaller, more sensible soil units, the soil units chosen for mapping were strongly based on geology, topography and the amount of exposed surface rock within the unit.

In addition to the sites discussed above an overview of the soils in the Khan River valley was obtained.

3.2 Soil results

Most of the area is dominated by rock and very shallow soils of the Mispah and Glenrosa forms. A total of 10 soil units were identified during field observations and were named as: **Cg**, **Gra1**, **Gra2**, **Gra3**, **Qs**. **Sc1**, **Sc2**, **DZ**, **Col** and **E**. These are shown in Figure 12.

The soil units are summarised in the soils legend (Table 1) in terms of the dominant soil form and family, average soil depth, a broad description of the erosion status, the dominant geology, the general topography and soil form, the derived land capability categorised in terms of arable land, grazing, wetland/riparian or barren land. The estimated agricultural potential in terms of cultivation and livestock farming as well as the area and percentage of total area comprised by each unit is also provided.

Table 1: Soil legend based on soil types, geology and amount of exposed surface rock

SOIL LEGEND							
Soil Unit	**Dominant Soil Form and Family**	**Soil Depth (mm)**	**Broad Geological, Landscape and Soil description**	**Land capability**	**Agricultural Potential**	**Area (ha)**	**% Of Total Area**
Cg	Coega 2000	50-250	Slightly eroded; Flat to gently sloping plains with scattered stones (50-150mm) on the surface. Very shallow soils (50-250 mm) underlain by hardpan carbonate.	Barren	Very low	47.64	3.74
Gra1	Mispah 1100	0-100	Highly eroded; Very steep, undulating granite outcrops with 60-80% exposed surface stone and rock. Very shallow soils (50-100 mm) underlain by hard or slight weathered rock dominated by the Mispah form.	Barren	Very low - none	268.26	21.00
Gra2	Mispah 1100	0-100	Highly eroded; Steep to mild rolling granite outcrops with 5-20% exposed surface rock. The soil surface is mostly covered with a thin layer (30mm) of quartzite gravel. Very shallow soils (50-100 mm) underlain by hard or slightly weathered rock of the Mispah form.	Barren	Very low - none	110.35	8.63
Gra3	Mispah 1200	0-100	Highly eroded; Mild rolling granite outcrops with frequent linear schist bands with 10-50% exposed surface rock. The soil surface is mostly covered with a thin layer (30mm) of quartzite gravel. Very shallow soils (50-100 mm) underlain by hard or slightly weathered rock.	Barren	Very low - none	112.70	8.82
Qs	Glenrosa 1211	50-100	Highly eroded; Mild to steep rolling quartzite outcrops (2-5% exposed surface rock) with frequent linear schist bands. The soil surface is mostly covered with a thin layer (30mm) of quartzite gravel. Very shallow soils (50-100 mm) underlain by slightly weathered rock.	Barren	Very low - none	197.51	15.47
Sc1	Mispah 1100	0-100	Highly eroded; Flat to slight undulating, narrow and wide bands of linear schist outcrops (tilted 30-80 degrees vertically) with 60-80% exposed surface rock. Very shallow soils (50-100 mm) underlain by hard or weathered rock dominated by the Mispah and Glenrosa forms.	Barren	Very low - none	270.42	21.17
Sc2	Glenrosa 1212	50-200	Highly eroded; Flat to slight undulating, narrow and wide bands of linear schist outcrops (tilted 30-80 degrees vertically) with 5-20% exposed surface rock. Very shallow soils (50-100 mm) underlain by hard or weathered rock dominated by the Glenrosa form.	Barren	Very low - none	53.41	4.18
DZ	Dundee 1120	400-1 500+	Drainage zones; Mainly narrow, flat, dry streambeds consisting of varying shallow to deep sandy and gravelly soil deposits.	Barren	Very low - none	55.08	4.31
Col	-	0-50	Highly eroded; Flat to slight rolling, medium to coarse grained colluvial and alluvial material. Very little soil geneses, not classified in to a soil form.	Barren	Very low - none	58.83	4.62
E	-	0	Severely eroded zones. Areas subject to severe erosion within the generally high eroded landscape.	Barren	Very low - none	102.95	8.06
					TOTAL	**1277.15**	**100.0**

Soil unit **Cg** consists of flat to gently sloping plains with scattered stones (50-150mm) on the surface and comprises 3.74% of the surveyed area. These are shallow soils (50-250 mm) underlain by hardpan carbonate dominated by the Coega form (see Figure 12 for sampling and photo points).

Figure 2: Photo taken at soil unit Cg, sampling point AK22

Soil unit **Gra1** consists of very steep, undulating granite outcrops with 60-80% exposed surface stone and rock and comprises 21% of the surveyed area. These are shallow soils (50-100 mm) underlain by hard or slight weathered rock dominated by the Mispah form.

Figure 3: Photo taken at soil unit Gra1, photo point BL19

Soil unit **Gra2** consists of steep to mild rolling granite outcrops with 5-20% exposed surface rock and comprises 8.63% of the surveyed area. The soil surface is mostly covered with a thin layer (30mm) of quartzite gravel. These are shallow soils (50-100 mm) underlain by hard or slightly weathered rock of the Mispah form.

Figure 4: Photo taken at soil unit GRa2, sampling point BF17

Soil unit **Gra3** consists of mild rolling granite outcrops with frequent linear schist bands with 10-50% exposed surface rock and comprises 8.82% of the surveyed area. The soil surface is mostly covered with a thin layer (30mm) of quartzite gravel. These are shallow soils (50-100 mm) underlain by hard or slightly weathered rock.

Figure 5: Photo taken at soil unit Gra3, photo point BD19

Soil unit **Qs** consists of mild to steep rolling quartzite outcrops (2-5% exposed surface rock) with frequent linear schist bands and comprises 15.47% of the surveyed area. The soil surface is mostly covered with a thin layer (30mm) of quartzite gravel. These are shallow soils (50-100 mm) underlain by slightly weathered rock.

Figure 6: Photo taken at soil unit Qs, sampling point AK9

Soil unit **Sc1** consists of flat to slight undulating, narrow and wide bands of linear schist outcrops (tilted 30-80 degrees vertically) with 60-80% exposed surface rock and comprises 21.17% of the surveyed area. These are shallow soils (50-100 mm) underlain by hard or weathered rock dominated by the Mispah and Glenrosa forms.

Figure 7: Photo taken at soil unit Sc1, photo point BH21

Soil unit **Sc2** consists of flat to slightly undulating, narrow and wide bands of linear schist outcrops (tilted 30-80 degrees vertically) with 5-20% exposed surface rock and comprises 4.18% of the surveyed area. These are shallow soils (50-100 mm) underlain by hard or weathered rock dominated by the Glenrosa form.

Figure 8: Photo taken at soil unit Sc2, photo point BB22

Soil unit **DZ** (drainage zones) consists of narrow, flat, dry streambeds with varying shallow to deep sandy soil deposits and comprises 4.31% of the surveyed area.

Figure 9: Photo taken at soil unit DZ, sampling point AS22

Soil unit **Col** consists of flat to slight rolling, medium to coarse grained colluvial and alluvial material and comprises 4.62% of the surveyed area. Very little soil geneses was evident in this unit and hence it was not classified into a soil form.

Figure 10: Photo taken at soil unit Co1, sampling point AE10

Soil unit **E** consists of areas subject to severe erosion within the generally high eroded landscape and comprises 8.06% of the surveyed area.

Figure 11: Photo taken at soil unit E, photo point BC25

3.3 Khan River Valley

An approximately 20 km stretch of the soils in the Khan River valley was visually assessed. The valley consists predominantly of a 100m-800m sandy riverbed with steep rocky sides.

The soils appear to be dominated by the Dundee soil form consisting of deep, stratified, sandy soil deposits (alluvial material). Several soil profiles were observed in cuttings caused by water action. The stratified sandy layers, varying in thickness, texture and colour are the result of continuous deposition of soil material by floods.

3.4 Other derived soil properties

Derived soil properties of each unit, e.g. fertility, erodibility, dry land production potential and irrigation potential are given in Table 2. Properties were evaluated in terms of three classes: high, moderate, and low with classification in-between these. The classes are defined below.

Table 2: Other derived soil properties

Soil Unit	Erodibility	Dry land crop production potential	Soil potential for irrigation
Cg	Low	None	Very low - none
Gra1	Moderate - high	None	Very low - none
Gra2	Moderate - high	None	Very low - none
Gra3	Moderate	None	Very low - none
Qs	Moderate - high	None	Very low - none
Sc1	Moderate - high	None	Very low - none
Sc2	Moderate	None	Very low - none
DZ	Moderate - high	None	Very low - none
Col	Moderate - high	None	Very low - none
E	High	None	Very low - none

Erodibility

Low: Soils with stable physical and chemical properties which occur on flat to gentle slopes to ensure low erosion susceptibility in the natural state. Few erosion protection measures are necessary.

Medium: Soils with low to moderately unstable physical or chemical properties or soils occurring on moderate to steep slopes. Sheet and rill erosion often occur in the natural state but may become severe when these soils are disturbed or due to any misuse such as overgrazing. Erosion protection measures are necessary.

High: Soils with unstable physical and chemical properties or soils occurring on very steep slopes. Rill and donga erosion often occur in the natural state and will become severe during any disturbance or misuse. Specialised erosion protection measures are necessary.

Dry land crop production potential

Low: Production is seriously limited by negative soil properties such as insufficient soil depth, very sandy textures, abrupt texture and structure transitions between horizons, very high clay textures, strong structured horizons, wet and water logged horizons, steep slopes and low fertility.

Medium: Production is limited by some negative soil properties such as insufficient soil depth, very sandy textures, abrupt texture and structure transitions between horizons, very high clay texture, strong structured horizons, wet and water logged horizons, steep slopes and low fertility.

High: Production is limited by very little negative soil properties such as insufficient soil depth, very sandy textures, abrupt texture and structure transitions between horizons, very high clay textures, strong structured horizons, wet and water logged horizons, steep slopes and low fertility.

Soil potential for irrigation

Low: Irrigation potential is seriously limited by negative soil properties such as insufficient soil depth, very sandy textures, abrupt texture and structure transitions between horizons, very high clay textures, strong structured horizons, wet and water logged horizons, steep slopes and low fertility.

Medium: Irrigation potential is limited by some negative soil properties such as insufficient soil depth, very sandy textures, very high clay textures, strong structured horizons, wet and water logged horizons, steep slopes and low fertility.

High: Irrigation potential is limited by very little negative soil properties such as insufficient soil depth, very sandy textures, very high clay textures, strong structured horizons, wet and water logged horizons, steep slopes and low fertility.

3.5 Soil chemical analyses

A total of eight soil (0-100 mm) samples of the dominant soil forms were taken. The localities of the sampling points are shown on the detailed soil map (Figure 12). The soil chemical results were not available at the time of writing but will be included in the final report. The coordinates of the sampling points are given in Table 3.

Table 3: Coordinates of soil sampling points

Coordinates of Soil Sampling Points				
Soil sampling point	Projected Coordinate System WGS 1984, Zone 33 K		Geographic Coordinate System WGS 1994	
	Y (m)	X (m)	X (dd)	Y (dd)
AK9	525650.00	522750.00	-22.37498	15.22099
AK22	525650.00	524700.00	-22.37496	15.23993
AN23	526100.00	524850.00	-22.37089	15.24138
AS22	526850.00	524700.00	-22.36412	15.23991
AU16	527150.00	523800.00	-22.36142	15.23116
BA23	528050.00	524850.00	-22.35327	15.24135
BE27	528650.00	525450.00	-22.34784	15.24717
BF17	528800.00	523950.00	-22.34651	15.23260

4 PRE-MINING LAND CAPABILITY

The soil characteristics of each soil unit are described in the soils legend Table 1; also summarised in Table 1 is the derived land capability.

The total surveyed area was classified as barren land due to the extremely arid conditions, the lack of soil, and rocky nature of the area (see Section 2 Methodology). No map was compiled. The area and percentage of each land capability class is given in Table 4.

Table 4: Areas and percentages of land capability classes

Areas and Percentages Comprised by Land Capability Classes				
Land Capability	Soil Units	Unit Count	Area	Area (%)

Class			(ha)	
Arable	-	0	0	0
Grazing	-	0	0	0
Wetland	-	0	0	0
Barren	Cg, Gra1, Gra2, Gra3, Qs. Sc1, Sc2, DZ, Col and E	48	1,277.15	100.0
Total			**1,277.15**	**100.0**

5 LAND USE

5.1 Pre-mining Land Use

No high intensity land uses were observed during the time of the field assessment. Earlier prospecting activities took place in the early 1970s. Prior to exploration activities, the area could have been utilised for grazing purposes as cattle are grazed on areas adjacent to the mining area.

5.2 Historical agricultural production

No historical data in terms of agricultural production could be obtained. No cultivation ever took place in the area due to the extremely arid conditions. According to the general assessment made during the field assessment for the specific surveyed area, the carrying capacity is approximately 200 ha per large stock unit.

5.3 Evidence of misuse

No direct evidence of misuse was observed. The extensive erosion in the area could not necessarily be ascribed to misuses such as overgrazing. The natural buffer against erosion provided by the vegetation cover in extremely arid areas is very low. The nature of precipitation in these arid areas, which include isolated high intensity thunderstorms is mostly the cause of severe erosion. However, previously misuses such as overgrazing could have contributed to the current erosion status of the area.

5.4 Existing structures

Apart from the Exploration Camp, consisting of a few prefabricated units, no structures occur in the surveyed area. There are some old foundations and water tanks left behind by previous exploration crews. Numerous sealed boreholes were found in the area.

6 WETLANDS

No wetlands exist in the surveyed area.

7 SENSITIVE LANDSCAPES

In terms of soils and land capability, no sensitive landscapes were identified. The areas indicated on the soil map (Figure 12) as drainage zones (soil unit DZ) are differentiated as an unique habitat. The sensitivity of this habitat and other possible habitats with unique species should be determined.

8 CONCLUSION

The surveyed area consists of an extremely arid area dominated by rocky outcrops with very shallow soils of the Mispah and Glenrosa forms. The stripping and stockpiling of topsoil for later rehabilitation will be very difficult.

The total surveyed area was classified as barren land due to the extremely arid conditions, the lack of soil, and the rocky nature of the area.

No high intensity land uses were observed during the time of the field assessment.

9 RECOMMENDATIONS

All possible efforts should be made to strip and stockpile all loose soil material on the surface at the open pit area and the footprint of permanent facilities in order to save a natural seed source for later rehabilitation of the area.

10. REFERENCES

Chamber of Mines of South Africa, 1981. Guidelines for the rehabilitation of land disturbed by surface coal mining in South Africa. Johannesburg.

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APPENDIX 1:

SOIL ISSUES RELATED TO MINING ACTIVITIES AND IMPACTS

GUIDELINES FOR STRIPPING AND HANDLING OF SOILS DURING THE CONSTRUCTION AND OPERATIONAL PHASES

1.1 CONSTRUCTION PHASE

The soil assessment indicated that the proposed Mining Area is situated in a highly eroded rocky area and topsoil barely exists. A thin gravelly soil layer often occurs within a discontinuous soil-rock complex. The stripping of topsoil in the majority of the area appears to be very difficult. However, it is strongly recommended that in the open pit area, and the footprint of permanent facilities, attempts should be made to grade off all loose material on the surface and store it on stockpiles in order to conserve a source of natural seeds.

The stockpiles should be placed at localities less subject to erosion e.g. flat areas such as crests or footslopes and erosion precaution techniques such as compaction, berms and terraces should be applied to prevent erosion of the stockpiles.

1.2 OPERATIONAL PHASE

(See 1.1)

ENVIRONMENTAL IMPACT ASSESSMENT

2.1 CONSTRUCTION PHASE

The impact on soils, land capability and land use during the construction phase will be due to the disturbance or covering of the natural surface for the construction of various structures such as opencasts, waste rock dumps, the tailings facility, plants, roads, etc.

2.1.1 Soil

Nature of impact – Any disturbance of the natural surface for the construction of structures such as opencasts, waste rock dumps, the tailings dump, plants, etc.

The soil assessment indicated that the Mining Area is situated in a highly eroded rocky area and topsoil barely exists. A thin gravelly soil layer often occurs within a discontinuous soil-rock complex. The stripping of topsoil in the majority of the area appears to be very difficult.

The erection of such structures will result in:

- Loss of the original spatial distribution of natural soil forms and horizon sequences.

- Loss of original topography and drainage pattern.
- Loss of original soil depth and soil volume.

Status of impact: The impact will be negative and a cost to the holistic environment.

Extent: The impacts will be mainly site-specific and will be confined to the footprint of facilities and structures.

Duration: Impacts of structures that can be demolished during the decommissioning phase will probably be of long-term nature. Impacts of structures such as rock dumps and the tailings dump which will not be demolished during the decommissioning will be permanent.

Severity of impact: The impact of permanent structures will be severe because productive functioning of the original soil surface will cease permanently.

Certainty of impact: Impacts will definitely occur if the mining operation takes place.

Mitigation: The footprint of permanent facilities should be contained as far as possible. Attempts should be made to grade off all loose material on the surface of the pit area and footprints of permanent facilities. This material should be stockpiled to conserve a natural seed source and should be spread as a thin layer on disturbed areas during the rehabilitation process.

2.1.2 Land capability

Nature of impact – Any disturbance of the natural surface for the construction of structures such as opencasts, waste rock dumps, the tailings dump, plants, etc.

Land capability is largely determined by soil properties and therefore the impact on land capability will largely be determined by the impact on the soil. All adverse affects on soils will probably adversely affect land capability. The erection of such structures will result in the original land capability classified as barren due to extreme arid conditions to cease completely.

Status of impact: The impact will be negative and a cost to the holistic environment.

Extent: The impacts will be mainly site-specific and will be confined to the footprint of facilities and structures.

Duration: Impacts of structures that can be demolished during the decommissioning phase will probably be of long-term nature. Impacts of structures such as opencasts, rock dumps and the tailings dump which will not be demolished during the decommissioning phase will be permanent.

Severity of impact: The impact of permanent structures will be severe because the original land capability will change permanently.

Certainty of impact: The impacts will definitely occur.

Mitigation: The footprint of permanent facilities will be contained as far as possible.

2.1.3 Land use

Nature of impact – Any disturbance of the natural surface for the construction of structures such as opencasts, waste rock dumps, the tailings dump, plants, etc.

The erection of such structures will result in the current possible land uses to cease completely.

Status of impact: The impact will be negative and a cost to the holistic environment.

Extent: The impacts will be mainly site-specific and will be confined to the footprint of facilities and structures.

Duration: Impacts of structures that can be demolished during the decommissioning phase will probably be of long-term nature. Impacts of structures such as opencasts, rock dumps and the tailings dump which will not be demolished during the decommissioning will be permanent.

Severity of impact: The impact will be severe because current possible land uses at the footprint of permanent facilities will cease permanently.

Certainty of impact: The impacts will definitely occur.

Mitigation: The footprint of permanent facilities will be contained as far as possible.

2.2 OPERATIONAL PHASE

The impacts on soil, land capability and land use as described in the construction phase will continue during the operational phase and expand as the footprint of permanent facilities increase.

2.3 CLOSURE PHASE

Impacts during closure and decommissioning will be similar to construction, in terms of heavy equipment and machinery operating on site. There will likely also be an increase in contractors from the operational phase. Although no new areas should be disturbed, the continued presence of equipment and people could result in further impacts on soils through spills or unauthorised access to undisturbed areas. There should be no further impact on land capability and once decommissioning activities cease, land capability should be restored to a certain extent.

Status of impact: The impact will be negative.

Extent: The impacts will be mainly site-specific and will be confined to the footprint of facilities and structures.

Duration: Further impacts will be short term, only be for the duration of closure.

Severity of impact: The impacts will not be severe.

Certainty of impact: The impacts will definitely occur.

Mitigation: The footprint of activities will be contained as far as possible. Access should be restricted to previously disturbed areas and existing roads. These requirements should be included in contractor agreements, with penalty clauses for non-compliance.