Rehabilitation Plan for KPSX: Weltevreden

Addendum to Existing Closure Plan

Project Number:

BHP2692

Prepared for:

BHP Billiton Energy Coal South Africa (Pty) Limited

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 Introduction

It is widely recognised that landscape rehabilitation after mining is essential in order to reinstate a functional end land use which positively contributes towards the future biophysical and societal demands of the people and the animals living in proximity to a disturbed environment. Mining activity in South Africa has a legacy of poor rehabilitation post extraction however this has changed substantially in recent years due to legislative requirement, enforcement and environmental responsibility by mining houses.

Mine rehabilitation must be considered as an on-going process aimed at restoring the physical, chemical and biological quality or potential of air, land and water regimes disturbed by mining to a state acceptable to the regulators and to post mining land users (Whitehorse Mining Initiative, 1994).

BHP Billiton Energy Coal South Africa Propriety Limited (BECSA) is the holder of an approved Mining Right (Ref No. MP 30/5/1/2/2/125 MR) and Environmental Management Programme (EMP) for Klipspruit Colliery (KPS), located near Ogies, Mpumalanga Province. The KPS EMP was approved in 2003 in terms of Section 39 of the Minerals Act, 1991 (Act No. 50 of 1991) and in 2009 was subsequently updated to meet the requirements of the Mineral and Petroleum Resources Development Act, 2002 (Act No 28 of 2002) (MPRDA).

BECSA is proposing to extend the Life of Mine (LoM) of its operations by implementing the Klipspruit Extension (KPSX) Project which incorporates Klipspruit South (KPSX: South), as well as BECSA's three neighbouring Prospecting Rights to the north east, collectively referred to as Weltevreden (KPSX: Weltevreden). The Mining Right for KPS incorporates the Klipspruit Main Pit, the Smaldeel Mini-pit, Bankfontein and KPSX: South. The KPSX: Weltevreden Project will extend the KPS LoM by at least another twenty (20) years. The regional and local setting of KPSX: Weltevreden is depicted in Plan 1 and Plan 2, Appendix A.

In addition to the approved EMP, an application for a Water Use Licence Application (WULA) will be submitted to the Department of Water and Sanitation (DWS) for various water uses at KPSX: Weltevreden. An Integrated Water and Waste Management Plan (IWWMP) will be developed to manage the water resources and waste streams produced during the mining operations.

BECSA has applied for an amendment to the Mining Right and the Mining Work Programme for KPS in terms of the provisions of Section 102 of the MPRDA to incorporate the KPSX: Weltevreden resource. In addition, a Section 102 EIA/EMP Amendment Report will be submitted to the Department of Mineral Resources (DMR). The WULA will be submitted to the Department of Water and Sanitation (DWS) according to Section 21 of the National Water Act, 1998 (Act No. 36 of 1998) (NWA). In addition, environmental authorisation is required for listed activities triggered in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA).

Digby Wells Environmental (Digby Wells) has been appointed by BECSA as the independent Environmental Assessment Practitioner (EAP) to conduct the Environmental Impact Assessment (EIA) according to the NEMA, as well as associated specialist studies for the opencast development at KPSX: Weltevreden, as well as the required Public Participation Process (PPP). This rehabilitation is compiled in support of the above mentioned environmental authorisation and will be submitted to the relevant competent authorities.

This report is an addendum to the existing Closure Plan compiled by BECSA for the existing KPS operations and builds on the already existing work and information gathered.

The objective of this rehabilitation plan is to ensure activities associated with KPSX: Weltevreden and associated infrastructure will be designed to prevent, minimise or mitigate adverse long-term environmental and social impacts and create a self-sustaining ecosystem post closure.

The infrastructure associated with the KPSX: Weltevreden Project will consist of the following activities:

- Open pit including ramps and box cuts;
- Haul roads;
- Overburden and topsoil stockpiles;
- Substation for associated power;
- PCD and associated pipelines;
- Borrow pit;
- Clean water cut off canals;
- Workshop and mobile offices; and
- Electricity supply to workshop and shovel.

The rehabilitation objectives for the proposed project are as follows and are aligned with the current objectives set within the Closure Plan for KPS:

- Maintain and minimise impacts to the ecosystem within the study area;
- Implement progressive rehabilitation measures, where possible;
- Re-establishment of a suitable post-mining land use (grazing is proposed as the end land use).
- Prevent soil, surface water and groundwater contamination;
- Comply with relevant local and national regulatory requirements; and
- Maintain and monitor the rehabilitated areas.

This Plan will be a guideline for on-going surface rehabilitation during operations and only addresses KPSX: Weltevreden.

1.1 Terms of Reference

Digby Wells Environmental (Digby Wells) has been appointed by BECSA to compile an addendum rehabilitation plan for the existing closure plan, compiled for Klipspruit Colliery, for the KPSX: Weltevreden Project, located near Ogies, Mpumalanga Province (Figure 1).

This report addresses the aspects particular to the KPSX: Weltevreden Project, however in addition to this provides detail with respect to general rehabilitation measures that can be implemented and needs to be read in conjunction with the existing Closure Plan.

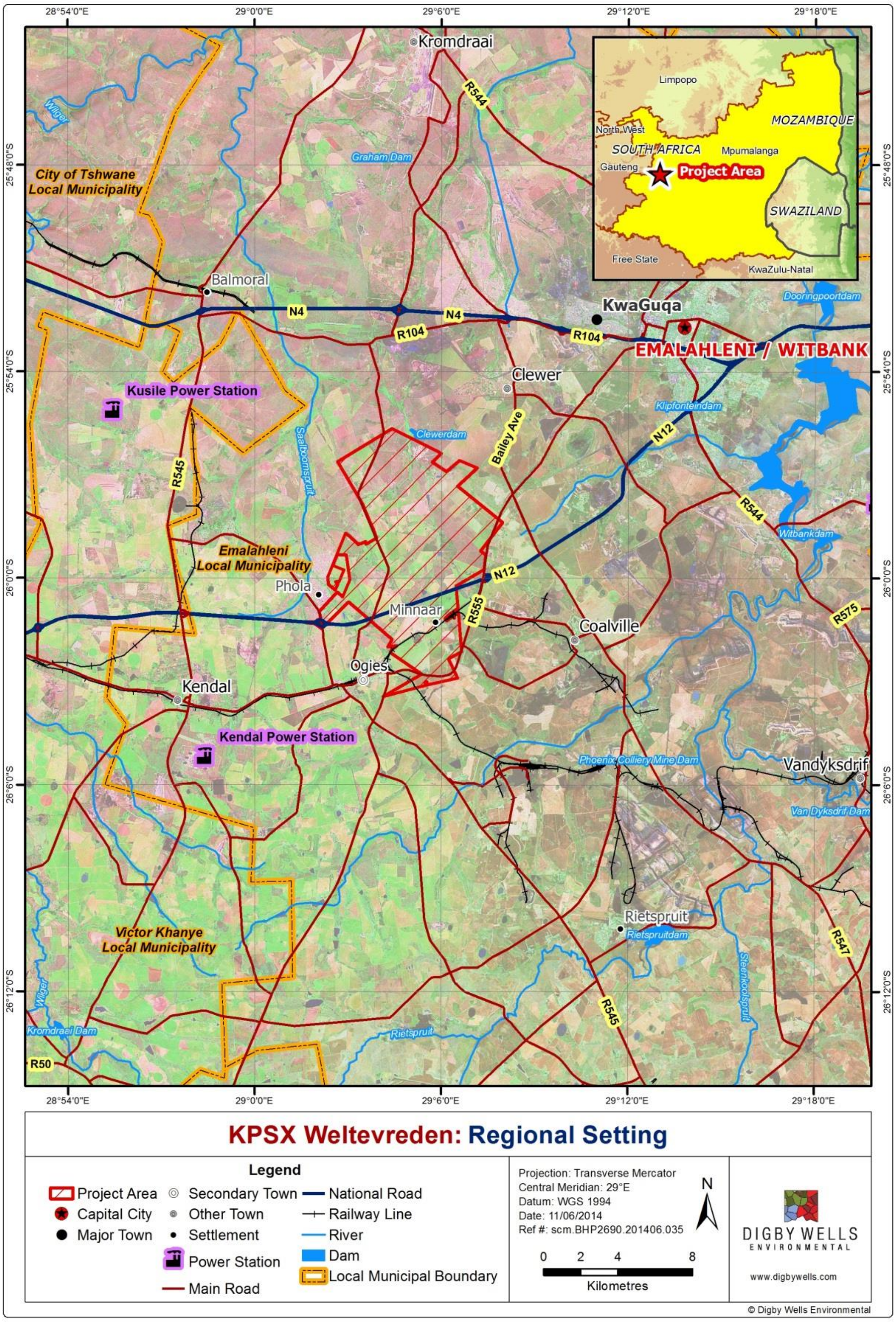

Figure 1: Regional Setting

1.2 Project Locality

The proposed project will be located east of the R555, north of the town of Ogies, on either side of the N12 national road approximately 65 km east of Johannesburg and 50 km west of Witbank in the Mpumalanga Province of South Africa (Refer to Figure 2).

Figure 2: Local Setting

1.3 Legislative Requirements and Guiding Documents

Relevant legislation governing mine rehabilitation, closure cost assessment (closure provision) and closure planning is described in the Mineral and Petroleum Resources Development Act (Act No. 28 of 2002) (MRPDA). The definition for environmental management plan as stated in the MPRDA is '*means a plan to manage and rehabilitate the environmental impact as a result of prospecting, reconnaissance, exploration or mining operations conducted under the authority of a reconnaissance permission, prospecting right, reconnaissance permit, exploration right or mining permit, as the case may be*.' Specific sections include the following:

- Section 38 on 'Integrated environmental management and responsibility to remedy';
- Section 39 on 'Environmental management programme and environmental management plan';
- Supporting MPRDA Regulations include sections 53 – 57 and 60 – 62.

With respect to financial provision NEMA now caters for the fact that an EMPr must contain information relating to financial provision provisioning for rehabilitation or management of negative Environmental Impacts Associated with Prospecting and Mining Operations as outlined in the NEMA regulations for either a Basic Assessment for Full Scoping and Environmental Impact Assessment.

There are several guideline documents which provide recommendations on how rehabilitation and closure should be undertaken. For the purpose of the plan the following guideline documents will be considered, however is not limited to:

- Guidelines for the Rehabilitation of Mined Land. Chamber of Mine of South Africa/ Coaltech. November 2007; and
- Best Practice Guidelines (BPGs) series developed by the Department of Water Affairs (DWA).

In addition to the abovementioned guideline documents further regulations must be considered pertaining to closure and rehabilitation. These are as follows:

- Mineral and Petroleum Resources Development Act (Act 28 of 2002): Mineral and Petroleum Resources Development Regulations (2004);
- International Finance Corporation (IFC) Environmental, Health and Safety (EHS) guidelines;
- Mineral and Petroleum Resources Development Act (Act 28 of 2002);
- Amendment Bill of 2007;
- Constitution of the Republic of South Africa Act, 1996 (Act 108 of 1996);
- National Environmental Management Act (Act 107 of 1998);

- National Water Act (Act 36 of 1998);
- National Environmental Management: Waste Act 2008 (Act No. 59 of 2008);
- Mine Health and Safety Act (Act 29 of 1996);
- National Environmental Management: Air Quality Act (Act 39 of 2004); and
- National Heritage Resources Act (Act 25 of 1999).

1.4 Aims and Objectives

The main aim in developing this rehabilitation plan is to mitigate the impacts caused by mining and industrial activities and to restore land back to a satisfactory standard. It is best practice to develop the rehabilitation plan as early as possible so as to ensure the optimal management of rehabilitation issues that may arise. It is critical that a mine's closure plan is defined and understood from before mining progresses and is complimentary to the rehabilitation goals. Internationally and in the South African context, the broad rehabilitation objectives include three schools of thought, explained below:

- Restoration of previous land capability and land use;
- No net loss of biodiversity; and
- What the affected community wants, the affected community gets.

The specialist studies that have been conducted have aided in the compilation of the rehabilitation plan. Rehabilitation and closure objectives need to be tailored to the project at hand and be aligned with the Environmental Management Plan (EMP). The overall rehabilitation objectives for the project are as follows:

- Maintain and minimise impacts to the ecosystem within the study area (area defined as the project area where mining will be taking place);
- Establishment of the suitable post mining land capability, vegetation and biodiversity (grazing has been defined as the post mining land use and capability);
- Implement progressive rehabilitation measures where possible (i.e. open pit areas);
- Prevent soil, surface water and groundwater contamination;
- Comply with the relevant local and national regulatory requirements; and
- Maintain and monitor the rehabilitated areas.

In accordance with applicable legislative requirements for mine closure, the holder of a prospecting right, mining right, retention permit or mining permit must ensure that:

- The closure of a prospecting or mining operation incorporates a process which must start at the commencement of the operation and continue throughout the life of the operation;

- Risks pertaining to environmental impacts must be quantified and managed proactively, which includes the gathering of relevant information throughout the life of a prospecting or mining operation;
- The safety and health requirements in terms of the Mine Health and Safety Act, 1996 (Act No. 29 of 1996) are complied with;
- Residual and possible latent environmental impacts are identified and quantified;
- The land is rehabilitated, as far as is practicable, to its natural state, or to a predetermined and agreed standard or land use which conforms with the concept of sustainable development; and
- Prospecting or mining operations are closed efficiently and cost effectively.

1.5 Assumptions

- The rehabilitation plan is based on the final end land use, as prescribed in existing closure plan compiled for KPS.
- The storm water management plan, designed as a component of the EMP, will take into consideration rehabilitation. Storm water management will therefore not be included in the rehabilitation plan; and
- The rehabilitation plan should be revised and updated annually to take into account further developments.

2 Expertise of Specialist

The Rehabilitation Team at Digby Wells is made up of a group of equipped and experienced professionals that that have had ample experience with similar mining projects in the Waterberg Coalfield. Relevant details of the specialists involved in this study are described below:

Brett Coutts is an Ecologist with a BSc Honours in Ecology, Environment and Conservation. Brett gained practical hands on experience as a project manager on environmental rehabilitation projects at Hydromulch and his roles and responsibilities include the compilation of Basic Assessment (BA) reports, Scoping & Environmental Impact Reports, compilation of Environmental Management Plans (EMP), GIS mapping and Biodiversity Action Plans linking to rehabilitation.

Danie Otto is a Botanist with an M.Sc in Environmental Management relating to phytoremediation rehabilitation of tailings facilities. He has written rehabilitation plans for coal, gold, uranium, asbestos operations as well as for smelter slag and waste. Danie has implemented, monitored and overseen rehabilitation of wetlands, gold tailings (sloping down, capping and vegetating), asbestos dumps as well as smelter slag dump rehabilitation plans.

3 Methodology and Approach

3.1 Rehabilitation and Closure Planning

3.1.1 Legal Requirements

Relevant legislation governing mine rehabilitation, closure cost assessment (closure provision) and closure planning is described in the Mineral and Petroleum Resources Development Act (Act No. 28 of 2002) (MRPDA) and the NEMA Regulations. The definition for environmental management plan as stated in the MPRDA is '*means a plan to manage and rehabilitate the environmental impact as a result of prospecting, reconnaissance, exploration or mining operations conducted under the authority of a reconnaissance permission, prospecting right, reconnaissance permit, exploration right or mining permit, as the case may be*.'

Specific sections include the following:

- Section 38 on 'Integrated environmental management and responsibility to remedy';
- Section 39 on 'Environmental management programme and environmental management plan';
- Supporting MPRDA Regulations include sections 53 – 57 and 60 – 62;
- Financial Provision with respect to NEMA as included in 1 (f), 7 (a), (c) and Clause 7 Amendment of Section 24 P of the third amendment to NEMA

Recently, the NEMA has undergone two amendments; these amendments have now included provisions related to financial provision and rehabilitation contained within Sections 1 (f), 7 (a), (c) and Clause 7 Amendment of Section 24 P of the third amendment to NEMA. These amendments now specifically stipulate that activities triggered in terms on NEMA must have a closure and rehabilitation plan compiled, which needs to include aspects related to financial provision and rehabilitation of mining related activities.

In addition to this Draft Regulation pertaining to the Financial Provision for Rehabilitation, the Closure and Post Closure of Prospecting, Exploration, Mining or Production Operations (GN.940 of 31 October 2014, in terms of NEMA) have been published for comment. These regulations will also need to be taken into account when promulgated and they will influence how closure costs are calculated and indicate that financial provision must be included for rehabilitation, decommissioning and closure activities and remediation and management of latent or residual environmental impacts. In addition to this an annual assessment must be undertaken for the above mentioned and thus resulting in the closure and rehabilitation plans to be updated and include updated financial provision. The review must also be undertaken by a specialist team which must include a mining engineer, a surveyor and an environmental assessment practitioner and must be audited by an independent auditor and submitted for approval to the Minister responsible for mineral resources within 15 months of the effective date of issue of the right.

For rehabilitation purposes, this regulation stipulates what information will be required for the final rehabilitation plan. The final rehabilitation, decommissioning and closure plan will form a component of the environmental management programme and will be subjected the same requirements of the environmental management programme with regards to opportunities. The objectives of the final rehabilitation plan are the following:

- Provide the applicant's vision, objectives and criteria for rehabilitation, decommissioning and closure of the project;
- Outline the design principles for closure;
- Explain the risk assessment approach and outcomes and link closure activities to risk mitigation;
- Detail the closure actions that clearly indicate the measures that will be taken to mitigate and/or manage Identified risks and describes the nature of residual risks that will need to be monitored and managed post closure;
- Commits a schedule, budget, roles and responsibilities for rehabilitation, decommissioning and closure of each relevant activity or item of infrastructure;
- Identify knowledge gaps and how these will be addressed and filled;
- Detail the full closure costs for the life of project at increasing levels of accuracy as the project develops and approaches closure;
- Outlines monitoring, auditing and reporting requirements; and
- Be measureable and auditable.

The final rehabilitation, decommissioning and closure plan must contain information that is necessary for the definition of the closure vision, objectives and design and relinquishment criteria, what infrastructure and activities will ultimately be decommissioned, closed, removed and remediated and the risk drivers determining actions and how the closure actions will be implemented to achieve closure relinquishment criteria and the monitoring auditing and reporting requirements. The final rehabilitation, decommissioning and closure plan must be prepared in a manner that is measurable and auditable.

The Draft Regulations also contain information associated with what is required for an annual rehabilitation plan and can be considered as a performance assessment against the final rehabilitation plan and progress towards closure. For the purpose of this report every effort has been made to align the content of this report with the requirements contained within the Draft Regulations, however it must be noted that there are certain gaps that will need to be addressed when this report is updated on an annual basis.

3.1.2 Review of Existing Information

All baseline information that has been completed (including specialist studies) has been reviewed, which included, but was not limited to, the following information:

- Existing authorisations held;
- Baseline reports compiled;
- Understanding of the social and environmental aspects; and
- Review of specialist reports.

All information enabled the fine tuning of the objectives for rehabilitation and environmental monitoring. These objectives will take into consideration the following:

- Rehabilitation and Closure Plan:
  - Post-mining development landforms and soil;
  - Hydrology;
  - Waste material characteristics; and
  - Biodiversity aspects.
- Environmental monitoring:
  - Location of mining activities in proximity to surface and groundwater resources;
  - Identification of sensitive receptors in the vicinity of the infrastructure; and
  - Legal requirements in terms of environmental monitoring.

3.1.3 Soil Planning and Rehabilitation

The rehabilitation plan contains soil information, as described in the Soil Assessment Report (Digby Wells, 2014) beginning with the preparation of the land for mining including:

- Location of soil types that should be stripped and the stripping depths of the different soil types; and
- Soil stockpiling guidelines defining what soils can be stockpiled together and in what manner.

Progressive monitoring should take place on at least a quarterly basis and should involve the following:

- Inspection of soil stockpiles to check degradation and/or pollution (these are stockpiles that have been created from areas where soil has been stripped);
- Fertility analysis quarterly and amelioration procedures prior to re-vegetation; and
- Evaluating and readjusting the rehabilitation plan.

3.2 Rehabilitation Plan Compilation

The rehabilitation plan compiled for the proposed project has followed the above methodology and details the following (information derived from various specialist reports undertaken for the proposed project):

- Statutory requirements, both at a national and international level;
- Survey data analysis and interpretation;
- Soil management;
- Vegetation and fertilizer management;
- Alien invasive control plan;
- Progressive rehabilitation options: where possible, areas that can be rehabilitated in conjunction with the operational activities and the alignment of this with the overall planning of the proposed power station;
- Monitoring criteria and guidelines; and
- Details of the respective plans shown in GIS.

4 Project Overview

The proposed infrastructure associated with the opencast activities on KPSX: Weltevreden include (Refer to Figure 3):

- Opencast pit including ramps and box cuts;
- Haul roads;
- Overburden and topsoil stockpiles;
- Substation for associated power;
- PCD and associated pipelines;
- Borrow pit;
- Clean water cut off canals;
- Workshop and mobile offices; and
- Electricity supply to workshop and shovel.

4.1 Mining Method

The mining method to be utilised on KPSX: Weltevreden will be opencast strip mining. Box cuts will be created and haul roads will allow haul trucks to access the mined areas by means of a ramp. The coal will be temporarily stockpiled within the KPSX: Weltevreden Project area where it will eventually be hauled by the trucks and conveyor to KPS for beneficiation and further processing. Following beneficiation, the coal will be transported via rail to the Richards Bay Coal Terminal for export with a small component for domestic use.

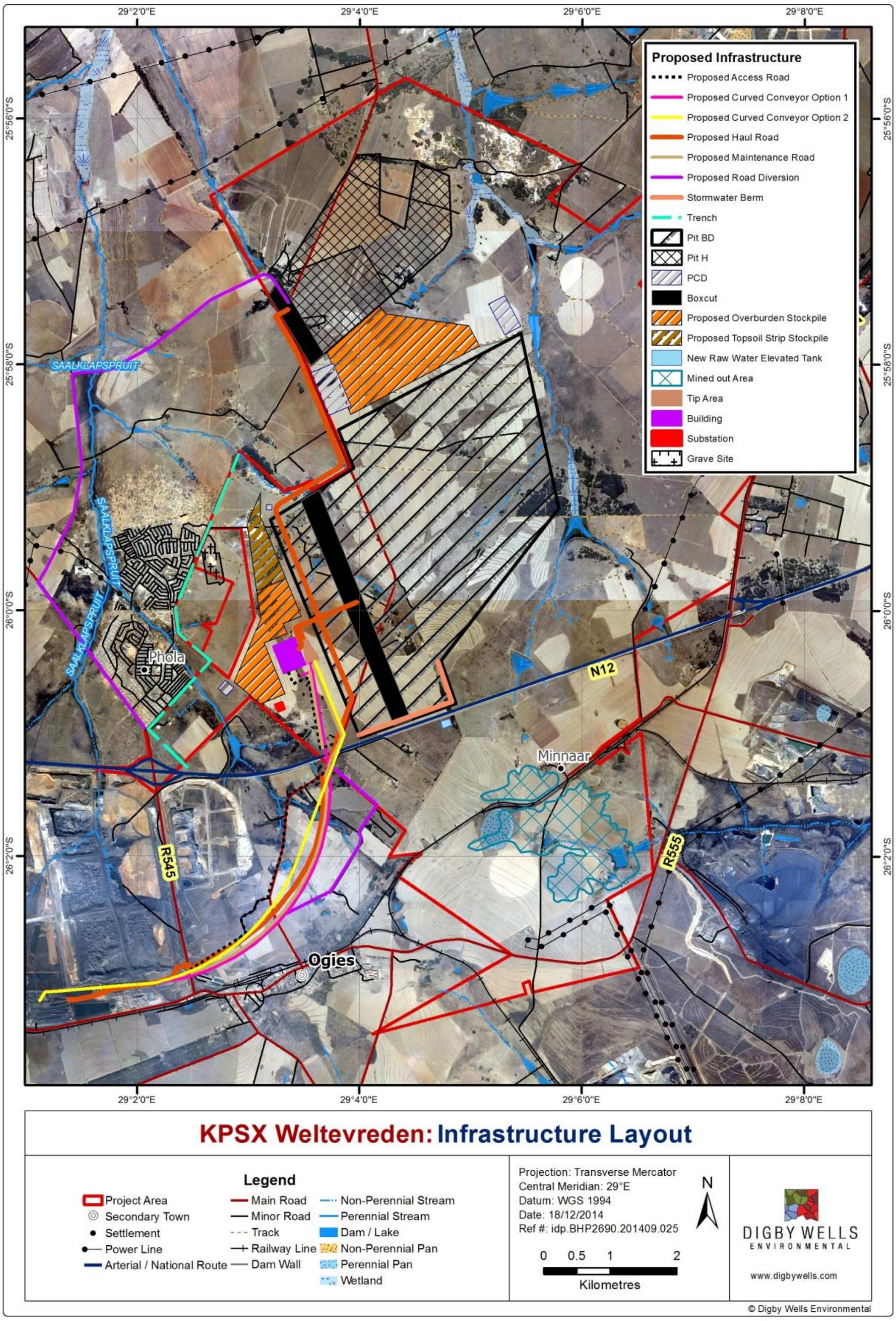

Figure 3: Proposed Infrastructure within the KPSX: Weltevreden Mining Right Area

5 Current State of the Environment

This section is a brief summary of the baseline environment. This baseline information is needed to determine the opportunities and constraints that the environment places on mine closure. This includes the biophysical and socio-economic environments and defines the zones of influence.

5.1 Climate

The average daily maximum temperatures range from 8.1°C in June to 21°C in February, with daily minima ranging from 8.1°C in June to 20°C in January. Annual mean temperature for KPSX area is given as 14.8°C. It is worth mentioning that the highest temperature recorded was 30.2 °C and a lowest of -1 C in the area.

The annual maximum, minimum and mean relative humidity is given as 71 %, 67 % and 70 %, respectively. The daily maximum relative humidity remains above 60 % for most of the year, and range from 64 % in November to 77 % in July. The daily minimum relative humidity recorded range between 61.1 % (October) and 69.6 % in occurring in September.

The three year (2011-2013) annual total rainfall maximum and average for the KPSX Weltevreden site are 1,064.9 mm and 795.3 mm respectively. The highest total monthly precipitation (228.1 mm) was observed in December. The rate decreases down to 4.1 mm in June.

5.2 Topography

The topography of the area is generally flat and stretches in some places. There are no significant topographical features like ridgelines and mountain peaks that are prominent features in some landscapes

5.3 Land Use and Capability

The predominant present land use within the KPSX: Weltevreden Project site is agriculture, dominated by grazing (57%) and commercial dry-land (arable) farming occupying 42% of the project site. The wetlands and water body areas within the project site are used for grazing purposes.

Land capability is determined by a combination of soil, terrain and climatic features. Land capability classification indicates sustainable long term use of land under rain-fed conditions while soil properties implicating limitations associated with the various land use classes are also taken into consideration.

The land capability within the KPSX: Weltevreden project site varies between wetlands and arable land. Wetlands are covering 40% while 58% of the soil types present represent Arable Class II and the remaining 2% Arable Classes III and IV.

5.4 Soils

The KPSX: Weltevreden project site is dominated by the presence of high potential agricultural soils such as Hutton, Clovelly, Pinedene and Oakleaf soils, which represent 60% of the total area. Forty percent of the project area consists of wetland soils. The Hutton, Avalon, Pinedene, Oakleaf and Clovelly soil types present within the project site can all be stripped and stockpiled together because the inherent soil properties are similar. The soil types are dominated by deep well drained red and yellow soils.

However the Avalon and Longlands soils do contain a soft plinthic layer in the subsoil. This soft plinthic layer should not be stripped with the brown Avalon and grey Longlands subsoil, because this layer hardens to a rock like consistency when exposed to air. Fernwood wetland soils should be stripped, if allowed and agreed upon by the authority, and stockpiled separately from all other soils.

The soil fertility status of KPSX: Weltevreden is augmented through annual fertilisation to sustain commercial crop production as can be seen from the phosphorous (P) content in the topsoil. Natural soils (uncultivated) within the Ogies region is expected to contain 1 – 5 mg kg^{-1} P in the topsoil. The cultivated soils within the project site contain 25 – 37 mg kg-1 P in the topsoil. This is a clear indication that the soil fertility was adjusted to ensure commercial successful maize production on these high agricultural potential soils. The high agricultural potential is proven through farmers records over the past 25 years of maize production. The average yield over the 25 year period is 7 tons maize per ha on the farm.

The soil pH tends to be low except for Sample 1 where lime was recently added, see Table 5-1. Any cultivation of soils needs to take cognisance of the natural acidification process through monitoring and subsequent neutralisation of acidity through liming.

The fertility content of the topsoil is a resource and enough reason to strip and stockpile the topsoil which is the first 0.3 m of the soil profile, separately, followed by subsoil stripping and stockpiling.

Table 5-1: Basic soil fertility indicators of the major soil groups found within the proposed project sites

Sample Number	Description	pH (KCl)	P mg kg^{-1}	K mg kg^{-1}	Na mg kg^{-1}	Ca mg kg^{-1}	Mg mg kg^{-1}
1	Hutton topsoil	7.02	33	133	3	1931	100
2	Hutton subsoil	6.00	5	97	3	596	92
3	Pinedene topsoil	4.89	20	74	7	287	56
4	Pinedene subsoil	4.48	3	27	4	172	30
5	Hutton topsoil	4.71	26	64	3	306	51

Sample Number	Description	pH (KCl)	P mg kg^{-1}	K mg kg^{-1}	Na mg kg^{-1}	Ca mg kg^{-1}	Mg mg kg^{-1}
6	Hutton subsoil	3.63	3	33	5	199	33
7	Fernwood topsoil	4.90	37	56	3	213	34
8	Fernwood subsoil	4.83	11	38	4	223	31
9	Clovelly topsoil	4.64	25	121	3	372	51
10	Clovelly subsoil	5.01	2	48	8	576	97

Note: The use of stripped stockpiled soil for rehabilitation purposes needs to include detailed post rehabilitation but pre-vegetation soil analysis as well as detailed liming and fertiliser recommendations based on the soil analytical results, as well as the type of vegetation to be established.

5.5 Fauna and Flora

5.5.1 Vegetation Communities

Five vegetation types were identified to occur within the project area. These are listed below:

- Secondary Grassland;
- Rocky Outcrops;
- Riparian Areas;
- Agricultural Fields; and
- Alien Vegetation.

5.5.1.1 Rocky Outcrops

The rocky outcrops vegetation type was limited to the hillslopes of the Saalklapspruit River and Grootspruit River just above various wetland features that are evident throughout the river and riparian habitats. These exposed rocky areas were found to harbour a variety of epilithic plant species that are characteristic of rocky habitats. Floral growth forms such as herbs, sedges and reeds were all represented. Trees were absent with the execption of shrubs that prefer this habitat type. Grasses was found on the periphery of the rocky outcrops and these most often were grassland species pioneer subclimax and climax species were found in equal numbers.

Observed plants including woody plants: Blue Bush (*Diospyros lycoides)* and an understorey layer comprised of grasses: mostly *Hyparrhenia hirta* (Common Thatching Grass), *Themeda triandra* (Red Grass) and *Cymbopogon excavatus* (Common Turpentine Grass); and forbs: *Cleome maculata*, *Crassula obovata and Frithia humulis (**EN**)*.

5.5.1.2 Riparian areas

The wetland/riparian vegetation type is composed of typical riparian plant species which are adapted to permanent or perennial saturation. This includes *Schoenoplectus* and *Cyperus* species as well as a number of wet grasses, such as Cotton Wool Grass (*Imperata cylindrica*), Rye Grass (*Lolium perenne*), Rescue Grass (*Bromus catharticus*) and swamp couch Grass (*Cynodon dactylon*).

Other forb species present include Edging lobelia (*Lobelia erinus*) and, as a result of the dams which have been constructed and grazing and trampling by livestock this vegetation type has been impacted. Additionally Cotton Wool Grass (*Imperata cylindrica*) patches occur in the study area, indicating surface water seep points. These water seep points are seen as areas where diversity will differ from the surrounding vegetation.

5.5.1.3 Agricultural fields

The agricultural fields are comprised of Maize *(Zea mays)*. These areas have been colonised by problem plants on the periphery such as Yellow Nut Sedge (*Cyperus esculentus*) White Mexican Poppy (*Argemone ochroleuca*).

Due to the high levels of transformation and disturbance, areas of cultivated land are not considered natural habitat and therefore have a low ecological integrity. When left fallow these areas also tend to be readily encroached by various NEMBA listed invasive plants. No medicinal, endemic, Red Data or protected species were recorded in the cultivated lands and the probability of such species occurring in this vegetation community is considered low. Accordingly, the conservation importance of cultivated land is considered low.

5.5.1.4 Grassland

The grassland unit was identified as the original or primary vegetation type in the area. The grasslands have formed and are maintained as a result of natural factors such as fire and frost, both of which are important in not allowing trees to start dominating the area, thereby creating a savanna landscape. The grassland habitat type identified at the project site was the remaining grassland after the majority of the area was utilized for agricultural activities predominantly maize farming. The effects of the anthropogenic activities, in the form of declining habitat, are a major threat to these grassland areas of the study site and the province as a whole. The grassland was encountered on relatively flat rolling hill slopes, with the majority of the very flat and agriculturally suitable areas used for maize farming. The ecological integrity and sensitivity was found to high and the grasslands are seen as very important with regards to its biodiversity maintenance function. The grass layer was largely dominated by Gum Grass (*Eragrostis gummiflua)*, Weeping Love grass (*E. curvula*), Common Thatch grass (*Hyparrhenia hirta*) forbs present were, Small white albuca (*Albuca setosa*), *Dianthus basuticus,* Giant Bell flower *(Wahlenbergia grandiflora)* and Chironia (*Chironia purpurascens*). Few alien invasives were encountered however Pompom weed

(*Campuloclinium macrocephalum*) and Bankrupt Bush (*Seriphium plumosum*). No trees were encountered in this vegetation type.

5.5.1.4.1 Secondary Grassland

The secondary grassland vegetation type is composed of original grassland vegetation, which has been largely impacted on/transformed previously by agricultural activities (specifically grazing). The grass layer is dominated by Weeping Love Grass (*Eragrostis curvula)* and Tough Love Grass (*Eragrostis plana)*. Forbs present include *Pelargonium luridium, Nemesia fruticans, Monopsis decipiens*. Alien and invasive vegetation includes White Flower Mexican Poppy (*Argemone ochroleuca),* Yellow Nut Sedge *(Cyperus esculentus), Sticky Nightshade (Solanum sisimbriifolium)*.

Much of the Secondary Grasslands have been impacted upon by grazing, however in consideration of the broader landscape matrix, this vegetation type provides valuable natural grassland habitat for both flora and fauna. The ecological integrity of this vegetation community varies according to the specific disturbance. No Red Data/protected flora species were recorded in this vegetation type. The suitability of the Secondary Grassland vegetation community as habitat for other Red Data and/or protected species of both flora and fauna is not regarded as high and accordingly, the conservation importance of these areas is regarded to be moderate.

5.5.1.5 Exotic tree stands

Stands of Exotic Trees including Red River Gum (*Eucalyptus camaldulensis)* and Black Wattle (*Acacia mearnsii*) are found within the Study Area. These tree stands are believed to have been historically planted to provide timber or screening for the farmhouses. They are regarded to be a highly disturbed vegetation community. Infestations have occurred along the water courses. Little vegetation is supported in the ground beneath these trees. No Red Data, protected or medicinal species were recorded in this community and the probability of occurrence of such species is considered low. The conservation importance of these areas is therefore considered low. A full assessment of the alien invasive species encountered on the study area is provided in the Flora and Fauna Specialist Report.

5.5.2 Alien plant species

Invasion by destructive alien plant species erodes the natural capital of ecosystems, compromises their stability and is a growing problem in South Africa (Richardson and van Wilgen 2004). Alien invasion for the Weltevreden study area was extensive and well-established, including alien bushclumps of <6m in height, as well as an abundance of alien shrubs and forbs. Stands of Exotic Trees including Red River Gum (*Eucalyptus camaldulensis) Populus x canescense* (Grey poplar) and Black Wattle (*Acacia mearnsii*) are found throughout the study area. These trees were historically planted as wind breaks by local farmers around farm houses. These fast colonising plants have since spread and are now found in various locations across the study area, including watercourses. Little vegetation is supported in the ground beneath these trees. The conservation importance of these areas is therefore considered low. A management plan and monitoring programme is recommended to control these plants.

5.5.3 Species of Special Concern (Red Data)

An assessment to determine the presence of any RDL plant species, as well as suitable habitat to support any such species, was undertaken. The complete PRECIS (Pretoria Computer Information Systems) red data plant list for the grid reference (2629AA and 2529CC) was enquired from SANBI (South African National Biodiversity Institute). From the Flora and Fauna assessment list the potential species to be prepared for was identified, one of which was *Frithia humulis*. The plant *Frithia humulis* (EN) was encountered on the Weltevreden study area.

One Orange Listed species, namely *Hypoxis hemerocallidae*, scattered throughout the subject property. Any *H. hemerocallidae* species encountered during mining activities should be rescued and relocated to areas with increased sensitivity such as wetland/riparian zones with associated buffers.

It should however be noted that five Red Data species were historically recorded in the surrounding area of which only one, *Frithia humilis,* is endangered, and was encountered during this survey. The other four were either least concern or data deficient. *Frithia humilis* occurs in association with sandstone outcrops. Five protected species had also been recorded in the area: *Boophane disticha, Crinum bulbispermum, Eucomis autumnalis, Gladiolus dalenii and Gladiolus crassifolius.* It should be noted that all of the species from the genus *Gladiolus* are protected*. Boophane disticha, Gladiolus crassifolius and Gladiolus dalenii* grow in grassland often in rocky places. *Crinum bulbispermum* prefers moist grassland habitat, usually along rivers and *vleis. Eucomis autumnalis* grows in grassland, particularly moist places and rocky ridges. The preferred habitat types of these protected species coincide with the designated sensitive areas of the study site. It is therefore important that recommendations presented in this report be followed as far as possible.

5.5.4 Fauna

5.5.4.1 Mammals

Three rodents were caught in the Sherman traps, some of the traps had been disturbed possibly from larger species or cattle. These species were *Crocidura mariquensis* (Swamp Musk Shrew), *Rhabdomys pumilio* (Striped Mouse) and Multimammate Mouse (*Mastomys natalensis)*.

Evidence of blue (treated) mielie kernels and dead rodents were evident during specifically the dry season survey. These dead rodents can poison birds of prey and other predators.

The majority of the farms in the area are involved in agriculture and cattle grazing and the local farmers were able to give an indication on a number of larger mammal species that are found in the area. Mammal activity is most prominent in the Grassland habitat, although it was found that small mammal activity will is high in the other habitat types present as well. Cape Clawless Otter (*Aonyx capensis*), Common Duiker (*Sylvicapra grimmia*) and Striped Polecat (*Ictonyx striatus*), *Civettictis civetta* (African Civet), *Atelerix frontalis* (South African Hedgehog), *Lepus saxatilis* (Scrub hare), *Felis serval* (Serval), *Genetta tigrina (*Muskeljaatkat), *Lutra maculicollis* (Spotted necked otter), *Damaliscus dorcas phillipsi* (Blesbok), *Galerella sanguinea* (Slender mongoose), *Atilax paludinosus* (Water Mongoose) and *Cynictis penicillata penicillata* (Yellow mongoose) were recorded during field investigations/

The Common Duiker (*S. grimmia*) was found in the Natural Grassland vegetation. These small antelope flourish in a range of different habitats in woodlands, grasslands and savanna (Kingdon 1997). They benefit from reduced predation and patches of low secondary growth, even in urban areas.

Cape Clawless Otter (*Aonyx capensis*) was observed by the central pan, in the Natural Grassland, located on the central northern section of the study area. Signs of this species were also identified on the eastern section of the site, within the grassland system and associated streams

The Striped polecat (*Ictonyx striatus)* is nocturnal, hunting mostly at night. During the day it will burrow into the undergrowth or sleep in the burrows of other animals.

5.5.4.2 Birds

During the day of the site visit a number of species were observed, the southern central areas of the property adjacent to the farmhouse and main N12 road included species such as Redeyed Dove (*Streptopelia semitorquata*), Laughing Dove (*Spilopelia senegalensis),* Cape Turtle Dove (*Streptopelia capicola*), Common Fiscal (*Lanius collaris*), Cape Sparrow (*Passer melanurus*), Neddicky (*Cisticola fulvicapilla*), Swainsons Spurfowl (*Pternistis swainsonii*), Helmeted Guineafowl (*Numida meleagris*), Black Shouldered Kite (E*lanus axillaris)* and large numbers of Feral Pigeons. Throughout the more natural areas of the property a Grass Owl (*Tyto capensis*) was observed within the wetland habitat. This species is considered Vulnerable in South Africa, with between 1 000 and 5 000 birds remaining in this country (Barnes, 2000).

Although not seen on the days of the site visit, a number of birds of prey should be present periodically throughout the year and would in all likelihood include Red Data summer migrants species such as Pallid Harrier (*Circus macrourus*) and Montagu's Harrier (*Circus pygargus)*.

The grasslands and agricultural fields of the property harbour a number of typical highveld endemics. These included several White Storks along with widow, weaver and bishop species (within the wetter areas). A number of African Quailfinch's (*Ortygospiza fuscocrissa*) were observed within the grasslands – these species generally feed on the seeds of the wetter grass species and are renowned wetland indicators. African Pipit (*Anthus cinnamomeus*) and Cape Longclaw (*Macronyx capensis*) were observed throughout the property – although there is enough nesting habitat for the more endangered lark and pipit species in the general area it must be noted that any explosives, increased traffic loads and earth movement will negatively impact on the breeding of all lark and pipit species, however this is usually not a permanent impact. The grassland area is also ideal habitat for quail and button-quail species although these species are highly nomadic and were not identified during the site investigation. The altitude and species type of the grassland suggests that the area could be home to some endemic and endangered lark and pipit species such as Rudd's Lark (*Heteromirafra ruddi*) and Botha's Larks (*Spizocorys fringillaris*) (which has been observed in the area according to the SABAP1 records.

A number of water birds were identified within the open water of the farm dams in the northern section of Weltevreden these included Sacred Ibis (*Threskiornis aethiopicus*), Red-knobbed Coot (*Fulica cristata*), African Snipe (*Gallinago nigripennis*), Grey Heron (*Ardea cinerea)*, Black-headed Heron (*Ardea melanocephala*), Egyptian Goose (*Alopochen aegyptiaca)*, Spurwinged Goose (*Plectropterus gambensis*) Yellowbilled Duck (*Anas undulata*), White-faced Duck (*Dendrocygna viduata*), Great White Egret *(Ardea alba)*, Cattle Egret (*Bubulcus ibis*), Common Sandpiper (*Actitis hypoleucos*)and Three-banded Plover (*Charadrius tricollaris*). The dam in the southern section was home to Greater flamingos (*Phoenicopterus roseus*) this observation was made during both site visits. During the summer months all areas of standing water within and adjacent to the proposed site will contain a number of wading and water species along with vagrants and due to the close proximity of a larger pan systems in the surrounding vicinity a number of birds will be observed flying from one destination to the other.

5.5.4.3 Herpetofauna

Three frog species were identified on site, namely: the Clicking Stream Frog (*Strongylopus grayii*), Giant Bullfrog *(Pyxicephalus adspersus)* and Common River Frog (*Amietia angolensis*)

6 Strategic Planning and Sustainable Development for Closure (SD)

6.1 Closure Vision/Land Use Vision

It is important that a post closure vision is defined from the outset. Workshops and toolboxes are methodologies in which this vision is discussed and defined:

Land Use Vision

"To ensure that mine disturbance can be satisfactorly rehabilitated and that the residual liability for mine closure is tolerable and to ensure land is rehabilitated to, as far as is practicable, its natural state, or to a predetermined and agreed standard or land use which conforms with the concept of sustainable development"

6.2 Existing Mine SD Objectives/Commitments

The following commitments/objectives have been set by BECSA with respect to rehabilitation and closure:

- Protect and enhance the reputation of BHP Billiton as a responsible corporate citizen;
- Ensure shareholder value is preserved;
- Establish BHP Billiton management accountability and ownership of closure activity;
- Ensure that stakeholders' needs, concerns and aspirations are taken into account when considering closure;
- Comply with relevant or applicable legislative requirements;
- Ensure the health, safety and welfare of all humans and animals are safeguarded from hazards resulting from mining operations that have been terminated;
- Limit or mitigate adverse environmental effects to an extent that it is acceptable by all parties;
- Mitigate socio-economic impacts in relation to a particular area in which an operation is located following decommissioning and subsequent closure as far as reasonably possible;
- Help protect indigenous values;
- Provide a reasonable basis on which the financial consequences of closure can be estimated, recognised and managed including any tax consequences so that mines are closed efficiently and cost effectively;
- Avoid or minimise costs and long term liabilities to the company and to the government and public;
- Ensure land is rehabilitated to, as far as is practicable, its natural state, or to a predetermined and agreed standard or land use which conforms with the concept of sustainable development; and

- Ensure investment decisions include appropriate consideration of closure, including both quantitative and qualitative impacts of closure.

6.3 Existing Community Commitments and Post-mining Land Use

Based on the already approved Environmental Management Programme Report, Social and Labour Plan and stakeholders consulted for the existing KPS, the end land use that has been discussed and agreed upon is grazing. It is assumed that the end land use for the KPSX: Weltevreden Project would be the same, thus resulting in the end land use to be grazing.

6.4 Post-mining Infrastructure Use

With the evolution of the closure and rehabilitation plan, the post-mining use of the mining infrastructure needs to be evaluated and determined whether or not it will support the mine's SD contributions. What infrastructure will support SD can potentially remain depending on the final post-mining land use; and what infrastructure does not support SD must be demolished and rehabilitated.

6.5 Key Stakeholders and Closure Needs

The aim of this step is to identify in the local community the individuals, organisations and/ or businesses that at interested in participating in the realisation of the SD of any project. Stakeholder engagement regarding the project is and will be an ongoing process. With specific reference to stakeholder engagement associated with closure and rehabilitation, the I&AP's will need to be involved in the closure planning process from the beginning, through the life of mine and should be part of the mine closure solution. The affected stakeholders are incorporated into the agreed draft closure vision that has been defined in Closure Vision.

The public participation process (PPP) should be viewed as an on-going process and should present stakeholders with relevant and accessible project information as it becomes available. The setting up of the Communication Strategy will encourage open and transparent communication for the development of trust between all stakeholders and will contribute to the facilitation of a project whose design and implementation, if approved, will be acceptable, and ideally beneficial, to all stakeholders involved.

The process of engagement with stakeholders is an ongoing process and will continue throughout the LoM. Any changes that occur with respect to the closure vision or particular aspects associated with closure and rehabilitation needs input from stakeholder and thus the development and progress of the Closure and Rehabilitation Plan needs to take into account the required involvement of all parties concerned.

7 Land Preparation

The aim of land preparation is to ensure that the area impacted is kept to an absolute minimum. All infrastructure and mining activities need to be designed with closure in mind. Sensitive areas should be demarcated as no-go areas and managed appropriately. Top soil stockpile areas are also to be demarcated as no-go areas.

7.1 Vegetation Conservation

The vegetation is mostly to be mulched across the areas of disturbance prior to soil stripping. The mulched vegetation must be removed together with the topsoil so as to preserve the organic content in the soil as well as the seed bank for the replacement of soil and re-vegetation.

7.2 Soil

According to the land type data, 30-40% of the dominant soils occurring in the crest positions are classified as Hutton soils. The soils are predominantly sandy and apedal (non-structured) in both the A and B horizons. Rooting depth can be limited by parent rock occurring below the B soil horizon in places.

The project site is dominated by the presence of high potential agricultural soils such as Hutton, Clovelly, Pinedene and Oakleaf soils which represent 60% of the project site. Forty percent of the project consists of wetland soils.

Care must be taken during the reclamation process to prevent compaction on the one hand and to replace soil volumes back to a representative arable pre-mining soil and land capability while emulating the pre mining landscape.

Considering the importance and time of formation of the soil properties then it is clear that managing soil stockpiles properly should have a high priority in opencast mining operations. Topsoil (the first 0.3 m) should be stored separately from subsoil because it contains more nutrients and microbes than subsoil. It is recommended that the topsoil stockpiles should be limited in height (4-5 m in height) because aeration can be compromised which in turn influences microbial activity and therefore soil quality, however this may not be practical as space on site may be limited. This may result is stockpiles being up to 25 m in height. This may result in additional costs when closure is concerned (additional amelioration may be required) and it is recommended that fertility analysis should be completed to determine the nature and extent of amelioration required before topsoil is utilized for rehabilitation.

Allowing subsoil to contaminate topsoil dilutes the nutrient and organic matter content causing soil infertility. Infertility imbalances then have to be reclaimed and optimised by using costly fertilizers.

More important than chemical imbalances which can be easily restored at cost, is soil compaction and volumes of replacement during soil reclamation. Heavy mining equipment is used during soil reclamation and soil is compacted beyond agricultural reclamation leaving behind areas of low soil and land capabilities. Such areas have limited land use options and specialized management needs.

Post mining soil reclamation is very difficult or near impossible if the stockpiled topsoil materials are of inferior quality due to mismanagement during storage. Good quantity and quality topsoil is an essential ingredient in the process of soil reclamation. Factors leading to decay in soil quality are:

- Contamination impacts on soil quality;
- Erosion impacts on soil volume;
- Indiscriminate storage impacts on soil quality; and
- Indiscriminate use impacts on soil volume.

An important factor in the management of stockpiles impacting on soil quality is the storage height of topsoil. The topsoil stockpile should be constructed with great care to keep within accepted limits for example:

- The stockpile sides should be angled ensuring stability at 1:3 (18.5 degrees from horizontal);
- The geographic location of the stockpile should be indicated within the rehabilitation plan document;
- The stockpile area should be clearly demarcated, fenced and strict access control practised to prevent vehicles driving on the stockpile as well as unwanted borrowing of soil material for other purposes than rehabilitation; and
- It is suggested soil stockpile height should be limited to 4-5 m, however this may not be practical as space on site may be limited. This may result is stockpiles being up to 25 m in height. This may result in additional costs when closure is concerned (additional amelioration may be required) and it is recommended that fertility analysis should be completed to determine the nature and extent of amelioration required before topsoil is utilized for rehabilitation.

Soil should not be stripped or redistributed if the top or subsoil is too wet. Use the stick test to determine if soil is too wet to redistribute. A sharpened broom sized stick must be pushed into and removed from the soil surface. If soil sticks to the stick then the soil is too wet to handle. Serious compaction may result if machine handling of wet soil occurs.

7.2.1 Soil Types for Stripping and Stockpiling

The Hutton, Avalon, Pinedene, Oakleaf and Clovelly soil types present within the project site can all be stripped and stockpiled together because the inherent soil properties are similar. The soil types are dominated by deep well drained red and yellow soils. However the Avalon and Longlands soils do contain a soft plinthic layer in the subsoil. This soft plinthic layer should not be stripped with the brown Avalon and grey Longlands subsoil respectively, because this layer hardens to rock like consistency when exposed to air. Wetland soils should be stripped, if allowed and agreed upon by the authority, and stockpiled separately from all other soils

7.2.2 Estimated Available Soil Volumes

Table 7-1 below contains information regarding estimated volumes of stripped soil to be stockpiled for use in rehabilitation. The Table does not include the deeper than 1 m of subsoil volume of soil to be potentially stripped and excavated. It is recommended that the topsoil (the top 0.30 m of the soil profile) be stripped first then the remaining subsoil. The table below represents the available soil that can be stripped from the open cast mining areas (total area = 1886 ha).

Table 7-1: Estimated soil volumes to be stockpiled for re-use after stripping (from open cast areas), use the soil types plan as a guide

Soil type	Area (ha)	Stripping depth (m)	Estimated volume (m^3)
Arable	1131.6	1	1 131 6000
Wetland Soils	754.4	1	7 544 000

7.2.3 Stockpile Locations

The soils should be stockpiled on the parent soils and as close to the originally stripped and final rehabilitation areas as possible. The top and sub soils are to be stockpiled in a berm like manner within the project area. Stockpile Management

7.2.3.1 Compaction Avoidance

Soils should be stockpiled loosely. Achieving this will depend on the equipment being used during the stripping and stockpiling process. Soils should be dumped in a single lift if truck and shovel methods are used. If the dumps are too low, then the height could be increased by using a dozer blade or backacter bucket to raise the materials. Generally no higher than 4m is the prescribed stockpile height (Tanner *et. al*., 2007). This may not be practical as space on site may be limited. This may result is stockpiles being up to 25 m in height. This may result in additional costs when closure is concerned (additional amelioration may be required) and it is recommended that fertility analysis should be completed to determine the nature and extent of amelioration required before topsoil is utilized for rehabilitation.

7.2.3.2 Topsoil Stockpile Vegetation.

The stockpiles are potentially going to be in place for the life of the project or at least partly as not all will be used during concurrent rehabilitation as newly stripped areas will be used for rehabilitation of filled in areas. Thus, the topsoil stockpiles should be vegetated to avoid soil loss due to erosion and weed colonisation as well as fertility loss. A similar seed mixture to the final one recommended for rehabilitation should be used. See Section 8.2.1.4 on Re-Vegetation and Biodiversity Establishment.

7.2.3.3 Topsoil and Subsoils Stockpile Maintenance and Monitoring

Once established, stockpiles should be managed to ensure that losses from the stockpiles are minimized and that additional damage the physical, chemical or biotic component is minimised. It must be ensured that the stockpiled soil is only used for its intended purpose. The topsoil stockpiles must be clearly demarcated as “No Go” zones and monitored frequently. Employee awareness programmes are to be carried out to reduce the risk of stockpile “robbery” or contamination. The topsoil stockpile must remain vegetated at all times. The vegetation must be monitored and managed accordingly to avoid erosion losses.

8 Rehabilitation Actions

The actions contained within this section are to be implemented in conjunction with those contained within the existing Closure Plan compiled by BECSA, December 2013.

The criteria which are described herein are mostly preliminary actions and the table below gives the definitions of the various aspects involved in the compilation of the plan and the level of detail required at this time of the project. Some areas may at a further stage than anticipated, and this is described in the summary table below.

Table 8-1: Definitions of the main closure criteria of a preliminary closure plan

Main criteria	Definition of preliminary closure plan requirements
Closure criteria - Preliminary Rehabilitation Plan	The criteria used in the closure cost estimate are based on experience and available information.
Impacts / Mitigation - Preliminary Rehabilitation Plan	The potential closure and post closure impacts are based on general experience and technical investigations or significance rating.
Rehabilitation – Preliminary Rehabilitation Plan	The suggested rehabilitation methods are based on experience and known methods from other sites. No trails have been undertaken.

8.1 Physical Closure

This section refers to the recommended actions to be taken when the physical surface structures associated with the recently ceased mining needs to be decommissioned, demolished, closed and ensured to be safe. This includes all mine related infrastructure, roads as well as railway extension.

8.1.1 Surface Closure

8.1.1.1 Infrastructure Removal

The following steps should be followed during infrastructure removal (Tanner et. al, 2007):

- Identify infrastructure items that may be of use to the future land users;
- In association with those users and the authorities, define what could be left, how it would be used and how sustainable that use would be;
- The remaining infrastructure should be assessed for its suitability for re-use/recycling;
- The re-usable items should be removed from the site;
- Hazardous material locations and deposits require specialised assessment and analysis to determine how these materials should be decontaminated and to ensure that all residual hazardous materials are deposited in officially-sanctioned hazardous waste deposit sites;
- Mining infrastructure that will be left on site must be rendered safe;
- Remaining structures should be demolished and the demolition rubble removed;
- The final landform agreed for the infrastructure areas should be created; and
- Soil should be replaced on the disturbed area and re-vegetated.

8.2 Biophysical Closure and Rehabilitation

8.2.1 Final Landform and Ecological Functionality

In terms of the remaining infrastructure, once the site has been cleared of all infrastructure and rubble the exposed underlying materials should be reshaped to create a gently sloping, free-draining topography. The topsoil and sub soil that was removed during the construction phase should be replaced (as the final top layer), fertilised and ripped. In cases where the foundations of the structures are impractical to remove, the foundations should be covered with a combination of soft overburden or B horizon material topped with a layer of topsoil, which should be at least 1 m thick. After these tasks have been completed the infrastructure sites can be included in the rehabilitation process for re-vegetation, monitoring and maintenance.

8.2.1.1 Pit Management

One of the key uncertainties in final landform prediction is the bulking factor of different materials. Soft materials and hard materials have different bulking factors once removed from the ground. Soft materials will generally compact by 10%, while hard materials may expand by as much as 25-30%. As a consequence of these factors, prediction of the final landform depends on how accurately the volumes of soft overburden, hard overburden and coal are known and detailed records kept.

Based on previous expereince, there is a possiblity that there may be a deficit of material and an overall change in the final topography elevation. It is suggested that the final topography plan, once desigend tries to emulate the premining topography. A crucial principle when concidering the final topography is to ensure that the final topography is a free draining environment and that no water is allowed to pond as this increases the risk of surface water infiltrating into the groundwater system and comining into contact with carbaneous material, if any, and increases the risk of AMD formation. Pit voids that are partially filled or left, will be allowed to fill with water to a self stabilised level. Water quality monitoring should be undertaken for these voids to determine if the water within these voids is becoming acidic.

In the event that material that is carbaneous is used as backfill (overburden, slurry and/or discard is placed back into the pit, it should be placed at the bottom of the pit and be incapsulated with non-carbenous material. The main reason for placing the material at the bottom of the pit is to ensure that this material is covered with water for the foreseeable future and does not move through the area at a large flow rate, then it is assumed that the rate of oxidation of the these layers will be lower than expected, however the longer term impacts associated with AMD would need to be addressed. In addition to this a clay layer may need to be placed down before this material is placed back into the pit to reduce the risk of AMD generating water moving out of the system.

The topsoil layer and its vegetation will minimise the movement of oxygen from the atmosphere into rehabilitated areas.

Possible migratory measures could include the following:

- Undertake testing to determine the potential of AMD formation (geochemical testing) for all hard rock formations in the pit to confirm which ones will be the major source of AMD formation;
- Detailed study to estimate the volume and quality of decant water that could emerge when mining in the area stops and the pits have been rehabilitated;
- Stockpile acid generating material separately from non-acid generating material.
- Once rehabilitation starts place the acid generating material at the bottom of the pit and encapsulate this material with a clay layer (limited to the lower lying areas) to minimise the movement of oxygen between the acid generating and non-acid generating material (place acid generating material at the bottom of the pit);
- Rehabilitate the surface with vegetation as soon as possible to minimise the movement of surface water into the soil (penetration of surface water);
- Identify groundwater and surface water monitoring locations that are related directly downstream of the decant positions;
- Monitoring these locations on a quarterly basis for the next 10 years to identify trends and to identify if AMD is occurring; and
- Reducing groundwater recharge as much as possible;
- Preventing oxygen ingression by rehabilitating opencast areas with an upper layer of soil which is placed over a layer of weathered material or using a capping layer of clay;
- Disposal of the all acid generating waste rock below the predicted water table in the rehabilitated pits to minimise oxidizing conditions in the material; and
- Preventing water movement out of the mined areas;
- On-going biomonitoring post closure; and
- Investigations into the potential of constructing a water treatment facility post closure to treat AMD water.

8.2.1.2 Final Land Use and Capability

The final end land use that is proposed is currently set at grazing and all rehabilitation efforts adopted should rehabilitate the site to a grazing land capability.

8.2.1.3 Soil Replacement

8.2.1.3.1 Location

Once the final land-form has been created, soil replacement can begin. The soils are to be replaced, if possible, into the original locations of these soils.

8.2.1.3.2 Compaction Avoidance

Compaction limits the effectiveness of replaced soils. The equipment used during the replacement of the soils has a major impact on the compaction levels. Ideally heavy machinery should not be used to spread and level soils during replacement. The truck and shovel method should be used since it causes less compaction than, for example, a bowl scraper.

When using trucks to deposit soils, the full thickness of the soil required can be placed in one lift. This does, however, require careful management to ensure that the correct volumes of soil are replaced. The soil piles deposited by the trucks will have to be smoothed before re-vegetating the area.

The soils that are deposited with trucks need to be smoothed before re-vegetation can take place. A dozer (rather than a grader) should preferably be used to smooth the soils since it exerts a lower bearing pressure and thus compacts less than wheeled systems.

8.2.1.3.3 Soil Amelioration

Replaced soils require both physical and chemical amelioration as the actions of soil removal, stockpiling and replacement result in high levels of soil compaction and a dilution of the fertility of the soil originally present and concentrated in the surface layers. The actions that should be taken during the amelioration of soils are as follows:

- The deposited soils must be ripped to ensure reduced compaction;
- An acceptable seed bed should be produced by surface tillage;
- Restore soil fertility;
- Incorporate the immobile fertilisers in to the plant rooting zone before ripping; and
- Apply maintenance dressing of fertilisers on an annual basis until the soil fertility cycle has been restored.

8.2.1.4 Re-Vegetation and Biodiversity Establishment

8.2.1.4.1 Aims and Objectives

The main aim of re-vegetation for the project area is to restore the area back to a grazing land capability/use. The overall objectives for the re-vegetation of reshaped and top-soiled land are to:

- Prevent erosion;
- Restore the land to the agreed land capability;
- Re-establish eco-system processes to ensure that a sustainable land use can be established without requiring fertilizer additions; and
- Restore the biodiversity of the area as far as possible.

8.2.1.4.2 Rehabilitation Species

Some of the criteria that should be considered during the selection of the appropriate species for rehabilitation include:

- Use species which are perennial and well adapted to the area namely:
  - *Digitaria eriantha* (Fingergrass)*;*
  - *Chloris gayana* (Rhodes grass)*;*
  - *Eragrostis tef* (Teff)*; and*
  - *Cynodon dactylon (*Kweek*);*
- The species should be tolerant of adverse soil conditions;
- Species should have a large biomass and prolific root system; and
- As areas of rehabilitation expand, maintenance costs increase, so species selected should be those with minimal maintenance cost, or with production and financial returns that exceed the cost.

The proposed seed mixture for final rehabilitation and for soil stockpiles is provided in the tables below.

Table 8-2: Rehabilitation seed mixture (final)

Species	Rate(kg/ha)
Chloris gayana (Rhodes grass)	4
Digitaria eriantha (Fingergrass)	8
Cynodon dactylon (Kweek)	5
Eragrostis teff (Teff)	2

Species	Rate(kg/ha)
TOTAL	**19**

Table 8-3: Rehabilitation seed mixture (stockpiles)

Species	Rate(kg/ha)
Chloris gayana (Rhodes grass)	4
Digitaria eriantha (Fingergrass)	4
Cynodon dactylon (Kweek)	3
Eragrostis teff (Teff)	1
TOTAL	**12**

The seeding rates given are approximations only; with highly efficient planters, e.g. gel planters, these rates may be significantly reduced. Please note that in sensitive areas like pans, *Chloris gayana* should be excluded from the mix and that *Cynodon dactylon* is increased.

8.2.1.4.3 Re-vegetation

The common methods used to establish vegetation include seeding and hydroseeding. Flat areas should be seeded using tractor implements and slopes too steep for tractors should be hydroseeded.

In the event where soils are stripped and returned directly (i.e. no stockpiling) and the areas stripped have good vegetation cover with suitable species present, natural re-colonisation may occur and there will be no need for re-seeding. In this case, it may be best to simply replace the stripped soils, lightly level and rip thoroughly, and leave for one growing season to assess the extent and suitability of the natural re-vegetation, however, this method is not suitable for any areas previously infested with alien invader species such as wattle.

Mulching with locally cut grass will also enhance the seed bank and ecological succession.

8.2.1.5 Surface and Groundwater

The final profile achieved should be acceptable in terms of the surface water drainage requirements and the end land use objectives.

Mitigation methods proposed include:

- It is recommended that the mine should supply equal/better quality water to affected parties that rely on groundwater in the receiving environment, if proven that there is impact on specific users.

8.2.2 Air Quality

Revegetation is critical for acceptable closure of the area to achieve sustainable and good air quality. It is recommended in order to minimise the erosion to reduce the potential for fugitive dust generation.

8.2.3 Rehabilitation of Infrastructure

The following section gives a brief description regarding rehabilitation and closure of the infrastructure associated with the proposed project railway loop extension and associated infrastructure.

8.3 General Infrastructure

Large scale infrastructure such as power lines, could be utilised post closure to assist with the development of the area once closure of the site occurs. In the event that infrastructure remains the associated long term liabilities need to be assessed and determine. In the event that all infrastructure is to be decommissioned and demolished then the following needs to implemented:

- All infrastructure, including buildings and selected access roads are removed and appropriate rehabilitation measures implemented to achieve the desired land end use;
- Any hazardous material found within the areas is removed and disposed of at the appropriate facility; this includes hydrocarbon spillages that may have occurred to soil. These areas need to remediated using the appropriate measures and either the soil needs to be bio remediated or disposed of at an appropriate hazardous disposal site;
- Concrete that is not contaminated with hazardous waste could be used as backfill in the open pit, if contaminated than it must be disposed of at an appropriate facility;
- Concrete facilities, such as supporting foundations, should be demolished to 1 m below ground level;
- The mine areas must be cleared of all demolition waste and rubble;
- When shaping of the site is undertaken, reshaping must be free draining and should resemble the surrounding topography;
- Appropriate topsoil must be placed back on disturbed areas, the thickness of topsoil deposited should be aligned to the final land use;
- An appropriate seed mixture of species that are drought tolerant should be utilised for rehabilitation purposes;

8.4 Stockpiles (Waste Rock Dumps and Run of Mine)

The stockpiles that will be designed and constructed will be temporary for the life of mine, when the mine is decommissioned, these facilities should also be decommissioned and rehabilitated. Areas where stockpiles are located need to be cleaned up of any contamination that has occurred and placed on one of the existing dumps prior to final dump rehabilitation The area needs to be shaped and ripped to an appropriate depth (normally 1m) and should be free draining. An appropriate seed mixture should be utilised and monitoring of alien invasive needs to be undertaken.

8.5 Areas where Hydrocarbons and Hazardous Materials are Stored

Facilities such as the upgraded fuel facility will need to be decommissioned and made safe. All infrastructure such as tanks, that potentially could be utilised for future use should be removed. Concrete lined bunded areas need to be broken down and this material disposed of at an appropriate facility. Shaping, topsoil replacement and vegetation establishment can commence once this has been undertaken.

9 Monitoring and Maintenance

The purpose of monitoring is to ensure that the objectives of rehabilitation are met and that the rehabilitation process is followed. The physical aspects of rehabilitation should be carefully monitored during the operational phase as well as during the progress of establishment of desired final ecosystems.

The following items should be monitored continuously:

- Alignment of actual final topography to agreed planned landform;
- Depth of topsoil stripped and placed;
- Chemical, physical and biological status of replaced soil;
- Erosion status;
- Surface drainage systems and surface water quality;
- Groundwater quality at agreed locations;
- Vegetation cover;
- Vegetation species diversity;
- Alien invader establishment and control measure;
- Faunal re-colonisation (Sherman and pitfall trapping); and
- Proportion of mined land that has been fully rehabilitated.

9.1 Final Topography

The topography that is achieved during rehabilitation should be monitored and compared to the planned topography. The final profile achieved should be acceptable in terms of the surface water drainage requirements and the end land use objectives. The survey department should do an assessment of the reshaping carried out on the site and signoff should be obtained from the rehabilitation specialist before the topsoil is replaced. Post closure subsidence may be an actor in areas where the railway line was cut in and backfilled. Ensure that a small volume of soil is left available after final rehabilitation to fill in areas of subsidence, if they occur.

9.2 Soil

The recovery and effective use of the usable topsoil available is very important. It is also important to undertake regular reconciliation of the volumes stripped, stockpiled and returned to the rehabilitated areas. A topsoil balance can be used to keep track of soil resources on the mine.

The following actions should form part of monitoring soil quality and rehabilitation sustainability:

- Visual assessment should include specialist scoring of water ponding, plant vigour, yield, tilth, earthworms, runoff, ease of tillage, soil colour, soil aroma, soil structure and cloddiness; and
- Soil quality monitoring should include, bulk density, infiltration rate, water holding capacity, electrical conductivity, pH, soil nitrate and microbial activity.
- Assessment of rehabilitated soil thickness and soil characteristics by means of auger observations using a detailed grid; and
- Erosion occurrences; Erosion monitoring of rehabilitated areas should be undertaken and zones with excessive erosion should be identified. Erosion can either be quantified or the occurrence there-of simply recorded for the particular location.

9.3 Surface Water

The functionality of the surface water drainage systems should be assessed on an annual basis. This should preferably be done after the first major rains of the season and then after any major storm. An assessment of these structures will ensure that the drainage on the recreated profile matches the rehabilitation plan as well as to detect early on when any drainage structures are not functioning efficiently. These can then be repaired or replaced before it causes significant erosion damage.

9.4 Flora

The following recommendations have been suggested for post mining rehabilitation and monitoring of the proposed development area. Biodiversity assessments mid wet season should be undertaken by a qualified ecologist / botanist in order to monitor the rehabilitation progress with regards to Flora.

Mid wet season surveys are recommended to undertake the following suggested activities (Table 9-1).

Table 9-1: Flora monitoring recommendations post mining/during rehabilitation

Aspect		Suggested activity
Flora	Protected Trees	Monitoring of protected trees replanted
	Vegetation	Transects through disturbed areas. Sample plots to be identified and monitored
	Alien vegetation	Transects through disturbed areas. Sample plots to be identified and monitored.
	Erosion	Identify possible areas of poor vegetation cover which might lead to erosion. Any evidence of erosion should be attended to, by planting species with a dense root system, such as *Cynodon dactylon*.

Alien invasive species tend to out-compete the indigenous vegetation; this is due to the fact that they are vigorous growers that are adaptable and able to invade a wide range of ecological niches (Bromilow, 1995). They are tough, can withstand unfavourable conditions and are easily spread.

Alien Invasive control methods should be employed for the species identified during the flora assessment, as listed in Table 9-2 below in accordance with legislation. Alien species in South Africa are categorised according to the Alien and Invasive Species Lists, 2014 (GN R599 in *GG* 37886 of 1 August 2014) of the NEMBA (Act 10 of 2004). These species identified must be controlled by an invasive species management programme (Table 9-2).

Table 9-2: Control of existing alien plant species identified on site

Species (Category)	English Name	Growth form	Grass	Ripar	Rocky	Agric land	Alien clumps
Acacia mearnsii (2)	Black Wattle	Tree					x
Agave sisalana (2)	Sisal	Succulent				x	x
Asclepias fruticosa	Shrubby milkweed	Shrub	x	x			
Bidens pilosa	Common Blackjack	Herb	x		x		x

Species (Category)	English Name	Growth form	Grass	Ripar	Rocky	Agric land	Alien clumps
Bromus catharticus	Rescue grass	Grass	x	x			x
Campuloclinium macrocephalum(1b)	Pompom weed	Herb	x		x		
Cirsium vulgare (1b)	Scottish thistle	Herb	x				x
Conyza albida	Tall fleabane	Herb	x	x	x		
Cyperus esculentus	Yellow Nut Sedge	Sedge		x			
Datura stramomium (1b)	Common thorn apple	Herb	x	x		x	
Eucalyptus camuldensis (1b)	Red River Gum	Tree					x
Oenothera rosea	Rose evening primrose	Herb	x		x	x	x
Paspalum urvillei	Vasey Grass	Grass				x	x
Persicaria lapathifolia	Spotted Knotweed	Herb		x			
Populus x canescens(2)	Grey Poplar	Tree		x			x
Salix babylonica	Weeping Willow	Tree		x			
Schkuhria pinnata	Dwarf marigold	Shrub	x		x		
Seriphium plumosum	Bankrupt Bush	Shrub	x			x	
Solanum mauritianum(1b)	Bugweed	Shrub	x		x		x
Solanum sisymbrifolium(1b)	Wild Tomato	Shrublet	x				
Tagetes minuta	Tall Khaki Weed	Herb	x			x	x
Taraxacum officinale	Dandelion	Herb	x				
Verbena bonariensis (1b)	Tall Verbena	Shrub	x			x	x

Invasive alien plant species are difficult to control. Methods should be used that are appropriate for the species concerned, as well as to the ecosystem in which they occur. When performing the controlling methodology for weeds and invaders, damage to the environment must be limited to a minimum. The methodology must be performed for at least three growing seasons to ensure the seed bank is depleted. Continual monitoring will be needed for seeds that are likely to be blown in from adjacent areas.

9.4.1 Integrated Control Strategies

The satisfactory control of weeds and other invasive species is usually only achieved when several complementary methods, including biological control, improved land management practices, herbicides and mechanical methods, are carefully integrated. Such a strategy is termed an Integrated Control Strategy (ICS).

Follow-up control of alien plant seedlings, saplings and coppice re-growth is essential to maintain the progress made with initial control work, and to prevent suppression of planted or colonizing grasses. Before starting new control operations on new infestations, all required follow-up control and rehabilitation work must be completed in areas that are originally prioritized for clearing and rehabilitation.

The following additional measures are recommended in order to prevent the future introduction or spread of alien species, and to ensure the rehabilitation of transformed areas:

- There must be no planting of alien plants (e.g. black wattle, eucalyptus and pampas grass) anywhere within the project area;
- Annual surveys, aimed at updating the alien plant list and establishing and updating the invasive status of each of the alien species, should be carried out (can be done by BECSA Mine staff);
- The transportation of soils or other substrates infested with alien species should be strictly controlled;
- Benefits to local communities as a result of the alien plant control programme should be maximised by not only ensuring that local labour is employed, but by also ensuring that cleared alien trees are treated as a valuable wood resource that can be utilised;
- It is considered essential that appropriate veld management (particularly appropriate grazing levels and burning frequencies) should be applied to areas of secondary indigenous vegetation (e.g. secondary grassland of historically cultivated areas), and especially the grassland vegetation of untransformed habitats.

Details regarding the management of Protected Tree species are described in the Protected Tree Permit Application and supporting documentation (Digby Wells, 2014).

9.5 Fauna

Mid wet season surveys are similarly recommended to undertake the following suggested activities (Table 9-3).

Table 9-3: Fauna monitoring recommendations post mining/during rehabilitation

Aspect	Suggestion

Fauna	Large Mammals	Camera traps along transect (every 100m) for 2 nights
	Mammals	Sherman along transect (every 100m) for 2 nights
	Avifauna	Bird counts
	Herpetofauna	Pitfall traps along transect (every 100m) for 2 nights
	Invertebrates	Pitfall traps along transect (every 100m) for 2 nights

10 Actions and Activities

The following tables below are the consolidated actions and activities associated with the rehabilitation of the KPSX: Weltevreden Project area and the consequent monitoring and maintenance needed.

Table 10-1: Landscape reshaping activities

ASPECT	Aim	ACTIONS
Shaping and Levelling	Shaping and levelling	One of the objectives of the rehabilitation plan is to try and rehabilitate the landscape back to an acceptable topography that is free draining. It is important that close monitoring during rehabilitation is undertaken to ensure that the desired topography is achieved.
	Clean and dirty water separation for rehabilitated areas	Appropriate clean and dirty water systems should be implemented and dirty water channelled away from rehabilitated areas.
Erosion	Filling of erosion gullies that have formed.	Additional soil material should be available to fill erosion gullies that may form as a result of incorrect profiling or during heavy rainfall events.

Table 10-2: Soil management activities

ASPECT	Aim	ACTIONS
Compaction Reduction	Stop excess traffic over reshaped areas	Limit the amount of vehicular movement over re-profiled areas to prevent unnecessary compaction of replaced soils.
	Awareness of compaction	Ensure that all workers/contractors are aware of the goal of minimizing compaction throughout the rehabilitation process.
	Record taking	Volumes of material moved should be recorded.
Soil Replacement	Move soils when Dry	Move/replace soil stockpiles when they are dry.

	Spread Overburden	Soft overburden material should be utilized over harder overburden and should be spread evenly over rehabilitated areas.
	Spread cover mix	Red topsoil (top 0.3 m) must be replaced last overlying the subsoil 0.5 m. The red and yellow soil represents arable soil and the thickness of the soil cover is recommended to be 0.5 m subsoil underlying 0.3 m topsoil providing a profile depth of 0.8 m. Wetland soil should also be replaced in lower landscape conditions 0.3 m wetland topsoil overlying 0.3 m wetland subsoil providing a soil cover depth of 0.6 m.
Smoothing and Spreading	Smooth surface	Rough level all topsoil using a dozer (not grader).
	Dozer spreading	All soil piles should be smoothed, by dozer, before fertilization.
Fertilizing	Improve growth properties	Undertake testing on soil to determine the appropriate fertilizer applications and rip through soil at least 100mm into underlying spoil material.
Ripping	Rip soils	Rip to a depth of at least 100mm into the underlying spoil

Table 10-3: Vegetation management activities

ASPECT	Aim	ACTIONS
Soil Dressing	Sustain microbial activity	Ensure organic content sufficient within the soils which are replaced. Mulch 1 t/ha of locally mowed grass and spread. The rate should be around 1t grass/hectare, so that it gives some erosion control in addition to indigenous seed.
	Improve growth properties	Once the soil properties have been established a qualified specialist should make recommendations as to fertilizer applications including timing and ratios.
	Spread fertilizer	A commercial spreader should be used. Calibrate this using a sheet/tarpaulin. Check that the spread is uniform. It is recommended that a competent contractor is used to do the work, and that the prep work and fertilization and seeding always has close supervision.

Re Vegetation	Plant areas with recommended species	Vegetate rehabilitated areas as per the recommended seed mixture.
Alien Invasive Species Management	Limit the alien invasive species colonization	Implement various control methods including selective/non-selective, contact/systemic herbicides as per regulations.

Table 10-4: Maintenance and monitoring recommendations

ASPECT	ACTIONS
Topography	The topography that is achieved during rehabilitation should be monitored and compared to the planned topography. The final profile achieved should be acceptable in terms of the surface water drainage requirements and the end land use objectives. The survey department should do an assessment of the reshaping carried out on the site and signoff should be obtained from the rehabilitation specialist before the topsoil is replaced.
Topsoil Depth	The recovery and effective use of the usable topsoil available is very important. It is essential to undertake regular reconciliation of the volumes stripped, stockpiled and returned to the rehabilitated areas. A topsoil balance must be used to keep track of soil resources on the mine. In addition to this detailed records of available topsoil should be marinated and also the volume and depth of topsoil replaced.
Replaced Soil Qualities	A final rehabilitation performance assessment should be done and information should be adequate for closure applications that involve: ■ Assessment of rehabilitated soil thickness and soil characteristics by means of auger observations using a detailed grid; ■ Erosion occurrences; ■ Soil acidity and salt pollution analyses (pH, electrical conductivity and sulphate) at 0-250 mm soil depth every 10 ha; and ■ Fertility analysis (exchangeable cations K, Ca, Mg and Na and phosphorus) every 16 ha (400x400 m). ■ Maintenance fertilization will be required to ensure that the soil fertility is adequate to support satisfactory plant growth, as this is the main factor preventing erosion.

Erosion	Erosion monitoring of rehabilitated areas should be undertaken and zones with excessive erosion should be identified. Erosion can either be quantified or the occurrence there-of simply recorded for the particular location.
Surface Water	The functionality of the surface water drainage systems should be assessed on an annual basis. This should preferably be done after the first major rains of the season and then after any major storm. An assessment of these structures will ensure that the drainage on the recreated profile matches the rehabilitation plan as well as to detect early on when any drainage structures are not functioning efficiently. These can then be repaired or replaced before it causes significant erosion damage.
Groundwater	Groundwater monitoring must be undertaken to monitor potential AMD formation that may emanate from any decant zones identified or seepage areas. The appropriate management of groundwater resources must be implemented in the event that AMD forms. This can either be passive or active treatment of a combination of both.
Fauna	Basal cover refers to the proportion of ground at root level which is covered by vegetation and by the rooting portion of the cover plants. The line-transect (or the quadrat bridge) method can be used. A target of approximately 15% basal cover should be set for fully established vegetation. Biodiversity assessments and surveys should be undertaken to establish the full range of plant species that have become established. Biodiversity and basal cover assessments should be undertaken annually with a rotation of summer and winter assessments.
Settling	Re-colonisation of fauna species through species assessment (Sherman and pitfall trapping).
Re-vegetation failure	Areas that settle and result in ponding will need to be topped-up from the reserve stockpiles.
Erosion	Area in which the re-vegetation is not successful must be investigated. Once the cause has been established remedial action must be undertaken, e.g. fertilization, ripping and replanting.

11 Conclusion

Mine rehabilitation must be considered as an on-going process aimed at restoring the physical, chemical and biological quality or potential of air, land and water regimes disturbed by mining to a state acceptable to the regulators and to post mining land users (Whitehorse Mining Initiative, 1994).

The overall objective of the rehabilitation plan is to ensure activities associated with the KPSX: Weltevreden Project and associated infrastructure will be designed to prevent, minimise or mitigate adverse long-term environmental and social impacts and create a self-sustaining ecosystem.

With respect to what has been recommended in the rehabilitation plan, there is a possibility that there may be long term post closure liabilities that need to me mitigated. Rehabilitation can and should reduce the significance of these liabilities, however liabilities such as groundwater impacts and the potential for AMD formation need to be considered and the appropriate tools adopted in the attempt to reduce the severity of this impact in the long term.

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