SOIL, LAND USE AND LAND CAPABILITY REPORT FOR THE PROPOSED DORSTFONTEIN EAST COAL MINE EXTENSION PROJECT

For and on behalf of TerraAfrica Consult

Approved by: Mariné Pienaar

Position: Soil scientist

Date: 20 June 2017

terraafrica
environmentalconsultants

DEFINITIONS AND ACRONYMS

Base status: A qualitative expression of base saturation. See base saturation percentage. Base Saturation Base saturation refers to the proportion of the cation exchange sites in the soil that are occupied by the various cations (hydrogen, calcium, magnesium, potassium). The surfaces of soil minerals and organic matter have negative charges that attract and hold the positively charged cations. Cations with one positive charge (hydrogen, potassium, sodium) will occupy one negatively charged site. Cations with two positive charges (calcium, magnesium) will occupy two sites.

Buffer capacity: The ability of soil to resist an induced change in pH.

Calcareous: Containing calcium carbonate or magnesium carbonate.

Catena: A sequence of soils of similar age, derived from similar parent material, and occurring under similar macroclimatic conditions, but having different characteristics due to variation in relief and drainage.

Cutan: Cutans occur on the surfaces of peds or individual particles (sand grains, stones). They consist of material which is usually finer than, and that has an organisation different to the material that makes up the surface on which they occur. They originate through deposition, diffusion or stress. Synonymous with clayskin, clay film, argillan.

Erosion: The group of processes whereby soil or rock material is loosened or dissolved and removed from any part of the earth's surface.

Fertilizer: An organic or inorganic material, natural or synthetic, which can supply one or more of the nutrient elements essential for the growth and reproduction of plants.

Fine sand: (1) A soil separate consisting of particles 0,25-0,1mm in diameter. (2) A soil texture class (see texture) with fine sand plus very fine sand (i.e. 0,25-0,05mm in diameter) more than 60% of the sand fraction.

Gleying: The process whereby the iron in soils and sediments is bacterially reduced under anaerobic conditions and concentrated in a restricted horizon within the soil profile. Gleying usually occurs where there is a high water table or where an iron pan forms low down in the soil profile and prevents run-off, with the result that the upper horizons remain wet. Gleyed soils are typically green, blue, or grey in colour.

Land capability: The ability of land to meet the needs of one or more uses under defined conditions of management.

Land type: (1) A class of land with specified characteristics. (2) In South Africa it has been used as a map unit denoting land, map able at 1:250,000 scale, over which there is a marked uniformity of climate, terrain form and soil pattern.

Land use: The use to which land is put.

Orthic A horizon: A surface horizon that does not qualify as organic, humic, vertic or melanic topsoil although it may have been darkened by organic matter.

Overburden: Material that overlies another material difference in a specified respect, but mainly referred to in this document as materials overlying weathered rock.

Ped: Individual natural soil aggregate (e.g. block, prism) as contrasted with a clod produced by artificial disturbance.

Pedocutanic, diagnostic B-horizon: The concept embraces B-horizons that have become enriched in clay, presumably by illuviation (an important pedogenic process which involves downward movement of fine materials by, and deposition from, water to give rise to cutanic character) and that have developed moderate or strong blocky structure. In the case of a red pedocutanic B-horizon, the transition to the overlying A-horizon is clear or abrupt.

Pedology: The branch of soil science that treats soils as natural phenomena, including their morphological, physical, chemical, mineralogical and biological properties, their genesis, their classification and their geographical distribution.

Saline, soil: Soils that have an electrical conductivity of the saturation soil extract of more than 400 mS/m at 25°C.

Slickensides: In soils, these are polished or grooved surfaces within the soil resulting from part of the soil mass sliding against adjacent material along a plane which defines the extent of the slickensides. They occur in clayey materials with a high smectite content.

Swelling clay: Clay minerals such as the smectites that exhibit interlayer swelling when wetted, or clayey soils which, on account of the presence of swelling clay minerals, swell when wetted and shrink with cracking when dried. The latter are also known as heaving soils.

Texture, soil: The relative proportions of the various size separates in the soil as described by the classes of soil texture shown in the soil texture chart (see diagram on next page). The pure sand, sand, loamy sand, sandy loam and sandy clay loam classes are further subdivided (see diagram) according to the relative percentages of the coarse, medium and fine sand sub-separates.

Vertic, diagnostic A-horizon: A-horizons that have both, high clay content and a predominance of smectitic clay minerals possess the capacity to shrink and swell markedly in response to moisture changes. Such expansive materials have a characteristic appearance: structure is strongly developed, ped faces are shiny, and consistence is highly plastic when moist and sticky when wet.

Declaration of EAP

Details of practitioner

Report author: M Pienaar
Contact number: 082 828 3587
Email address: mpienaar@terraafrica.co.za

Declaration of Independence

I, Mariné Pienaar, hereby declare that TerraAfrica Consult, an independent consulting firm, has no interest or personal gains in this project whatsoever, except receiving fair payment for rendering an independent professional service.

I further declare that I was responsible for collecting data and compiling this report. All assumptions, assessments and recommendations are made in good faith and are considered to be correct to the best of my knowledge and the information available at this stage.

TerraAfrica Consult cc represented by M Pienaar
May 2017

CURRICULUM VITAE

A. Personal Details

Last name: **Pienaar**

First name: **Mariné**

Nationality: **South African**

Employment: **Self-employed (Consultant)**

B. Contact Details

Email address: mpienaar@terraafrica.co.za

Mailing address: **PO Box 433, Ottosdal, 2610**

Telephone: **+27828283587**

Address: **Nr 8, 10th Street, Linden, Johannesburg, Republic of South Africa**

Current Job: **Lead Consultant and Owner of Terra Africa Consult**

C. Concise biography

Mariné Pienaar is a professionally registered agricultural scientist who has consulted extensively in the fields of soil, agriculture and land use in several African countries. These countries include South Africa, Liberia, Ghana, DRC, Mozambique, Botswana, Angola, Malawi and Swaziland. She is currently part of a team of specialist scientists selected by the South African Government to conduct a strategic assessment on the impact of shale gas development on the Karoo (specifically soil quality and agricultural production).

She is a guest lecturer at the University of the Witwatersrand, Johannesburg on the topic of "Soil and the Extractive Industries" as well as a contributing author on issues of soil quality and food security to the Bureau for Food and Agricultural Policy (BFAP) report. Mariné presented at the First Global Soil Week and organised sessions at the Second and Third Global Soil Weeks in Berlin, Germany. Mariné has also attended several international conferences and courses including the World Resources Forum in Davos, Switzerland and Conference on Environmental Toxicology and Chemistry, Barcelona.

D. Areas of expertise

- **Strategic assessment of land quality, soil properties and agricultural production as part of a multi-disciplinary team for large development projects**
- **Classification of soils according to their properties, genesis, use and environmental significance**
- **Sustainable land use and soil management**
- **Restoration of degraded soils**

- **Soil contamination assessment and remediation methods**
- **Agricultural potential assessment**
- **Resettlement planning**
- **Food production systems**
- **Assessment of ecosystem services and natural capital**

E. Qualifications

Academic Qualifications:

- **BSc (Agric) Plant Production and Soil Science;** University of Pretoria, South Africa, 2004
- **Senior Certificate / Matric;** Wolmaransstad High School, South Africa, 2000

Courses Completed:

- **World Soils and their Assessment;** ISRIC – World Soil Information, Wageningen, 2015
- **Intensive Agriculture in Arid- and Semi-Arid Environments** – Gilat Research Centre, Israel, 2015
- **Hydrus Modelling of Soil-Water-Leachate Movement;** University of KwaZulu-Natal, South Africa, 2010
- **Global Sustainability Summer School 2012;** Institute for Advanced Sustainability Studies, Potsdam, Germany, 2012
- **Wetland Rehabilitation;** University of Pretoria, South Africa, 2008
- **Enviropreneurship Institute;** Property and Environment Research Centre [PERC], Montana, U.S.A., 2011
- **Youth Encounter on Sustainability;** ACTIS Education [official spin-off of ETH Zürich], Switzerland, 2011
- **Environmental Impact Assessment │Environmental Management Systems – ISO 14001:2004 │Environmental Law;** University of Potchefstroom, South Africa, 2008
- **Carbon Footprint Analyst Level 1;** Global Carbon Exchange Assessed, 2011
- **Negotiation of Financial Transactions;** United Nations Institute for Training and Research, 2011
- **Food Security: Can Trade and Investment Improve it?** United Nations Institute for Training and Research, 2011

F. Language ability

Perfectly fluent in English and Afrikaans (native speaker of both) and conversant in French.

G. Professional Experience

Name of firm	Terra Africa Environmental Consultants
Designation	Owner | Principal Consultant
Period of work	December 2008 to Date

Successful Project Summary:

[Comprehensive project dossier available on request]
2015:

- *Buffelsfontein Gold Mine, Northwest Province, South Africa:* Soil and land contamination risk assessment for as part of a mine closure application. Propose soil restoration strategies.
- *Bauba A Hlabirwa Moeijelik Platinum mine [proposed] project, Mpumalanga, South Africa:* soil, land use and land capability assessment and impact on agricultural potential of soil.
- *Commissiekraal Coal Mine [proposed] project, KwaZulu*-Natal, South Africa: sustainable soil management plans, assessment of natural resource and agricultural potential and study of the possible impacts of the proposed project on current land use. Soil conservation strategies included in soil management plan.
- *Cronimet Chrome Mine [proposed] project, Limpopo Province, South Africa:* soil, land use and land capability of project area and assessment of the impacts of the proposed project.
- *Grasvally Chrome (Pty) Ltd Sylvania Platinum [proposed] Project, Limpopo Province, South Africa:* Soil, land use and agricultural potential assessment.
- *Jeanette Gold mine project [reviving of historical mine], Free State, South Africa:* Soil, land use and agricultural potential assessment.
- *Kangra Coal Project, Mpumalanga, South Africa:* Soil conservation strategies proposed to mitigate the impact of the project on the soil and agricultural potential.
- *Mocuba Solar Photovoltaic Power Plant, Zambezia, Mozambique:* soil, land use and land capability studies.

2014:

- *Italthai Railway & Macuse Port [proposed] Projects, Tete & Zambezia, Mozambique:* soil, land use and land capability assessments.
- *Eskom Kimberley Strengthening Phase 4 Project, Northern Cape & Free State, South Africa:* soil, agricultural potential and land capability assessment.
- *Richards Bay Integrated Development Zone Project, South Africa* [future development includes an additional 1500 ha of land into industrial areas on the fringes of Richards Bay]: natural resource and agricultural potential assessment, including soil, water and vegetation.
- *TFM Mining Operations [proposed] Integrated Development Zone, Katanga, DRC* [part of mining concession between Tenke and Fungurume]: soil and agricultural impact assessment study.
- *Exxaro Belfast Coal Mine [proposed] infrastructure development projects* [linear: road and railway upgrade | site-specific coal loading facilities]: soil, land capability and agricultural potential assessment.
- *Marikana In-Pit Rehabilitation Project of Aquarius Platinum, South Africa:* soil, land capability and land use assessment.

2013:

- *Eskom Bighorn Substation proposed upgrades, South Africa:* soil, land capability and agricultural potential assessment.
- *Exxaro Leeuwpan Coal Mining Right Area, South Africa:* consolidation of all existing soil and agricultural potential data. Conducted new surveys and identified and updated gaps in historic data sets.
- *WCL [proposed] development projects, Liberia:* Soil, land use and land capability study.
- *ESIA for [proposed] Musonoi Mine, Kolwezi area, Katanga, DRC:* soil, land use and land capability assessment.
- *Camutue Mining Concession, Angola:* Land use and agricultural assessment.

- *Manica Mining Project, Mozambique:* soil, land use and agricultural assessment.
- *AQPSA Marikana Mine, South Africa:* soil, land use and land capability data consolidation as part of the EMP consolidation process.

2012:

- *Banro Namoya Mining Operation, DRC:* soil, land use and agricultural scientist for field survey and reporting of soil potential, current land use activities and existing soil pollution levels, including proposed project extension areas and progressive soil and land use rehabilitation plan.
- *Bomi Hills Mining Project, Liberia:* soil, land use and agricultural scientist for field survey and reporting of soil potential, current land use activities and existing soil pollution levels, as well as associated infrastructure upgrades of the port, road and railway.
- *Kumba Iron Ore's Sishen Mine, Northern Cape, South Africa: soil, land use and agricultural scientist | Western Waste Rock Dumps [proposed] Project:* soil, land use and agricultural potential assessment, including recommendations regarding stripping/stockpiling and alternative uses for the large calcrete resources available.
- *Vetlaagte Solar Development Project, De Aar, South Africa:* soil, land use and agricultural scientist. Soil, land use and agricultural potential assessment for proposed new 1500 ha solar development project, including soil management plan.
- *Lunda Norte kimberlite diamond mining operation, Angola:* land restoration specialist for the assessment of current soil environmental issues. Development of agricultural plans for mine closure and social contribution. Design of sediment control measures and bamboo plantations for land restoration purposes.

H. Prior Tenures

Integrated Development Expertise; **Junior Land Use Consultant** [July 2006 to October 2008]
Omnia Fertilizer (Pty) Ltd; **Horticulturist and Extension Specialist** [January 2005 to June 2006]

I. Professional Affiliations

- South African Council for Natural Scientific Professions [SACNASP]
- Society for Environmental Toxicology and Chemistry [SETAC]
- International Society for Sustainability Professionals [ISSP]
- Soil Science Society of South Africa [SSSA]
- South African Soil Surveyors' Organisation [SASSO]
- South African Society for Crop Production [SASCP]
- International Association for Impact Assessment, South Africa [IAIAsa]
- Environmental Law Association [ELA]
- Soil Science Society of America [SSSA]

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1. Introduction

SRK Consulting (South Africa) (Pty) Ltd (from here onwards referred to as SRK) appointed Terra Africa Consult to conduct the Soil, Land Use and Land Capability study as part of the Environmental Impact Assessment (EIA) process for the Environmental Authorisation of the proposed Extension of the Dorstfontein East Mine. Dorstfontein Coal Mines (Pty) Ltd proposes to extend its operations on the western side of the mine referred to as Pit 1 Extension.

The largest part of the proposed project is located on the farms Dorstfontein 71 IS and Welstand 55 IS while small portions of land assessed as part of the buffer zone around the proposed pipeline alignments are located on the farms Rietkuil 57 IS, Rietkuil 558 IS, Fentonia 54 IS and Boschkrans 53 IS. The Project is located in the eMalahleni Local Municipality approximately 18 kilometres from Ga-Nala (formerly known as Kriel) in the Mpumalanga Province of South Africa (**Figure 1**).

2. Objective of the study

The objective of the Soil, Land Use and Land Capability study is to fulfill the requirements of the most recent South African Environmental Legislation with reference to the assessment and management of these natural resource aspects (stipulated in Section 3 below). The key components of assessment include determining the current baseline soil properties and the associated agricultural potential as well as current land uses. From this baseline data, the anticipated future impacts of the proposed extensions at the Dorstfontein East Project Area can be predicted and mitigation and management measures can be recommended to minimise negative impacts and maximise land rehabilitation success towards successful closure at the end of the project life.

The baseline soil chemistry determined during this study will serve as a measure during future soil and land quality monitoring procedures.

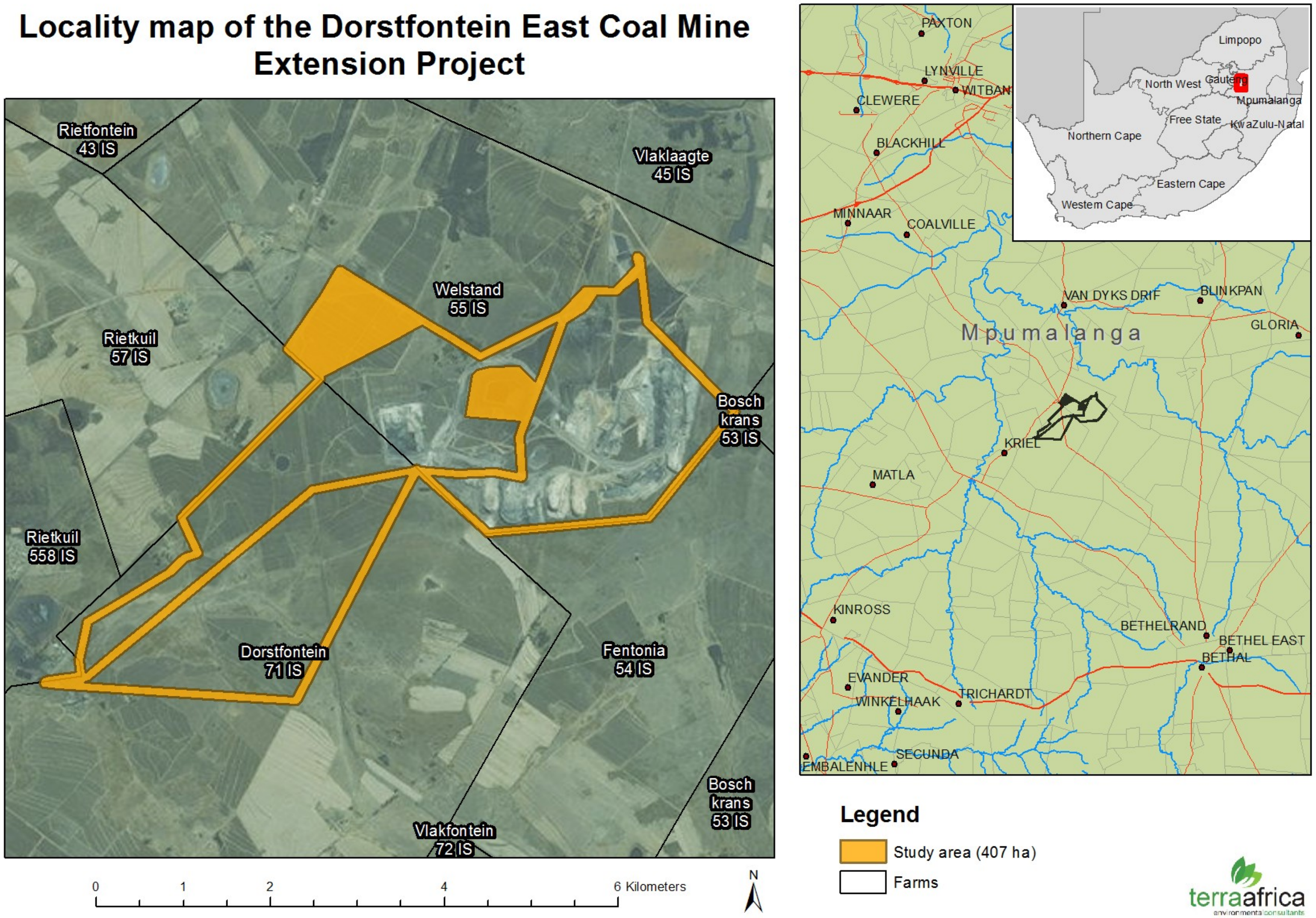

Figure 1: Locality map of the Dorstfontein East Coal Mine Extension Project

3. Environmental legislation applicable to study

The most recent South African Environmental Legislation that needs to be considered for any new or expanding development with reference to management of soil and land use includes:

- Soils and land capability are protected under the National Environmental Management Act 107 of 1998, the Mineral and Petroleum Resources Development Act 28 of 2002 and the Conservation of Agricultural Resources Act 43 of 1983.
- The National Environmental Management Act 107 of 1998 requires that pollution and degradation of the environment be avoided, or, where it cannot be avoided be minimised and remedied.
- The Conservation of Agricultural Resources (Act 43 of 1983) states that the degradation of the agricultural potential of soil is illegal.
- The Conservation of Agriculture Resources Act 43 of 1983 requires the protection of land against soil erosion and the prevention of water logging and salinization of soils by means of suitable soil conservation works to be constructed and maintained. The utilisation of marshes, water sponges and watercourses are also addressed.
- Government Notice R983 of 4 December 2014. The purpose of this Notice is to identify activities that would require environmental authorisation prior to commencement of those activities.

This report complies with the requirements of the NEMA and environmental impact assessment (EIA) regulations (GNR 982 of 2014). Table 1 below provides a summary of the requirements, with cross references to the report sections where these requirements have been addressed.

Table 1: List of specialist report requirements in terms of Appendix 6 of the EIA Regulations (2014)

A specialist report prepared in terms of the Environmental Impact Regulations of 2014 must contain:	Relevant section in report
Details of the specialist who prepared the report	Page iv – viii
The expertise of that person to compile a specialist report including a curriculum vitae	Pages iv - viii
A declaration that the person is independent in a form as may be specified by the competent authority	Page iii
An indication of the scope of, and the purpose for which, the report was prepared	Pages 11 and 14
The date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 8.2, page 18
A description of the methodology adopted in preparing the report or carrying out the specialised process	Section 8, page 16

The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	Sections 9 & 10, page 31
An identification of any areas to be avoided, including buffers	Section 9.5, page 29
A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Figure 5, page 34
A description of any assumptions made and any uncertainties or gaps in knowledge;	Sections 5 & 6, page 15
A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 9, page 20
Any mitigation measures for inclusion in the EMPr	Section 11, page 40
Any conditions for inclusion in the environmental authorisation	Section 11, page 40
Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 11, page 40
A reasoned opinion as to whether the proposed activity or portions thereof should be authorised and	Section 13, page 48
If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Section 13, page 48
A description of any consultation process that was undertaken during the course of carrying out the study	Not applicable
A summary and copies if any comments that were received during any consultation process	Section 7, page 16

4. Terms of reference

The following Terms of Reference as stipulated by SRK applies to the baseline soil and land capability study:

- Undertake a desktop study to establish broad baseline soil conditions, land capability and areas of environmental sensitivity in the proposed subject property;
- Undertake a soil survey of the proposed subject property area focusing on all landscape features including potentially wet areas;
- Describe soils in terms of soil texture, depth, structure, moisture content, organic matter content, slope and land capability of the area;
- Describe and categorise soils using the South African Soil Classification Taxonomic System;
- Identify and assess potential soil, agricultural potential and land capability impacts resulting from the proposed Dorstfontein East Coal Mine Extension Project (including impacts associated with the construction, operation, decommissioning and post closure phases of the project), using the prescribed impact rating methodology;

- Identify and describe potential cumulative soil, agricultural potential and land capability impacts resulting from the proposed development in relation to proposed and existing developments in the surrounding area;
- Recommend mitigation measures to minimise impacts and/or optimise benefits associated with the proposed project.

5. Assumptions

The following assumptions were made during the assessment and reporting phases:

- The footprint of the proposed extension will be limited to the areas assessed i.e. the pit extension and one of the three alternative pipeline alignments;
- the most significant impacts on soil, land use and agricultural potential will be as a result of the earth-moving activities associated with the proposed project;
- the earth-moving activities causing impacts will be that typically associated with opencast mining and pipeline construction.

6. Uncertainties, limitations and gaps

The following uncertainties, limitations and gaps exists with regards to the study methodology followed and conclusions derived from it:

- Soil profiles were observed using a 1.5m hand-held soil auger. A description of the soil characteristics deeper than 1.5m cannot be given.
- Access to the discard dump and the pipeline alignments directly next to the dump was limited as a result of ongoing mining activities. In order to classify the soil in this area, analysis of aerial imagery was used to determine the boundaries of the areas already affected by mining.

7. Response to concerns raised by I&APs

No comments and concerns with regards to the specialist field addressed in this report has been received up to the submission of the draft report to SRK. Should comments be received at a later stage, it will be included in this section.

8. Methodology

8.1 Desktop study and literature review

The following data was obtained and studied for the desktop study and literature review:

- Land type data for the site was obtained from the Institute for Soil Climate and Water (ISCW) of the Agricultural Research Council (ARC);
- Broad geological, soil depth and soil description classes were obtained from the Department of Environmental Affairs and studied. This data forms part of the Environmental Potential Atlas (ENPAT) of South Africa;
- The most recent aerial photography of the area available from Google Earth was obtained.

8.2 Site survey

A systematic soil survey was undertaken in three sections. The first site visit was on 9 June, then 22 and 23 August 2016 followed by a final survey on 22 April 2017. During the site surveys, soil profiles were identified at observation points between 100 and 150m apart in the study area (Figure 2). The season in which the site visits took place have no influence on the results of the survey except for a temporary difference in soil moisture content. The soil profiles were examined to a maximum depth of 1.5m using an auger. Observations were made regarding soil texture, structure, colour and soil depth at each survey point. A cold 10% hydrochloric acid solution was used on site to test for the presence of carbonates in the soil. The soils are described using the S.A. Soil Classification Taxonomic System (Soil Classification Working Group, 1991) published as memoirs on the Agricultural Natural Resources of South Africa No.15. For soil mapping, the soils were grouped into classes with relatively similar soil characteristics.

8.2 Analysis of samples at soil laboratory

Eight soil samples were collected at the subject property as follows: one topsoil and one subsoil at each sampling point. All sampling and survey points are indicated in **Figure 2**. Soil samples were sealed in soil sampling plastic bags and sent to Nvirotek Laboratories, Hartbeespoortdam for analyses. Samples taken to determine baseline soil fertility were analysed for electrical conductivity (EC), pH (KCl and H2O), phosphorus (Bray1), exchangeable cations (calcium, magnesium, potassium, sodium), organic carbon (Walkley-Black) and texture classes (relative fractions of sand, silt and clay)

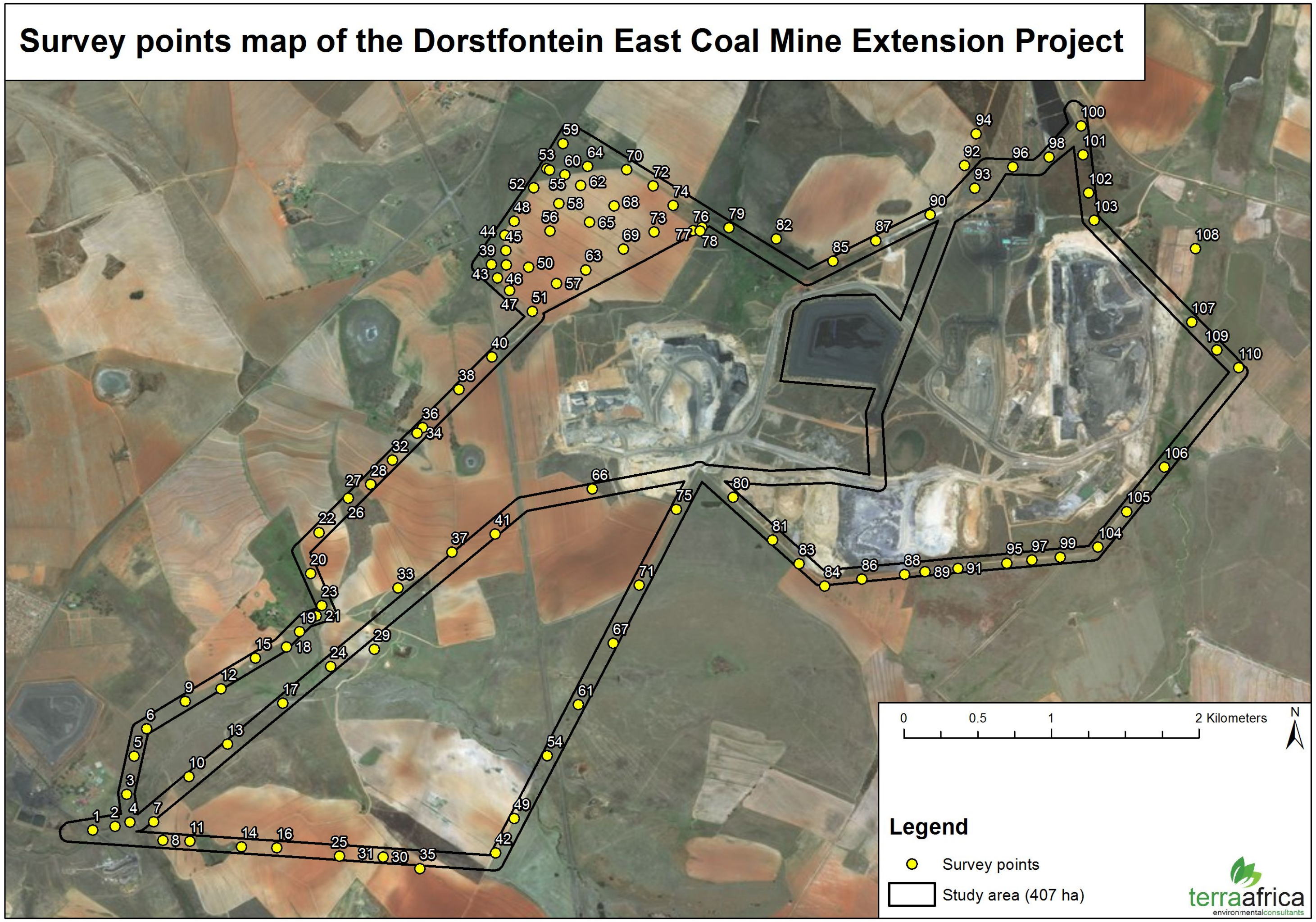

Figure 2: Survey points map of the Dorstfontein East Coal Mine Extension Project

8.4 *Land capability classification*

Land capability classes were determined using the guidelines outlined in Section 7 of The Chamber of Mines Handbook of Guidelines for Environmental Protection (Volume 3, 1981). The Chamber of Mines pre-mining land capability system was utilised, given that this is the dominant capability classification system used for the mining industry. **Table 1** indicates the set of criteria as stipulated by the Chamber of Mines to group soil forms into different land capability classes.

Table 2: Pre-Mining Land Capability Requirements

Criteria for Wetland	➢ Land with organic soils or ➢ A horizon that is gleyed throughout more than 50 % of its volume and is significantly thick, occurring within 750mm of the surface.
Criteria for Arable Land	➢ Land, which does not qualify as a wetland, ➢ The soil is readily permeable to the roots of common cultivated plants to a depth of 750mm, ➢ The soil has a pH value of between 4,0 and 8.4, ➢ The soil has a low salinity and SAR, ➢ The soil has a permeability of at least 1,5-mm per hour in the upper 500-mm of soil ➢ The soil has less than 10 % (by volume) rocks or pedocrete fragments larger than 100-mm in diameter in the upper 750-mm, ➢ Has a slope (in %) and erodibility factor (K) such that their product is <2.0, ➢ Occurs under a climatic regime, which facilitates crop yields that are at least equal to the current national average for these crops, or is currently being irrigated successfully.
Criteria for Grazing Land	➢ Land, which does not qualify as wetland or arable land, ➢ Has soil, or soil-like material, permeable to roots of native plants, that is more than 250-mm thick and contains less than 50 % by volume of rocks or pedocrete fragments larger than 100-mm, ➢ Supports, or is capable of supporting, a stand of native or introduced grass species, or other forage plants, utilizable by domesticated livestock or game animals on a commercial basis.
Criteria for Wilderness Land	➢ Land, which does not qualify as wetland, arable land or grazing land.

9. Baseline conditions

9.1 *Soil forms present in the study area*

Eighteen different soil forms were identified within the study area (**Figure 3**). Below follows a description of each of these soil forms:

<u>Arcadia (14.4 ha of the baseline study area)</u>

These dark brown to black vertic soils have deep A-horizons (80 cm deep on site) and are high in clay content with swelling-shrinking properties under conditions of water content changes. These expansive materials have a characteristic appearance: structure is strongly developed, ped faces are shiny, and consistence is highly plastic when moist and sticky when wet. The swell-shrink potential is manifested typically by the formation of conspicuous vertical cracks in the dry state and the presence, at some depth, of slickensides (polished or grooved glide planes produced by internal movement). The Arcadia soils on site have high grazing potential and very palatable, nutritious (sweet) grazing occurs on these soils.

<u>Avalon form (52.1 ha of the baseline study area)</u>

The Avalon soil form consists of an orthic A horizon (20 to 45 cm deep on study site) on a yellow-brown apedal B horizon overlying a red-mottled, soft plinthic B at a depth of 70 to 140 cm deep at different survey points on the study site. The yellow-brown apedal B horizon has structure that is weaker than moderate blocky or prismatic in the moist state. Avalon soil has usually a loamy texture with moderate organic matter status and is well drained. It is usually acidic and extremely low in bases. Phosphate status is low and P sorption capacity is moderate to high. Dolomitic lime would be needed to achieve good crop yields and fertilizer containing Zn would also be advisable. The soil is highly suited to dry land crop production, subject to appropriate chemical amelioration.

<u>Bainsvlei (7.5 ha of the baseline study area)</u>

The Bainsvlei soil form consists of an orthic A horizon overlying a red apedal B horizon that is underlain by soft plinthite. Red soil colours in both the moist and dry states dominate the colouration of this horizon. The depth of the orthic A horizons of the Bainsvlei profiles surveyed on site was 35 cm and the restrictive layers of soft plinthite that have signs of wetness were found from 120 cm deep. The oxides present in this soil form (it belongs to a larger group of oxidic soils) provide a micro-aggregating effect that reduces the dispersibility of fine particles and reduces erosion risk. This makes topsoil stripped from the Bainsvlei soil form highly suitable for land rehabilitation purposes. Bainsvlei soils with no restrictions shallower than 500mm are generally good for crop production and the Bainsvlei soils on site have arable land capability.

Bloemdal soil form (6.5 ha of the baseline study area)

The Bloemdal soil form consists of an orthic A horizon overlying a red apedal B horizon that is underlain by unspecified material with signs of wetness. Red soil colours in both the moist and dry states dominate the colouration of this horizon. The depth of the orthic A horizons of the Bloemdal profiles surveyed on site was 35 cm and the restrictive layers of unspecified material with signs of wetness were found from 120 cm deep.

The oxides present in this soil form (it belongs to a larger group of oxidic soils) provide a micro-aggregating effect that reduces the dispersibility of fine particles and reduces erosion risk. This makes topsoil stripped from the Bloemdal soil form highly suitable for land rehabilitation purposes. Bloemdal soils with no restrictions shallower than 500mm are generally good for crop production.

Bonheim (4.1 ha of the baseline study area)

The Bonheim soil form identified consists of a melanic A horizon (15 cm deep in study area), overlying a pedocutanic B horizon that is distinguished on the basis of an increase in clay as a result primarily of illuviation and accumulation and visually expressed as cutans. These soils are found in the study area in similar topographic positions as vertic soils but commonly are slightly higher upslope. The B horizon of Bonheim soils may have a plasticity index that would qualify it as vertic if it was a topsoil horizon. The melanic A horizon lacks slickensides that are diagnostic of vertic horizons but has structure that is strong enough so that the mayor part of the horizon is not both massive and hard or very hard when dry. The Bonheim soil form on site has grazing land capability and the natural high nutrient content of these soils is ideal as growing medium for sweet grazing.

Clovelly (11.5 ha of the baseline study area)

The Clovelly soil forms consist of a sandy-loam orthic A horizon on a well-drained yellow-brown apedal B horizon overlying unspecified material where limited pedogenesis has taken place. Soil depths of the Clovelly profiles surveyed on site was 100 cm deep. Manganese concretions were observed in less than 5 % of the profile from 100 cm. Clovelly soils with no restrictions shallower than 50 cm are generally good for crop production. The high quality orthic A and yellow-brown apedal B-horizons make it a suitable soil form for annual crop production (good rooting medium) and use as 'topsoil', having favourable structure (weak blocky to apedal) and consistence (slightly firm to friable). The Clovelly soil form is present has arable land capability and is suitable for crop production.

Glencoe form (104.2 ha of the baseline study area)

The Glencoe soil form consists of an orthic A horizon, overlying a yellow brown apedal B horizon on a hard plinthic B. The Glencoe soil form differs from Avalon form only on the basis that the soft plinthic horizon of the Avalon form is replaced by a hard plinthic horizon. Glencoe soil has a moderately high degree of weathering, depletion of bases and no significant acidity, sandy loam structure and a morphology which indicates a fluctuating water table. Available phosphorous (P) is very low. The soil is suited to dryland crop production if the plinthic layer is deeper than 60 cm and appropriate fertilization is done. The depth of the hard plinthic horizon of the Glencoe soils surveyed on site ranges from 50 to 150 cm which makes it suitable for crop production. Only small patches have a depth of 40 cm and less.

Glenrosa form (10.2 ha of the baseline study area)

The Glenrosa soil form consists of an orthic A horizon underlain by a hard lithocutanic B horizon. The lithocutanic B horizon (distinguished from hard rock by not only consistence and degree of weathering but also tonguing and cutanic character) may itself be 'hard or not hard' (Soil Classification Working Group 1991). To be called hard more than 70% must be parent rock, fresh or partly weathered with a hard consistence in the dry, moist and wet states. The cutanic character of the B horizon of the Glenrosa soil form as was visible in open profiles in the study area, take the form of tongues of topsoil extending into the partly weathered parent rock. The Glenrosa soil profiles on site are very shallow and situated on steep slopes. Topsoil stripping for stockpiling will result in very little topsoil to be stored for rehabilitation purposes.

Hutton form (37.9 ha of the baseline study area)

The Hutton soil forms consist of an orthic A horizon on a red apedal B horizon overlying unspecified material. The red apedal soils B1-horizon has more or less uniform "red" soil colours in both the moist and dry states and has weak structure or is structureless in the moist state. The range of red colors that is a key identification tool in differentiating between a red apedal and yellow-brown apedal is defined by the Soil Classification Working Group Book, 1991. Some of the defining red soil colors identified on the sites are bleached (10R 3/6), while some are bright red. The clay content of Hutton soils identified is between 10% and 25%.

Soil depths of the Hutton profiles surveyed on site ranged between 130cm and 150cm and deeper with restrictive layers of unspecified material without signs of wetness. Hutton soils with no restrictions shallower than 50cm are generally good for crop production. All Hutton profiles are structureless or have very weakly developed structure. . The high quality orthic A and red apedal B-horizons make it a suitable soil form for annual crop production (good rooting medium) and use as 'topsoil', having favourable structure (weak blocky to apedal) and consistence (slightly firm to friable). These topsoils are ideal for stripping and stockpiling for rehabilitation purposes for they are deep and have a favourable structure.

Katspruit form (Ka) (3.4 ha of the baseline study area)

The Katspruit soil form identified on the study site consists of an orthic A horizon overlying a non-calcareous G horizon and thus belonging to the Lammermoor family. The A horizon surveyed on site is non-calcareous and enriched with clay in the top 70 mm. It has a dark greyish-brown colour with medium faint grey mottles. The G horizon is saturated with water for long periods and is dominated by grey, low chroma matrix colours. This soil form is associated with wetland land capability and usually indicates the presence of seasonal or permanent wetlands.

Lichtenburg form (29.4 ha of the baseline study area)

The Lichtenburg soil form consists of an orthic A horizon on a red apedal B horizon overlying a hard plinthic horizon. The surface horizon is typically poorly structured and becomes easily degraded by cultivation. Low organic matter content and lack of iron oxides can lead to poor water infiltration and hard setting problems which call for judicious tillage and careful management of crop residues. The Lichtenburg soil form identified on site has a depth of 60cm overlying the hard plinthic horizon which makes the soil form suitable for summer crop production on the Highveld, because the upper solum drains freely while the plinthic horizon dams water within the lower part of the profile from where it can be tapped by crop roots during dry spells.

Longlands form (13.6 ha of the baseline study area)

The Longlands soil form consists of an orthic A horizon (15 cm to 30 cm on study site) overlying an E horizon that is underlain by a soft plinthic B horizon. A fluctuating water table has resulted in the accumulation of ferric oxides sufficient to form the soft plinthic B horizon in the lower part of what would otherwise have been a thick E horizon. Intermittent wetness may limit productivity in wetter seasons although in drier years the plinthic horizon could function as a reservoir for deep rooted crops. The Longlands soil form has a moderately high degree of weathering, depletion of bases and moderate acidity and a sandy loam texture. Groundwater vulnerability would be high in the case of pollution. Lateral discharge through the E and B horizons would result in the toe slope reception area being affected by a plume of polluted water.

Oakleaf (9.3 ha of the baseline study area)

The Oakleaf soil form consists of an orthic A horizon of 80 cm deep, overlying a neocutanic B horizon on unspecified material. The neocutanic horizon has non-uniform colouring and cutans and channel infillings area visible. Oakleaf soils have high agricultural production potential and are rather well-drained permitting that the rainfall and slope allows crop production. The fine sandy loam will be prone to both wind and water erosion when vegetation cover is removed or when stripped and stockpiled during mining activities. The Oakleaf soil on site has grazing land capability.

Tukulu (10 ha of the baseline study area):

The Tukulu soil form was only found on a small portion of land on the far eastern side of the Booysendal study area. This soil form consists of an orthic A horizon of 35 cm deep, overlying a neocutanic B horizon that is underlain by unspecified materials with signs of wetness. The neocutanic horizon has non-uniform colouring and cutans and channel infillings area visible. Tukulu soils have high agricultural production potential and are rather well-drained permitting that the rainfall and slope allows crop production. The fine sandy loam will be prone to both wind and water erosion when vegetation cover is removed or when stripped and stockpiled during mining activities. The Tukulu soil on site has arable land capability.

Wasbank form (8.2 ha of the baseline study area):

The Wasbank soil form consists of an orthic A horizon on an E horizon overlying a hard plinthic B horizon. The E horizon is essentially a greyish horizon which is usually paler in colour than the overlying topsoil, is loose, friable and non-plastic in the moist state and has a very weakly developed structure. The genesis of this horizon has not been the same everywhere. In the case of the Wasbank soil form it lies abruptly on a B horizon which is considerably less permeable. Here a temporary build-up of water above the B horizon occurs after rain and discharge occurs in a predominantly lateral direction. This phenomenon can be very beneficial for crop production during drier seasons. The profiles of the Wasbank soil form augered on site have depths of 40 cm to 80 cm before the hard plinthite horizon was reached. The suitability of the Wasbank soils on the study site ranges thus from marginally to highly suitable for crop production.

Witbank (68.2 ha of the baseline study area)

The Witbank soil form has been found in portions of land across the study area that has already been impacted upon by mining activities. Witbank is the only soil form that describes the anthropic group of soils in South Africa. Anthropic soils are those soils that have been so profoundly affected by human disturbance that their natural genetic character (i.e. their link to the natural factors of soil formation) has largely been destroyed or has had insufficient time to express itself. The areas where the Witbank form occurs have wilderness land capability.

9.2 Soil chemical conditions of the study area

9.2.1 Soil fertility

The pH of the majority of the analyzed soil samples in the study area ranges from 4.33 (extremely acid) to 6.39 (slightly acid). For successful crop production, a pH of between 5.8 and 7.5 is optimum and crops produced in soils with lower pH may suffer aluminium (Al) toxicities if toxic levels of Al are present. The danger of Al toxicity in maize only exists when the pH (KCl) is lower than 4.5. Even under these low pH levels, Al toxicity may not prevail. The pH of the soil can be improved by the addition of dolomitic lime or gypsum. However, this process is costly and adds to production costs of crops.

Phosphorus levels are low to sufficient (ranging between 1 mg/kg in the veld and 130 mg/kg P in the crop fields). The clay plus silt content in the top 150 mm of the soil ranges between 20% and 44% in the majority of the topsoil samples taken. For crop production optimum extractable P levels in the soil according to Bray 1 are 25.1 mg/kg for soils with a clay plus silt content of 20% and 17.2 mg/kg P for soils with a clay plus silt content of 40%. The calcium and magnesium levels are higher than what is adequate for crop plants but is not considered as toxic. The potassium levels are higher than what are adequate at all sampling points. The balance between these three cations can be corrected with chemical fertilizer.

The soil chemistry of the samples analysed indicate that soil at the project site has the chemical suitability for crop production. Intensive annual crop production would however require proper fertilization as soil nutrients should be balanced and will get depleted.

No serious soil chemical issues such as soil salinity or sodicity occur on site. Where the sodium (Na) concentration is more than 15% of the sum of all cations, crop production may be impaired. The sodium concentration at all the sampling points were sufficiently low except for one sampling point (DF07 and DF08) where both topsoil and subsoil samples have concentrations above 15% (20.53% and 16.32% respectively).

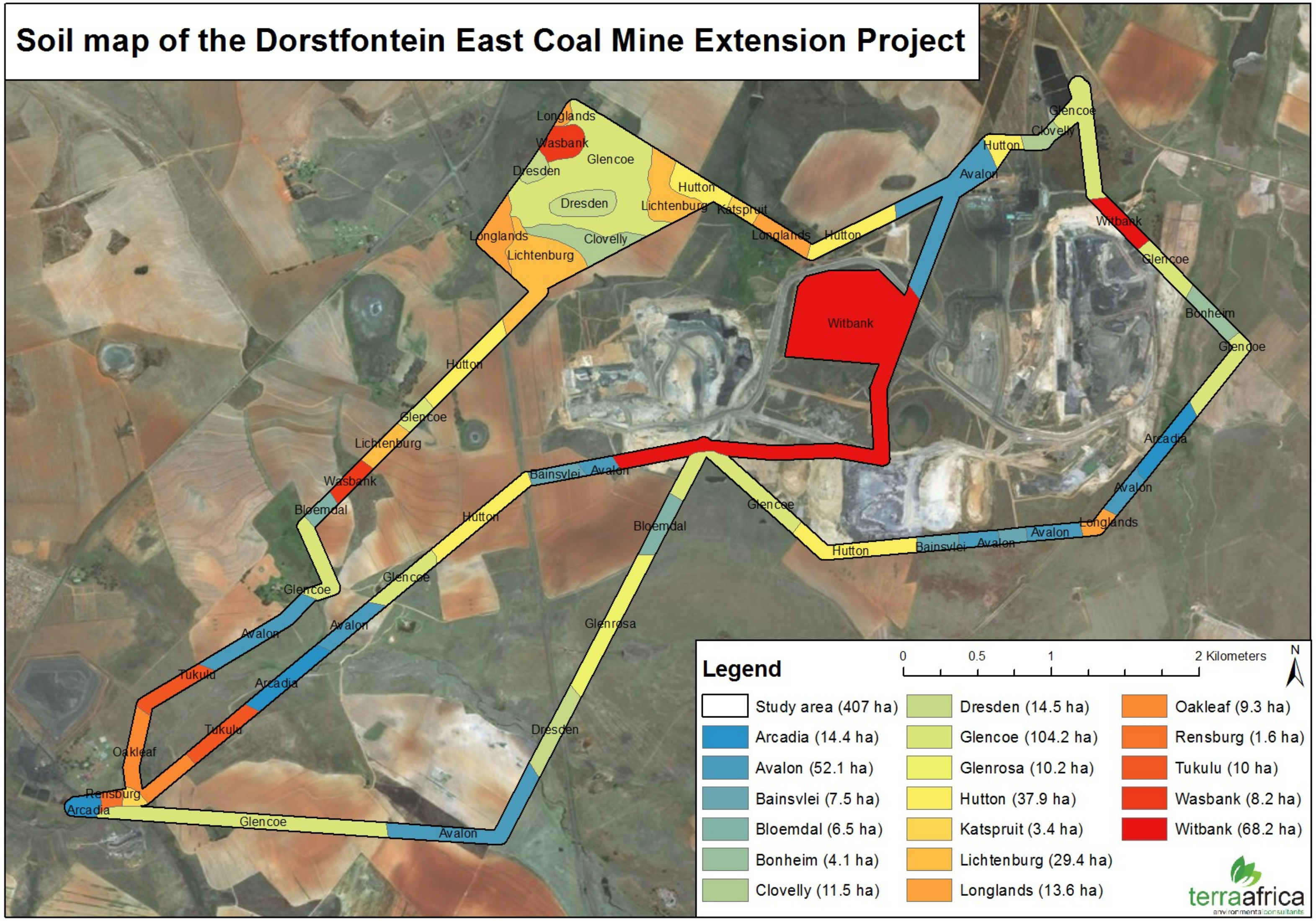

Figure 3: Soil map of the Dorstfontein East Coal Mine Extension Project

Table 3: Soil fertility analysis report

Lab No	Reference no	pH(KCl)	Bray I	K	Na	Ca	Mg	%Ca	%Mg	%K	%Na	EC
		-	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	%	%	%	mS/m
60540	DF03 Top	5,31	30	135	8	403	122	59,35	29,55	10,13	0,97	78,40
60541	DF04 Sub	5,48	2	66	7	370	141	57,76	36,00	5,26	0,98	52,40
60542	DF05 Top	4,33	130	150	6	239	53	56,94	20,74	18,33	1,27	38,10
60543	DF06 Sub	4,28	2	86	7	227	45	59,31	19,25	11,43	1,68	30,10
60544	DF07 Top	5,64	8	600	1485	2553	1305	40,58	34,01	4,88	20,53	7,59
60545	DF08 Sub	6,39	1	209	769	1236	1273	30,16	50,91	2,61	16,32	53,90

Lab No	Reference no	Ca:Mg	(Ca+Mg)/K	Mg:K	S-Waarde	Na:K	T	Density	S AmAC	Clay	Silt	Sand	C (Walkley-Black)
		1.5-4.5	10.0-20.0	3.0-4.0	cmol(+)/kg	-	cmol(+)/kg	g/cm3	mg/kg	%	%	%	%
60540	DF03 Top	2,01	8,78	2,92	3,40	0,10	3,40	1,32	9,12	10	17	73	0,24
60541	DF04 Sub	1,60	17,84	6,85	3,20	0,19	3,20	1,07	34,37	22	19	59	0,10
60542	DF05 Top	2,75	4,24	1,13	2,04	0,07	2,10	1,42	12,71	10	15	75	0,20
60543	DF06 Sub	3,08	6,87	1,68	1,75	0,15	1,91	1,17	59,91	20	16	64	0,03
60544	DF07 Top	1,19	15,28	6,97	31,45	4,21	31,45	0,96	1918,83	36	19	45	4,94
60545	DF08 Sub	0,59	31,01	19,48	20,49	6,24	20,49	1,24	426,77	36	18	46	0,34

9.2 *Agricultural potential*

9.2.1 Dryland crop production

The largest part of the study site is currently used for crop production. All the soil forms encountered at the study site are suitable and highly suitable for crop production with the exception of the Katspruit, Rensburg, Longlands, Dresden and Arcadia soil forms. The annual precipitation of 650 to 900 mm is sufficient for successful maize production. The plinthic soils such as Avalon, Glencoe and Lichtenburg are prized by maize farmers on the Highveld because the plinthic layer dams water in the lower profile which can be used by maize roots during periods of drought.

9.2.2 Irrigated crop production

The study site did not have any current irrigation infrastructure that was being used for irrigation purposes. No large dams with irrigation potential have been observed on site. The soil forms identified on the site have medium suitability for irrigated crop production as the presence of phreatic water in soil forms such as Avalon, Longlands and Glencoe may prove problematic during high rainfall years when dry land production methods will suffice. Although the establishment of irrigation infrastructure requires high initial capital investment, the site has potential for this production method should it ever become a future land use possibility.

9.2.3 Cattle farming

The grazing capacity of a specified area for domestic herbivores is given either in large animal unit per hectare or in hectares per large animal unit. One large animal unit is regarded as a steer of 450kg whose weight increases by 500g per day on veld with a mean energy digestibility of 55%.

The grazing capacity of the veld around the study area is 5 to 6 hectares per large animal unit or large stock unit (LSU) according to Morgenthal *et al.* (2004) in a report to the Institute for Soil, Climate and Water of the ARC. Areas where the wetland soils are dominant (Katspruit, Rensburg and Longlands soil forms) and where high clay content impedes drainage (Arcadia soil form) are more suitable for cattle farming than crop production.

Cattle farming is a viable long-term land use of certain parts of the site as long as the field quality is maintained by never exceeding the grazing capacity. Land use after decommissioning of the project should aim to re-establish the cattle farming potential of the land.

9.3 Land use and surrounding land use

The entire subject property and its immediate surrounds can be broadly defined as Eastern Highveld Grassland. The land use on the study area can be defined as crop production and a smaller part as livestock farming. Some 44% of the Eastern Highveld Grassland in which the study area falls is transformed primarily by cultivation, plantations, mines, urbanization and by building of dams. Cultivation may have had a more extensive impact, indicated by land-cover data.

Cattle farming will be a viable post mining land use of the site as long as the field quality is maintained by never exceeding the grazing capacity. Post-mining land use should aim to re-establish the cattle farming potential of the land.

9.4 Land capability

Following the classification system above in Section 8.4, the soil and land types identified in the study area could all be classified into four different land capability classes. Deeper soils of the Bloemdal, Glencoe, Hutton, Lichtenburg, Clovelly and Avalon soil forms have arable land capability which could also have been suitable for irrigated crop production should irrigation water and infrastructure be available. The Katspruit, Longlands and Rensburg soil forms indicates areas of seasonal to permanent wetness in the study area and has wetland land capability. Soil of the Witbank form has wilderness land capability since it has already been significantly altered by mining activities and the potential of this land to be used for agriculture after rehabilitation is very limited.

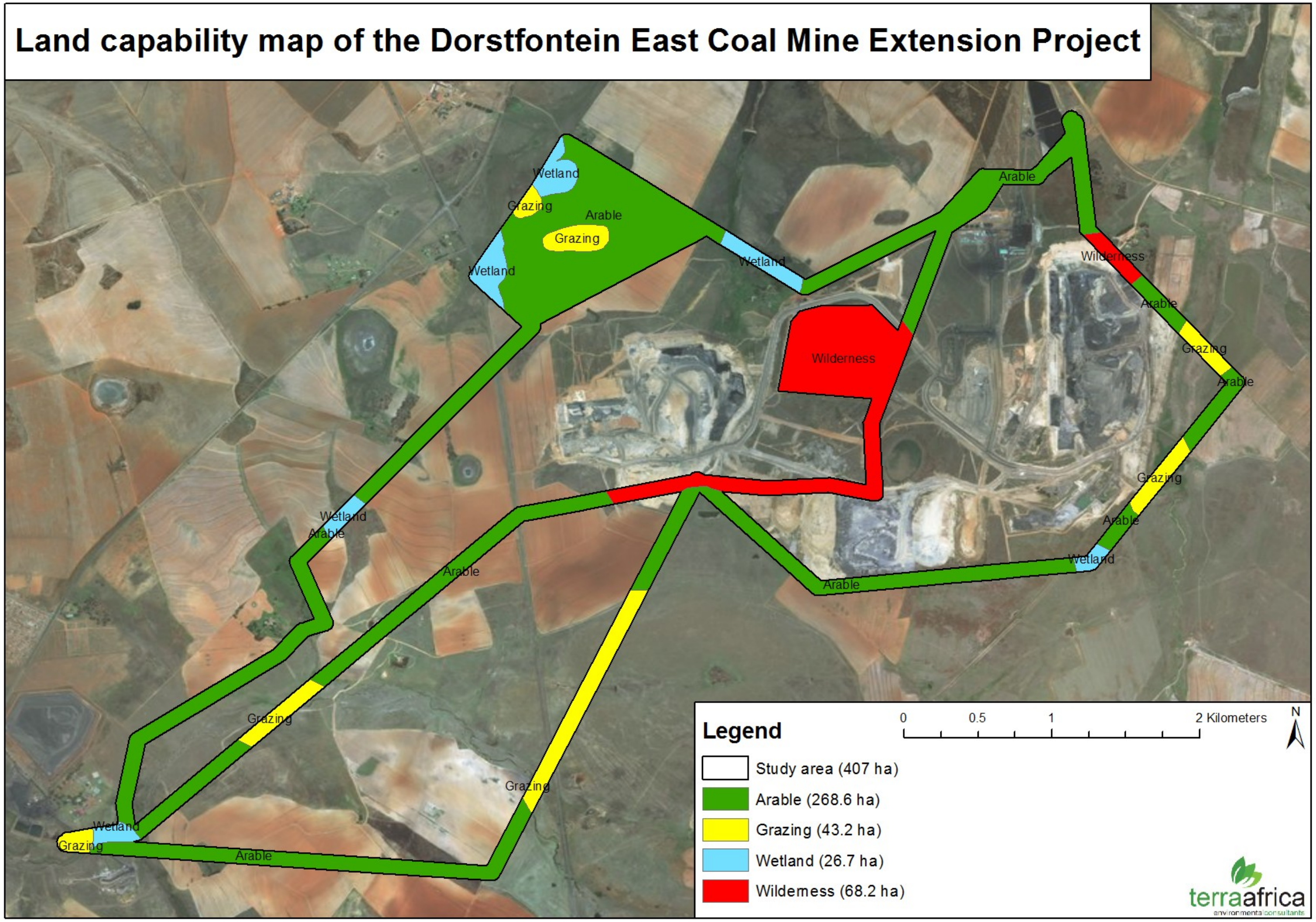

Figure 4: Land capability map of the Dorstfontein East Coal Mine Extension Project

10. Impact assessment

10.1 Assessment methodology

The first stage of risk/impact assessment is the identification and definition of environmental activities, aspects and impacts. This is supported by the identification of receptors and resources, which allows for an understanding of the impact pathway and an assessment of the sensitivity to change. The definitions used in the impact assessment are presented below.

- An activity is a distinct process or task undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or infrastructures that are possessed by an organisation.
- An environmental aspect is an 'element of an organizations activities, products and services which can interact with the environment'[1]. The interaction of an aspect with the environment may result in an impact.
- Environmental risks/impacts are the consequences of these aspects on environmental resources or receptors of particular value or sensitivity, for example, disturbance due to noise and health effects due to poorer air quality. In the case where the impact is on human health or well-being, this should be stated. Similarly, where the receptor is not anthropogenic, then it should, where possible, be stipulated what the receptor is.
- Receptors can comprise, but are not limited to, people or human-made systems, such as local residents, communities and social infrastructure, as well as components of the biophysical environment such as wetlands, aquifers flora and palaeontology.
- Resources include components of the biophysical environment.
- Impacts on the environment can lead to changes in existing conditions; the impacts can be direct, indirect or cumulative.
- Direct impacts refer to changes in environmental components that result from direct cause-effect consequences of interactions between the environment and project activities.
- Indirect impacts result from cause-effect consequences of interactions between the environment and direct impacts.
- Cumulative impacts refer to the accumulation of changes to the environment caused by human activities.

[1] The definition has been aligned with that used in the ISO 14001 Standard.

- Aspects and impacts associated with the proposed development have been differentiated into construction and operation phases of the project.

The aspects and impacts identified will be described according to the following:

- Spatial scope refers to the geographical scale of the impact and will take account of the physical extent of the aspect, receptor and proposed impact as well as the nature of the baseline environment within the area of impact.
- Duration refers to the length of time over which the stressor will cause a change in the resource or receptor.
- Severity refers to the degree of change to the baseline environment in terms of the reversibility of the impact; sensitivity of receptor to stressor; duration of impact (increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards and objectives.
- Frequency of activity refers to how often the proposed activity will take place.
- Frequency of impact refers to the frequency with which a stressor (aspect) will impact on the receptor.

The significance of the impact is then assessed by rating each variable numerically according to the defined criteria. Refer to the table below. The purpose of the rating is to develop a clear understanding of influences and processes associated with each impact. The severity, spatial scope and duration of the impact together comprise the consequence of the impact and when summed can obtain a maximum value of 15. The frequency of the activity and the frequency of the impact together comprise the likelihood of the impact occurring and can obtain a maximum value of 10. The values for likelihood and consequence of the impact are then read off a significance rating matrix and are used to determine whether mitigation is necessary[2]. This matrix provides a rating on a scale of 1 to150 (low, medium low, medium high or high) based on the consequence and likelihood of an environmental impact occurring.

The assessment of significance is undertaken twice. Initial significance is based on only natural and existing mitigation measures (including built-in engineering designs). The subsequent assessment takes into account the recommended management measures required to mitigate the impacts. Measures such as demolishing infrastructure, and reinstatement and rehabilitation of land, are considered post-mitigation.

[2] Some risks/impacts that have low significance will however still require mitigation

The impact assessment model outcome of the impacts was then assessed in terms of impact certainty and consideration of available information to be in line with international best practice guidelines in instances of uncertainty or lack of information by increasing assigned ratings or adjusting final model outcomes. In certain instances where a variable or outcome requires rational adjustment due to model limitations, the model outcomes have been adjusted.

Table 4: Criteria for Assessing Significance of Impacts

SEVERITY OF IMPACT (magnitude)	RATING
Insignificant / non-harmful	1
Small / potentially harmful	2
Significant / slightly harmful	3
Great / harmful	4
Disastrous / extremely harmful	5

SPATIAL SCOPE OF IMPACT (Extent)	RATING
Activity specific	1
Area specific	2
Whole site/plant/mine	3
Regional	4
National	5

DURATION OF IMPACT (temporal scale)	RATING
One day to one month	1
One month to one year	2
One year to ten years	3
Life of operation	4
Post closure / permanent	5

CONSEQUENCE

FREQUENCY OF ACTIVITY / DURATION OF ASPECT	RATING
Annually or less / low	1
6 monthly / temporary	2
Monthly / infrequent	3
Weekly / life of operation / regularly / likely	4
Daily / permanent / high	5

FREQUENCY OF IMPACT	RATING
Almost never / almost impossible	1
Very seldom / highly unlikely	2
Infrequent / unlikely / seldom	3
Often / regularly / likely / possible	4
Daily / highly likely / definitely	5

LIKELIHOOD (Probability)

Table 5: Interpretation of impact rating

Consequence

Likelihood														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
3	6	9	12	15	18	21	24	27	30	33	36	39	42	45
4	8	12	16	20	24	28	32	36	40	44	48	52	56	60
5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
6	12	18	24	30	36	42	48	54	60	66	72	78	84	90
7	14	21	28	35	42	49	56	63	70	77	84	91	98	105
8	16	24	32	40	48	56	64	72	80	88	96	104	112	120
9	18	27	36	45	54	63	72	81	90	99	108	117	126	135
10	20	30	40	50	60	70	80	90	100	110	120	1	140	150

	High	76 to 150	Improve current management
	Medium High	40 to 75	Maintain current management
	Medium Low	26 to 39	
	Low	1 to 25	No management required

SIGNIFICANCE = CONSEQUENCE x LIKELIHOOD

10.2 Impact assessment per project phase

10.2.1 Construction phase

During the construction phase, all infrastructure and activities required for the operational phase will be established. The main envisaged activities include the following:

- Transport of materials and labour with trucks and buses as well as other light vehicles using the existing access roads. This will compact the soil of the existing roads and fuel and oil spills from vehicles may result in soil chemical pollution.
- Earthworks will include clearing of vegetation from the surface, stripping topsoil (soil excavation) and stockpiling as well as drilling and blasting for the initial removal of overburden at the planned open cast pit as well as the construction of the pipeline. These activities are the most disruptive to natural soil horizon distribution and will impact on the current soil hydrological properties and functionality of soil. It will also change the current land use as well as land capability in areas where activities occur and infrastructure is constructed.
- Other activities in this phase that will impact on soil are the handling and storage of building materials and different kinds of waste. This will have the potential to result in soil pollution when not managed properly.

The disturbance of original soil profiles and horizon sequences of these profiles during earthworks is considered to be a measurable deterioration. This impact is considered to be permanent but will be localised within the site boundary. This impact is possible and will have moderate significance. Even though topsoil management is described in the Soil Management Plan (SMP), the impact will still have moderate significance as it is impossible to re-create original soil profile distribution.

Soil chemical pollution as a result of potential oil and fuel spillages from vehicles, is considered to be a moderate deterioration of the soil resource. This impact will be localised within the site boundary and have moderate significance on the soil resource when not managed. However, with proper waste management and immediate clean-up, the significance of this impact can be reduced to low (Soil Management Plan).

Soil compaction will be a measurable deterioration that will occur as a result of the heavy vehicles commuting on the existing roads as well as any new haul roads constructed for this project. This is a permanent impact that will be localised within the site boundary with moderate consequence and significance.

Soil erosion is also anticipated due to slopes and vegetation clearance. The impacts of soil erosion are both direct and indirect. The direct impacts are the reduction in soil quality which results from the loss of the nutrient-rich upper layers of the soil and the reduced water-holding capacity of severely eroded soils. The off-site indirect impacts of soil erosion include the disruption of riparian ecosystems and sedimentation. Soil erosion is a permanent impact for once the resource has been lost from the landscape it cannot be recovered. Although there are off-site indirect impacts associated with this, the impact is mainly considered to be local. The consequence and significance of the impact is considered as high. With proper mitigation measures and the embedded controls as recommended in the Soil Management Plan, it is anticipated that the significance of this impact can be reduced to moderate.

In areas of permanent changes such as road upgrades, the sinking of open pits and the erection of infrastructure and stockpiles, the current land capability and land use will be lost permanently.

10.2.2 Operational phase

The operational phase includes all the processes associated with the mining of the coal as well as the daily management of the mine and related activities. The main envisaged operational activities that will impact on soil, land use and land capability include the following:

- Open pits and surface infrastructure will both lead to surface impacts on soil resources. Surface infrastructure like haul roads and product stockpiles are by far the most disruptive to current land uses, land capability as well as agricultural potential of the soil. Soil underneath buildings and stockpiles are subject to compaction and sterilization of the topsoil;
- Daily traffic on roads for inspection and maintenance of infrastructure;
- Daily mining activities in different areas of the proposed project and
- Loading and hauling of coal at the product stockpiles and transporting it to distribution points.

The disturbance of original soil profiles and horizon sequences of these profiles is considered to be a measurable deterioration. This impact is considered to be permanent but will be localised within the site boundary. This impact is possible and will have moderate significance when unmanaged.

Soil chemical pollution as a result of pollutants leaching into subsurface soil horizons under the product stockpile, is considered to be a moderate deterioration of the soil resource. This impact will be localised within the site boundary and have moderate significance on the soil resource.

Soil compaction will be a measurable deterioration that will occur as a result of the weight of the topsoil and overburden stockpiles stored on the soil surface as well as the movement of vehicles on the soil surfaces (including access and inspection roads). This is a permanent impact that will be localised within the site boundary with medium consequence and significance in the mitigated scenario.

During the operational phase, topsoil stockpiles as well as roads running down slopes will still be susceptible to erosion. Soil surfaces with infrastructure such as concrete slabs and buildings will not be exposed to erosion any longer. This is a permanent impact that will be localized within the site boundary with medium consequence and significance. With proper mitigation measures and the embedded controls as recommended in the Soil Management Plan, it is anticipated that the significance of this impact will remain moderate. Taking the relatively high rainfall in the area and the slope of the terrain in consideration it is unlikely that soil erosion will have low significance.

The current land capability and land use of areas with active mining will be lost temporarily. However, the land capability and land use of areas where infrastructure will be decommissioned can be restored through mined land rehabilitation techniques.

10.2.3 Decommissioning and rehabilitation phase

Decommissioning and rehabilitation can be considered a reverse of the construction phase with the demolition and removal of the majority of infrastructure and activities very similar to those described with respect to the construction phase.

- Transport of materials away from site. This will compact the soil of the existing roads and fuel and oil spills from vehicles may result in soil chemical pollution.
- Earthworks will include redistribution of inert waste materials to fill the open pits as well as topsoil to add to the soil surface. These activities will not result in further impacts on land use and land capability but may increase soil compaction.
- With the decommissioning phase, soil surfaces are in the process of being replanted with indigenous vegetation and until vegetation cover has established successfully, all surfaces are still susceptible to potential soil erosion.
- Other activities in this phase that will impact on soil are the handling and storage of materials and different kinds of waste generated as well as accidental spills and leaks with decommissioning and rehabilitation activities. This will have the potential to result in soil pollution when not managed properly.

Soil chemical pollution as a result of potential oil and fuel spillages from vehicle, is considered to be a moderate deterioration of the soil resource. This impact will be localised within the site boundary and have moderate significance on the soil resource when not managed. However, proper waste management and immediate clean-up, the significance of this impact can be reduced to low (**Soil Management Plan**).

Soil compaction will be a measurable deterioration that will occur as a result of the heavy vehicles. This is a long-term impact because soil ripping will only alleviate compaction in surface soil layers and have little to no effect on deeper soil compaction. Soil compaction will be localised within the site boundary with medium consequence and significance in the unmitigated scenario.

Successful re-vegetation of all denuded areas with indigenous vegetation can reduce the significance of erosion to low.

10.2.4 Post - Closure phase

The post-closure phase occurs after the cessation of all decommissioning activities. Relevant closure activities are those related to the after care and maintenance of remaining structures. It is assumed that all mining activities and processing operations will have ceased by the post-closure phase of the mining project. The potential for impacts during this phase will depend on the extent of demolition and rehabilitation efforts during decommissioning and on the features that will remain, such as upgraded roads.

There will be no further impacts on soil during the post-closure phase.

11. Soil Management Plan

The purpose of the Soil Management Plan (SMP) is to ensure the protection of soils and maintenance of the terrain of the Dorstfontein East Coal Mine extension area footprint during the construction, operational, decommissioning and rehabilitation, as well as the post-closure phases. The plan contains methods that will be used to prevent adverse effects as well as a monitoring plan to assess potential effects during construction, operation, decommissioning and closure.

The objectives of the SMP are to:

- Address the prevention, minimisation and management of erosion, compaction and chemical soil pollution during construction, operations, decommissioning and closure;
- Describe soil stripping and stockpiling methods that will reduce the loss of topsoil;

- Define requirements and procedures to guide the Project Management Team and other project contractors;
- Define monitoring procedures.

11.1 Soil management during the construction phase

From the perspective of conserving the soil properties that will aid mine rehabilitation during the closure and rehabilitation phase, the key factors to consider during the preparation for the construction phase of the mining project are to minimise the area affected by the development, minimise potential future contact of toxic or polluting materials with the soil environment and to maximise the recovery and effective storage of soil material that will be most useful during the rehabilitation process after mining is complete. Some of these measures will minimise a combination of impacts simultaneously while other measures are specific to one impact.

11.1.1 Minimise mining infrastructure footprint

The existing pre-construction mine layout and design is aiming to minimise the area to be occupied by mine infrastructure (workshops, administration, product stockpile, etc.) to as small as practically possible. All footprint areas should also be clearly defined and demarcated and edge effects beyond these areas clearly defined. This measure will significantly reduce areas to be compacted by heavy construction vehicles and regular activities during the operational phase.

11.1.2 Management and supervision of construction teams

The activities of construction contractors or employees will be restricted to the planned areas. Instructions must be included in contracts that will restrict construction work and construction workers to the clearly defined limits of the construction site. In addition, compliance to these instructions must be monitored.

11.1.3 Location of stockpiles

Locate all topsoil stockpiles in areas where they will not have to be relocated prior to replacement for final rehabilitation. Refrain from locating stockpiles as close as possible to the extraction point for cost saving only to have it relocated later during the life of mine. The ideal is to place all overburden materials removed at mine opening in their final closure location, or as close as practicable to it.

11.1.4 Topsoil stripping

Wherever possible, stripping and replacing of soils should be done in a single action. This is both to reduce compaction and also to increase the viability of the seed bank contained in the stripped surface soil horizons.

11.1.5 Stockpiling of topsoil

To minimise compaction associated with stockpile creation, it is recommended that the height of stockpiles be restricted between of 4 – 5 metres maximum. For extra stability and erosion protection, the stockpiles may be benched.

11.1.6 Demarcation of topsoil stockpiles

Ensure all topsoil stockpiles are clearly and permanently demarcated and located in defined no-go areas. As the mining will last over several years it is important to have well defined maps of stockpile locations that correlate with these demarcated areas as re-vegetated stockpiles may easily be mistaken for something else. These areas should be maintained for rehabilitation purposes and topsoil should never be used as a filling material for roads, etc.

11.1.7 Prevention of stockpile contamination

Topsoil stockpiles can be contaminated by dumping waste materials next to or on the stockpiles, contamination by coal dust from product stockpile and the pumping out of contaminated water from the underground mine or pits are all hazards faced by stockpiles. This should be avoided at all cost and if it occurs, should be cleaned up immediately.

11.1.8 Terrain stability to minimise erosion potential

Management of the terrain for stability by using the following measures will reduce the risk of erosion significantly:

- Stripping of topsoil should not be conducted earlier than required (maintain vegetation cover for as long as possible) in order to prevent the erosion (wind and water) of organic matter, clay and silt.

- Reducing slope gradients as far as possible along road cuts and disturbed areas to gradients at or below the angle of repose of those disturbed surfaces; and
- Using drainage control measures and culverts to manage the natural flow of surface runoff.
- Soil stockpiles must be sampled, ameliorated (if necessary) and re-vegetated as soon after construction as possible. This is in order to limit raindrop and wind energy, as well as to slow and trap runoff, thereby reducing soil erosion.

11.1.9 Management of access and haulage roads

Existing established roads should be used wherever possible. Where possible, roads that will carry heavy-duty traffic should be designed in areas previously disturbed rather than clearing new areas, where possible. The moisture content of access road surface layers must be maintained through routine spraying or the use of an appropriate dust suppressant.

Access roads should be designed with a camber to avoid ponding and to encourage drainage to side drains; where necessary, culverts should be installed to permit free drainage of existing water courses. The side drains of the roads can be protected with sediment traps and/or gabions to reduce the erosive velocity of water during storm events and where necessary geo-membrane lining can be used.

11.1.10 Prevention of soil contamination

During the construction phase, chemical soil pollution should be minimised as follows:

- Losses of fuel and lubricants from the oil sumps and steering racks of vehicles and equipment should be contained using a drip tray with plastic sheeting filled with absorbent material;
- Using biodegradable drilling fluids, using lined sumps for collection of drilling fluids, recovering drilling muds and treating them off-site, and securely storing dried waste mud by burying it in a purpose-built containment area;
- Avoiding waste disposal at the site wherever possible, by segregating, trucking out, and recycling waste;
- Containing potentially contaminating fluids and other wastes; and
- Cleaning up areas of spillage of potentially contaminating liquids and solids.

11.2 Soil management during the operational phase

Soil management should be an on-going strategy through the operational phase as soil disturbing activities will continue in areas where mining continues and new areas are developed through mining activities.

It is recommended that concurrent rehabilitation techniques be followed to prevent topsoil from being stockpiled too long and losing its inherent fertility but opportunities may be limited by the geometry of the coal seams. Historical borrow pits and other disturbed sites must be rehabilitated as soon as they have reached the end of their life.

As new stockpiles are created, they should be re-vegetated immediately to prevent erosion and resulting soil losses from these stockpiles. It is recommended that vegetation removed during land clearance be composted during the operational phase and that this compost be used as a soil ameliorant for soil rehabilitation purposes.

All above soil management measures explained under the Construction Phase should be maintained for similar activities during the Operational Phase. In addition to this, the following Soil Management Measures are recommended:

- The vegetative (grass) cover on the soil stockpiles (berms) must be continually monitored in order to maintain a high basal cover. Such maintenance will limit soil erosion by both the mediums of water (runoff) and wind (dust).
- Drains and intercept drains must be maintained so that it continues to redirect clean water away from the operating plants, and to convey any potentially polluted water to pollution control dams.
- Routine monitoring will be required in and around the sites.

11.2.1 Managing potential soil contamination during the operational phase

The following management measures will either prevent or significantly reduce the impact of soil chemical pollution on site during the operation phase:

- Stockpiles are managed so they do not become contaminated and then need additional handling or disposal;
- A low process or storage inventory must be held to reduce the potential volume of material that could be accidentally released or spilled;

- Processing areas should be contained and systems designed to effectively manage and dispose of contained stormwater, effluent and solids;
- Storage tanks of fuels, oils or other chemicals stored are above ground, preferably with inspectable bottoms, or with bases designed to minimise corrosion. Above-ground (rather than in-ground) piping systems should be provided. Containment bunds should be sealed to prevent spills contaminating the soil and groundwater;
- Equipment, and vehicle maintenance and washdown areas, are contained and appropriate means provided for treating and disposing of liquids and solids;
- Air pollution control systems avoid release of fines to the ground (such as dust from dust collectors or slurry from scrubbing systems);
- Solids and slurries are disposed of in a manner consistent with the nature of the material by recognising and avoiding contamination; and
- Effluent and processing drainage systems avoid leakage to ground.

11.3 Soil management during the decommissioning and rehabilitation phase

At decommissioning the open pits will be backfilled and covered with a layer of topsoil. Some re-grading and re-contouring will be carried out. Soil management in the decommissioning phase will include the following:

11.3.1 Management and supervision of decommissioning teams

The activities of decommissioning contractors or employees will be restricted to the planned areas. Instructions must be included in contracts that will restrict decommissioning workers to the areas demarcated for decommissioning. In addition, compliance to these instructions must be monitored.

11.3.2 Infrastructure removal

All buildings, structures and foundations not part of the post-closure land use plan must be demolished and removed from site.

11.3.3 Site preparation

Once the site has been cleared of infrastructure and potential contamination, the slope must be re-graded (slope) in order to approximate the pre-mining aspect and contours. The previous infrastructure footprint area must be ripped a number of times in order to reduce soil compaction. The area must then be covered with topsoil material from the stockpiles.

11.3.4 Seeding and re-vegetation

Once the land has been prepared, seeding and re-vegetation will contribute to establishing a vegetative cover on disturbed soil as a means to control erosion and to restore disturbed areas to beneficial uses as quickly as possible. The vegetative cover reduces erosion potential, slows down runoff velocities, physically binds soil with roots and reduces water infiltration through evapotranspiration. Indigenous species will be used for the re-vegetation, the exact species will be chosen based on research available and then experience as the further areas are re-vegetated.

11.3.5 Prevention of soil contamination

During the decommissioning and rehabilitation phase, chemical soil pollution should be minimised as follows:

- Losses of fuel and lubricants from the oil sumps and steering racks of vehicles and equipment should be contained using a drip tray with plastic sheeting filled with absorbent material;
- Using biodegradable hydraulic fluids and lubricants in vehicles and machinery used during decommissioning and rehabilitation;
- Avoiding waste disposal at the site wherever possible, by segregating, trucking out, and recycling waste;
- Containing potentially contaminating fluids and other wastes; and
- Cleaning up areas of spillage of potentially contaminating liquids and solids.

11.4 Soil management during the closure phase

During the closure phase activities include the maintenance and aftercare of final rehabilitated land. In this regard, frequent visual observations should be undertaken to confirm if vegetation has re-established and if any erosion gullies have developed. In the event that vegetation has not re-established and erosion gullies have developed, remedial action should be taken.

12 Environmental Impact Statement

Almost the entire project site supports crop production with small areas of wetland land capability as well as grazing land capability that have natural vegetation which are suitable for cattle and sheep grazing. The proposed extension of the Dorstfontein East Coal Mine area consisting of a new open pit area and associated infrastructure (including a water pipeline), will impact upon soil and land capability properties as well as current land uses in the areas where the footprint will cause surface disturbance. Cumulative impacts are also related to increase in the surface footprint. These impacts can be reduced by keeping the footprint minimised where possible and strictly following soil management measures pertaining to topsoil stripping, stockpiling and conservation of the soil quality of topsoil stockpiles.

13 A reasoned opinion as to whether the activity should or should not be authorised

The proposed project developments fall within a larger area of coal mining projects intermixed with annual crop production and settlement. The land capability and soil quality of land affected by the surface footprint of mining activities will be compromised; the proposed mining area will impact on current crop production and will therefore affect primary grain production. Even if the mined land is rehabilitated with great care, current rehabilitation practices have not managed to restore the crop production potential of land in South Africa.

Soil management procedures and rehabilitation of the mined land can result in land being rehabilitated to grazing land capability and livestock and game farming may be possible on rehabilitated land after the mining activities have ceased. It is therefore of my opinion that the activity should not be authorized as a result of the loss of arable land in a province where arable land has already severely been compromised. However, should the project be authorised as a result of the economic and social benefits that such a project may bring, it is then highly recommended that the Katspruit, Rensburg and Longlands soil forms on the boundaries of the site be excluded from the area proposed for the mining development as it has wetland land capability that is a valuable natural asset.

It is further recommended that all the soil management measures indicated in this report be added to the Record of Decision (ROD) as part of the requirements.

14 Reference list

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