APPENDIX I: SOILS AND LAND CAPABILITY IMPACT ASSESSMENT REPORT

Report

COZA MINING
JENKINS IRON ORE PROJECT

Soils and Agricultural Potential

By

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Report Number GW/A/2016/08

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Declaration of Independence

I, D.G. Paterson, hereby state that I am a registered Practicing Natural Scientist (*Soil Science* – Registration No. 400463/04) and was responsible for supervising the compilation of this report in an impartial manner to acceptable scientific norms and standards.

Furthermore, I state that both I and ARC-Institute for Soil, Climate and Water are independent of any of the parties involved in this study.

February 2016

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1. TERMS OF REFERENCE

The ARC-Institute for Soil, Climate and Water (ARC-ISCW) was contracted by SLR Consulting (Pty) Ltd to undertake a soil investigation for the proposed Coza Mining (Pty) Ltd Jenkins project located to the south of the town of Kathu in the Northern Cape Province. The purpose of the investigation is to contribute to the Environmental Impact Assessment (EIA) process for the project.

The objectives of the study are;

- To classify the soils in the specified areas
- To assess broad agricultural potential as well as
- Determine the prevailing land capability and land use

With this information, potential impacts on the environment can be assessed and their significance determined.

2. SITE CHARACTERISTICS

2.1 Location

The Jenkins Iron Ore Project is located approximately 25 km south of Kathu on Portions 1 and Remaining Extent of the farm Jenkins 562 as indicated on Figure 1 (shown in blue). The area lies between latitudes 27^{o} 53' and 27^{o} 57' S and between longitudes 22^{o} 57' and 23^{o} 02' E, at the junction of the R27 and R386 roads. The R386 road approximately bisects the area.

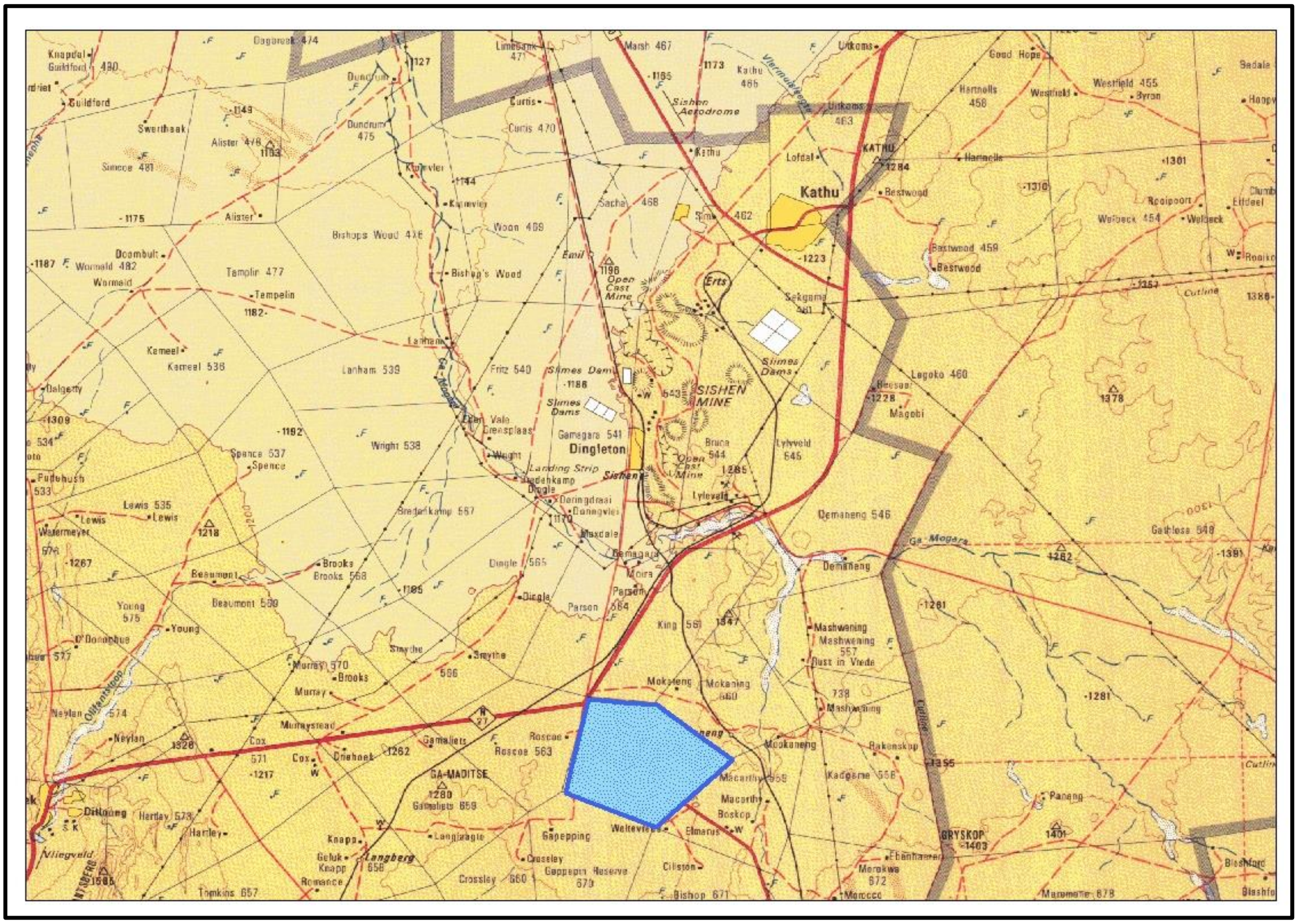


Figure 1 Locality map, Jenkins Project (study area in blue)

2.2 Topography

Most of the area lies at an altitude of between 1 220 and 1 250 m above sea level (mamsl), with flat to gently undulating topography, but in the extreme east of the area, there is a hill with steeper slopes, up to the highest point of 1 365 mamsl.

No surface drainage courses are present, but one or two small isolated pans occur.

2.3 Climate

The climate of the study area (Koch & Kotze, 1986) can be regarded as warm to hot with rain in summer and dry winters. The long-term average annual rainfall in this region of the Northern Cape is only 336 mm. Rainfall is erratic, both locally and seasonally and therefore cannot be relied on for agricultural practices.

Temperatures vary from an average monthly maximum and minimum of 32.0ºC and 17.8ºC for January to 18.2ºC and 2.5ºC for July respectively. The extreme high temperature that has been recorded is 41.6ºC and the extreme low –7.5ºC.

Climate data compiled from various weather stations in a triangle from Kathu in the north to Postmasburg in the south and Olifantshoek in the west, is given in Table 1.

Table 1 Climate data, Jenkins Project

<table>
<tr><th colspan="2" rowspan="2">Month</th><th>Rainfall(mm)
Zone 5S</th><th colspan="5">Temperature(°C)
Zone 5S</th><th colspan="3">Rainfall(mm)
Manganore 38 yr</th></tr>
<tr><th>R̄m</th><th>TX</th><th>TN</th><th>TM</th><th>TXH</th><th>TNL</th><th colspan="3">R̄m</th></tr>
<tr><td colspan="2">Jan</td><td>58.6</td><td>32.0</td><td>17.8</td><td>25.0</td><td>36.7</td><td>11.4</td><td colspan="3">65.1</td></tr>
<tr><td colspan="2">Feb</td><td>59.7</td><td>30.8</td><td>17.1</td><td>24.1</td><td>35.2</td><td>12.4</td><td colspan="3">73.9</td></tr>
<tr><td colspan="2">Mrt</td><td>65.7</td><td>28.4</td><td>15.1</td><td>21.9</td><td>33.0</td><td>8.9</td><td colspan="3">65.1</td></tr>
<tr><td colspan="2">April</td><td>34.7</td><td>25.1</td><td>10.9</td><td>18.0</td><td>29.8</td><td>4.2</td><td colspan="3">46.3</td></tr>
<tr><td colspan="2">May</td><td>15.6</td><td>21.1</td><td>6.4</td><td>13.8</td><td>26.4</td><td>0.2</td><td colspan="3">17.9</td></tr>
<tr><td colspan="2">Jun</td><td>5.6</td><td>18.2</td><td>2.8</td><td>10.5</td><td>22.6</td><td>-2.4</td><td colspan="3">6.9</td></tr>
<tr><td colspan="2">Jul</td><td>2.9</td><td>18.3</td><td>2.5</td><td>10.4</td><td>23.2</td><td>-2.9</td><td colspan="3">3.3</td></tr>
<tr><td colspan="2">Aug</td><td>5.4</td><td>20.9</td><td>4.6</td><td>12.8</td><td>27.0</td><td>-1.3</td><td colspan="3">10.3</td></tr>
<tr><td colspan="2">Sept</td><td>6.2</td><td>24.5</td><td>8.3</td><td>16.4</td><td>31.1</td><td>1.3</td><td colspan="3">6.9</td></tr>
<tr><td colspan="2">Oct</td><td>17.1</td><td>27.8</td><td>12.1</td><td>20.0</td><td>34.0</td><td>4.4</td><td colspan="3">21.7</td></tr>
<tr><td colspan="2">Nov</td><td>26.8</td><td>29.7</td><td>14.9</td><td>22.3</td><td>35.2</td><td>8.6</td><td colspan="3">30.7</td></tr>
<tr><td colspan="2">Dec</td><td>38.1</td><td>31.6</td><td>16.9</td><td>24.3</td><td>36.2</td><td>11.6</td><td colspan="3">43.9</td></tr>
<tr><td>RH</td><td>RL</td><td>R̄</td><td>ETX</td><td>ETN</td><td colspan="3" rowspan="2"></td><td>RH</td><td>RL</td><td>R̄</td></tr>
<tr><td>407.5</td><td>251.7</td><td>336.5</td><td>41.6</td><td>-7.5</td><td>847.2</td><td>174.6</td><td>385.9</td></tr>
</table>

(**Abbrev**. **RH** – highest mean annual rainfall, **RL** – lowest mean annual rainfall, **R̄m** – mean of mean monthly totals, **TX** – mean daily maximum temperature, **TN** – mean daily minimum temperature, **TM** – monthly mean temp., **TXH** – mean monthly max. temp., **TNL** – mean monthly minimum temp., **ETX** – highest maximum temp., **ETN** – lowest minimum temp.)

2.4 Parent Material

The central portion of the area is underlain by andesite of the Ongeluk Formation, Griqualand West Sequence, with shale, flagstone, quartzite and conglomerate of the Gamagara Formation, Postmasburg Group in the east and Quaternary sediments in the south-west (Geological Survey, 1977). The distribution is shown in Figure 2.

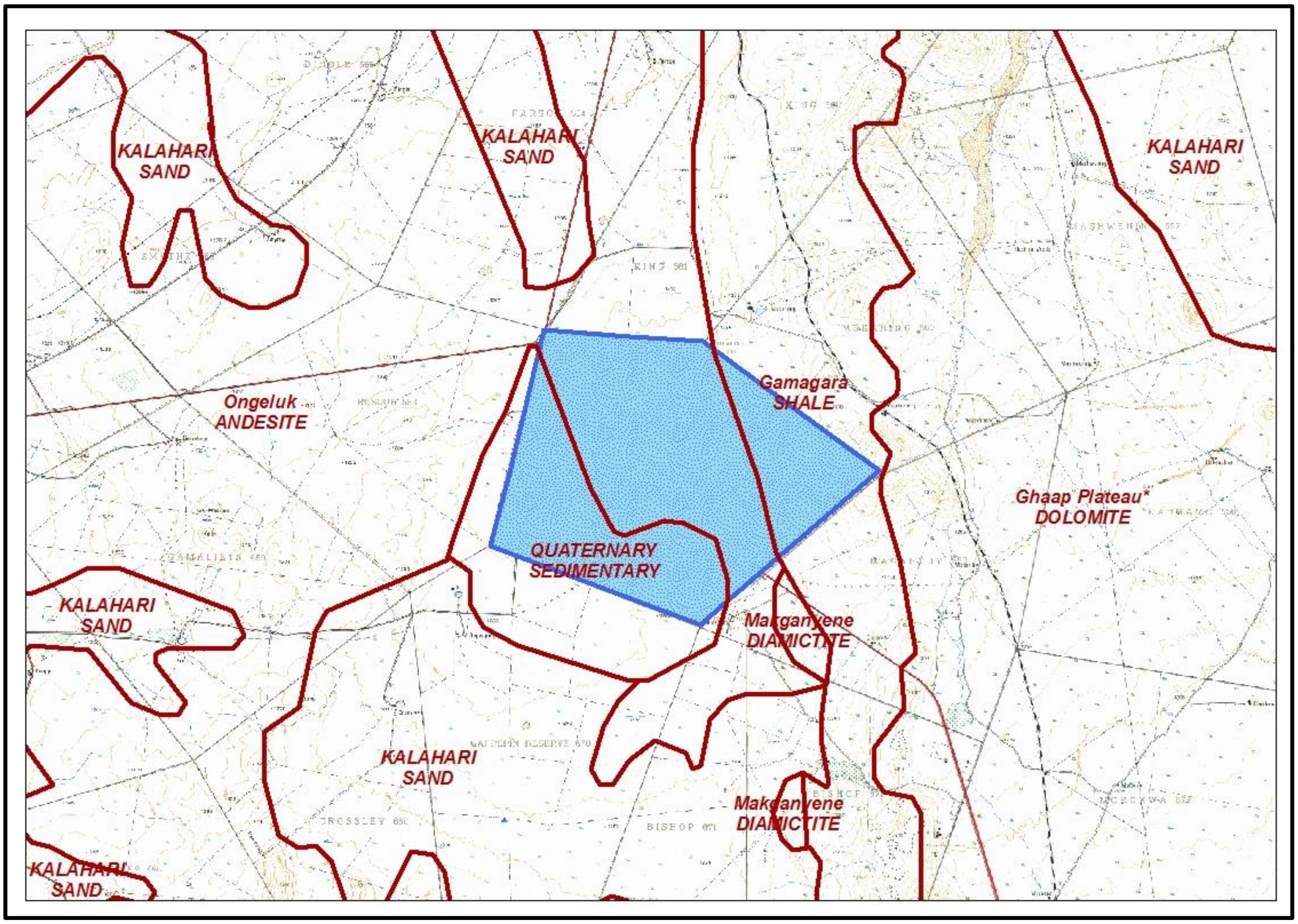


Figure 2 Geology map, Jenkins Project

3. METHODOLOGY

Existing information was obtained from the map sheet 2722 Kuruman (Eloff, Idema & Bennie, 1986) from the national Land Type Survey, published at a scale of 1:250 000. A ***land type*** is defined as an area with a uniform terrain type, macroclimate and broad soil pattern. The soils are classified according to MacVicar *et al* (1977).

The broad study area is covered by the following four land types, as shown on the map in the Appendix 1, namely:

- **Ae12** (Red, freely-drained, structureless soils, high base status)
- **Ag110, Ag111** (Shallow, red, freely-drained, structureless soils, high base status)
- **Ib238** (Rocky areas with shallow soils)

It should be clearly noted that, since the information contained in the land type survey is of a reconnaissance nature, only the general dominance of the soils in the landscape can be given, and not the actual areas of occurrence within a specific land type.

Also, other soils that were not identified due to the scale of the survey may also occur. **The site was not visited during the course of this study, and so the detailed composition of the specific land types has not been ground-truthed.**

A summary of the dominant soil characteristics of each land type is given in Table 2 below (the colours correspond to those used in the map in the Appendix).

The distribution of soils with high, medium and low agricultural potential within each land type is also given, with the dominant class shown in **bold type**.

4. SOILS

A summary of the dominant soil characteristics is given in **Table 2** below.

Table 2 Land types occurring (with soils in order of dominance)

Land Type	Depth (mm)	Dominant soils	Percent of land type	Characteristics	Agric. Potential (%)
Ae12	300-1200	Hutton 30/33	77%	Red, sandy soils, occasionally on hardpan calcrete	High: 0.0 **Mod: 77.4**
	0-300	Hutton 30/33	16%	Red, sandy soils, occasionally on hardpan calcrete	Low: 22.6
Ag110	0-300	Hutton 30/33	55%	Red, sandy soils on hard rock and calcrete	High: 0.0 Mod: 18.5
	0-300	Mispah 10/12	22%	Red-brown, sandy topsoils plus hard rock and calcrete	**Low: 81.5**
Ag111	0-300	Hutton 33/36	43%	Red, sandy/loamy soils on hard rock and calcrete	High: 0.0 Mod: 4.4
	0-250	Mispah 10/12/22	27%	Red-brown, sandy topsoils plus hard rock and calcrete	**Low: 95.2**
Ib238	-	Rock	63%	Exposed rock outcrops	High: 0.0 Mod: 3.2
	0-300	Hutton 30/33	29	Red, sandy soils on rock	**Low: 96.8**

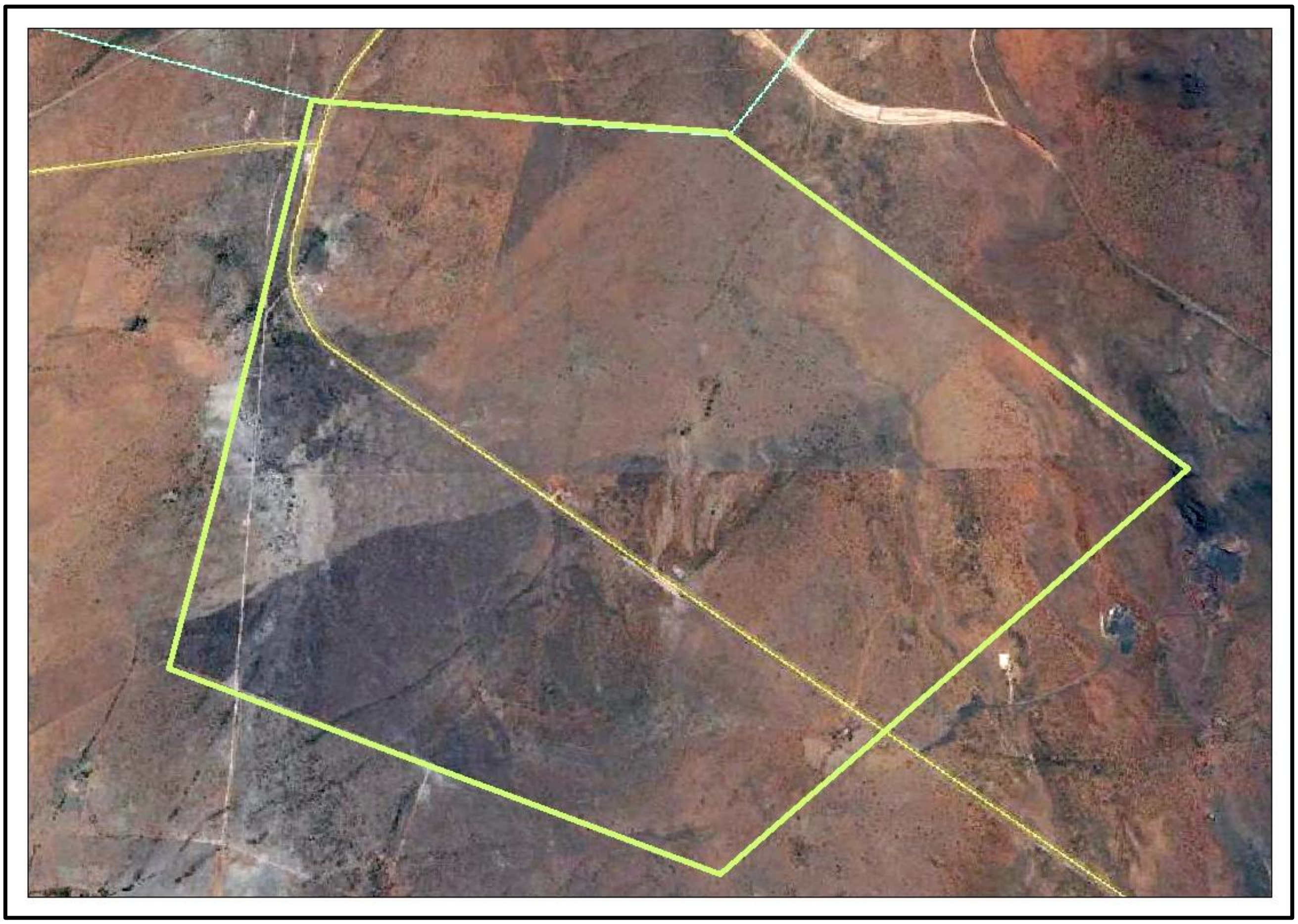
Note: Agricultural Potential, as shown in the right-hand column, refers to ***soil characteristics only*** and no climatic or other restrictions are taken into account.

5. AGRICULTURAL POTENTIAL AND LAND CAPABILITY

5.1 Agricultural potential

The main limiting factor that influences the agricultural potential rating is the combination of much shallow soil with the low average annual rainfall.

The Google Earth image (Figure 2) shows little or no agricultural activity in



the area and no evidence of irrigation.

Figure 2 Google Earth image of study area

Accordingly, the agricultural potential for the survey area is low. The only agricultural activities that would be expected to occur would be livestock and/or game farming. The average grazing capacity for this area is low, namely approximately 22-25 ha per animal unit and the long-term annual average NDVI (Normalized Difference Vegetation Index) is moderate to low (Schoeman & van der Walt, 2004).

5.2 Land Capability

The Land capability system for South Africa (Schoeman *et al.,* 2002, was used to obtain a general idea of the land capability and land use for this area.

The study area falls within land capability class VII, with land use options largely restricted to grazing, woodland or wildlife.

> **Concept:** Land in class VII has very severe limitations that make it unsuited to cultivation and that restrict use largely to grazing, woodland or wildlife; restrictions are more severe than those for Class VI because of one or more continuing limitations that cannot be corrected, such as very steep slopes, erosion, **shallow soil, stones**, wet soils, salts or sodicity and **unfavourable climate**.

6 IMPACTS AND SENSITIVITIES

6.1 Assumptions and limitations

The main limitation is that the soil information provided is at 1:250 000 scale, and has not been ground-truthed. However, the existing reconnaissance information, supported by the climatic characteristics of the area, indicate that this is a low potential area for agriculture. A previous study in the nearby vicinity (Paterson & Oosthuizen, 2013) did involve a ground-truthing phase, where the field study confirmed that the soils were generally very limiting for agriculture. It can be expected that the same situation will exist in the area covered by this report.

6.2 Impacts

The main potential impact will not be the loss of agricultural land, mainly due to the low prevailing agricultural potential. However, whenever any excavation or other surface disturbance is involved, the possibility of increased erosion, either by wind or water, exists.

6.3 Mitigation

Mitigation measures will include the requirement that any removal of surface vegetation be restricted to as small a footprint as possible. In addition, due to the wind erosion hazard in this area (sandy topsoils – see Table 2), wind protection measures should be taken wherever possible. Such measures will potentially include windbreaks (either natural vegetation or constructed (fencing, netting etc) perpendicular to the direction of the prevailing wind, and may need to be undertaken with the cooperation of an engineering specialist.

Regular monitoring (approximately every 6 months) should be carried out across all areas of mining activity. This can be done visually, but any signs of soil loss by wind or water, should be reported in order that preventative measures can be taken before any problem becomes worse.

Within the broader study area, there are ***no specific sensitive areas*** that need to be avoided, in terms of the soils or agricultural potential.

7 CONCLUSIONS

Taking the above-mentioned factors into account, the general agricultural potential rating is low, which agrees with the land capability rating of Class VII. The main adjacent land use activities are livestock grazing and mining that is confined to the nearby hills.

The overall impacts on the soils of the area are expected to be moderate to low due to the current land use as well as the fact that the survey area does not constitute an area of high agricultural potential. The impacts of previous mining activities on the soil will, however, require that adequate mitigation and management measures to be put in place.

It is the opinion of the author that there is no reason why the proposed activity should not be authorized, in terms of the soils occurring or their associated agricultural potential.

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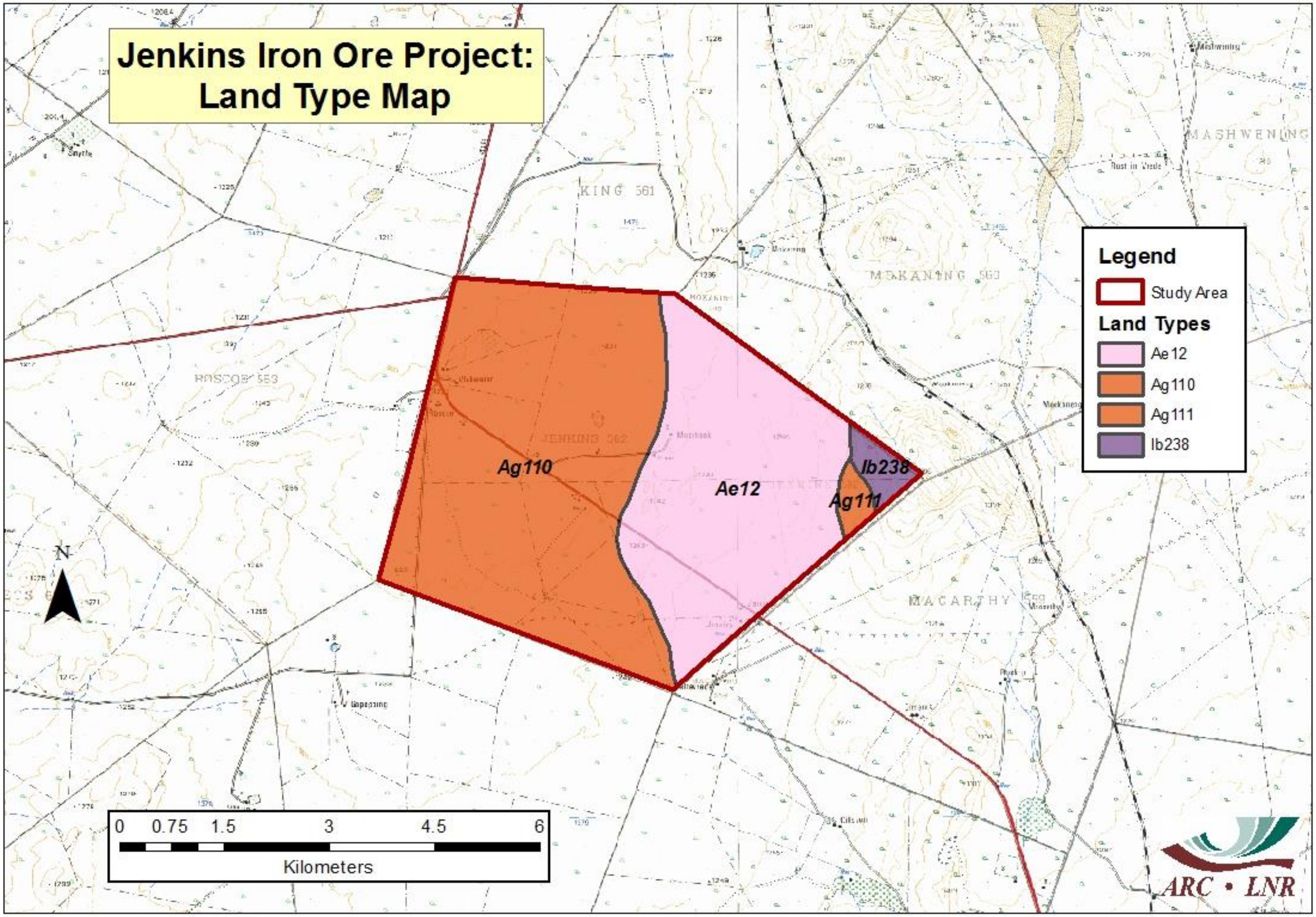
APPENDIX 1

LAND TYPE MAP


Jenkins Iron Ore Project:
Land Type Map
Legend
Study Area
Land Types
Ae12
Ag110
Ag111
Ib238
Ag110
Ae12
Ag111
Ib238
KING 561
ROSCOE 563
JENKINS 562
MOKANING 563
MACARTHY 559
MASHWENING
N
0 0.75 1.5 3 4.5 6
Kilometers
ARC • LNR

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PROFESSIONAL CAREER:

- 1981-1987: Soil Scientist: Soil and Irrigation Research Institute, Pretoria
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FIELDS OF SPECIALITY AND COMPETENCE:

- Soil classification and mapping
- Soil interpretations
- Soil survey project management
- Environmental assessment
- Soil survey and land capability course presentation
- Ground penetrating radar

PUBLICATIONS (see attached list):

- Three refereed articles (S.A. Journal of Plant and Soil)
- Nine Congress papers/posters
- S.A. Soil Classification (1991) (Member of working group)
- Seven 1:250 000 Land Type Maps
- Three Land Type Memoirs
- More than 200 soil survey reports and/or maps

COURSES COMPLETED:

- Course in Project Management (University of Stellenbosch)
- Course in Junior Personnel Management (Dept of Agriculture)
- Course in Handling of Grievances and Complaints (Dept of Agriculture)
- Course in Marketing (ARC-ISCW)
- Course in National Qualifications Framework Assessment, ARC-CO
- Training Course in Ground Penetrating Radar (GSSI, USA)
- Introduction to ArcGIS 8, GIMS, 2004

PROFESSIONAL STATUS:

- Registered Natural Scientist: Soil Science (SA National Council for Natural Scientific Professions) – registration number 400463/04
- Member of South African Soil Classification Working Group, 1990-present
- Convenor of South African Soil Classification Working Group, 2013-
- Member of Soil Science Society of South Africa (1982-present)
- President of Soil Science Society of South Africa (2005-2007)
- Member of South African Soil Survey Organisation (2000-present)
- Council Member of South African Soil Survey Organisation (2002-2003)
- Member of International Erosion Control Association
- Scientific Referee, S.A. Journal for Plant and Soil
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AWARDS:

Best article on Soil Science, South African Journal for Plant and Soil, 2011

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- Editor, Soil Science Society newsletter, 1993-present
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- Soil survey investigations at: Roodeplaat, Kathu, Steelpoort River, Palala River, Zeekoegat (Roodeplaat), Limpopo River, Lydenburg, Kendal, Clewer Sand (Witbank), Botha Sand (Witbank), Balmoral Colliery, Bafokeng (Rustenburg), Towoomba (Warmbaths), Hoeveld Stene (Middelburg), Quality Bricks (Witbank), Visagie Sand (Middelburg), Rosslyn, Coalbrook (Sasolburg), Stewart Coal (Delmas), Forzando Coal

(Hendrina), Vaalgro (Vereeniging), Ratanda (Heidelberg), Elspark (Boksburg), Thorncliffe Mine (Steelpoort), Jan Smuts Quarry (Boksburg), Ennerdale (Phase I & II), Thokoza, North Riding, Natalspruit (Alberton), Arnot, Kroondal (Phase I & II), Ga-Rankuwa, Hartebeespoort Dam, Kosmos, Assen, Grasmere, Magalies Moot (Pretoria), Valpre (Paulpietersburg), Cargo Carriers (Sasolburg), Waterval (Rustenburg), Rayton, Bronkhorstspruit, Zwavelpoort (Pretoria), Pietersburg, Trojan Mine (Steelpoort), Platinum Highway (Rustenburg), Moutse, Centurion, Salique (Klaserie), Northam, Greenside Colliery (Witbank), South Deep Mine (Westonaria), Bank Colliery, Steelpoort Platinum, Gautrain Route (Pta/Jbg), Rietspruit Mine (Ogies), Potgietersrus Platinum, Atok Mine (Lebowa), Blue Ridge Mine (Groblersdal), Ngodwana, Estancia (Breyton), Twickenham Mine (Steelpoort), Marikana.