February 2013

BIO-PHYSICAL SPECIALIST REPORT

PROPOSED CAMDEN ASH FACILITY: BIOPHYSICAL (SURFACE WATER, SOILS, LAND CAPABILITY AND TERRESTRIAL ECOLOGY) SPECIALIST STUDIES

Proponent: Eskom Holdings Limited

Prepared by: Zitholele Consulting

BIOPHYSICAL REPORT

Project 12670

PURPOSE OF THIS DOCUMENT

Eskom is the South African utility that generates, transmits and distributes electricity. Eskom supplies about 95% of the country's electricity, and about 60% of the total electricity consumed in Africa. Eskom plays a major role in accelerating growth in the South African economy by providing a high-quality supply of electricity.

Eskom is currently operating Camden Power Station as part of its electricity generation fleet. Throughout the operational life of the station, ash is generated. This ash is being disposed of in an authorised ash disposal site within the Camden Power Station premises.

The current ash disposal site has been providing disposal services for the last 44 years. This ash disposal site is now reaching the end of its life and as of the middle of 2014 a new ash disposal facility will be required.

To address this situation Eskom wants to construct a new ash disposal facility at the Camden Power Station. The construction of a waste disposal site is a listed activity in terms of Section 24(5) of the National Environmental Management Act (NEMA), as well as the National Environmental Waste Act, and therefore requires environmental authorisation from the Department of Environmental Affairs (DEA).

Eskom has appointed Zitholele Consulting (Pty) Ltd, an independent company, to conduct an Environmental Impact Assessment (EIA) to evaluate the potential environmental and social impacts of the proposed project. As part of the EIA several specialist studies have to be undertaken. This report details the findings of the biophysical specialist assessments including surface water, wetlands, soils and land capability, terrestrial ecology and the visual impact.

TABLE OF CONTENTS

SECTION PAGE

LIST OF FIGURES

LIST OF APPENDICES

LIST OF TABLES

1 INTRODUCTION

1.1 Project Background

Eskom is currently operating Camden Power Station as part of its electricity generation fleet. Throughout the operational life of the station, ash is generated. This ash is being disposed of in an existing ash disposal site within the Camden Power Station premises.

The current ash disposal site has been providing disposal services for the last 44 years. This ash disposal site is now reaching the end of its life and as of the middle of 2014 a new ash disposal facility will be required.

In order to establish a new ash disposal site within close proximity to the power station property and the current site, a site selection exercise in line with the Minimum Requirements for the Disposal of Waste by Landfill, Draft 3rd edition 2005 was undertaken to identify the most feasible site alternatives (only guideline document that covers site selection). Three main alternative sites were identified (please refer to Figure 1-1).

1.1.1 Alternative 1

Alternative 1 is located to the northwest of the current ash disposal site stretching from Camden village in the east, over the fallow land in the centre and into the farmland in the west.

1.1.2 Alternative 2

Alternative 2 is located to the south of the Camden Power Station on the southern side of the Richards Bay Railway line. The site mostly comprises farmland.

1.1.3 Alternative 3

Alternative 3 is located directly adjacent to Alternative 2 to the southwest of the power station. These alternatives are inside a small catchment sloping back towards De Jagers Pan and the power station. This area is also mostly farm and grazing land.

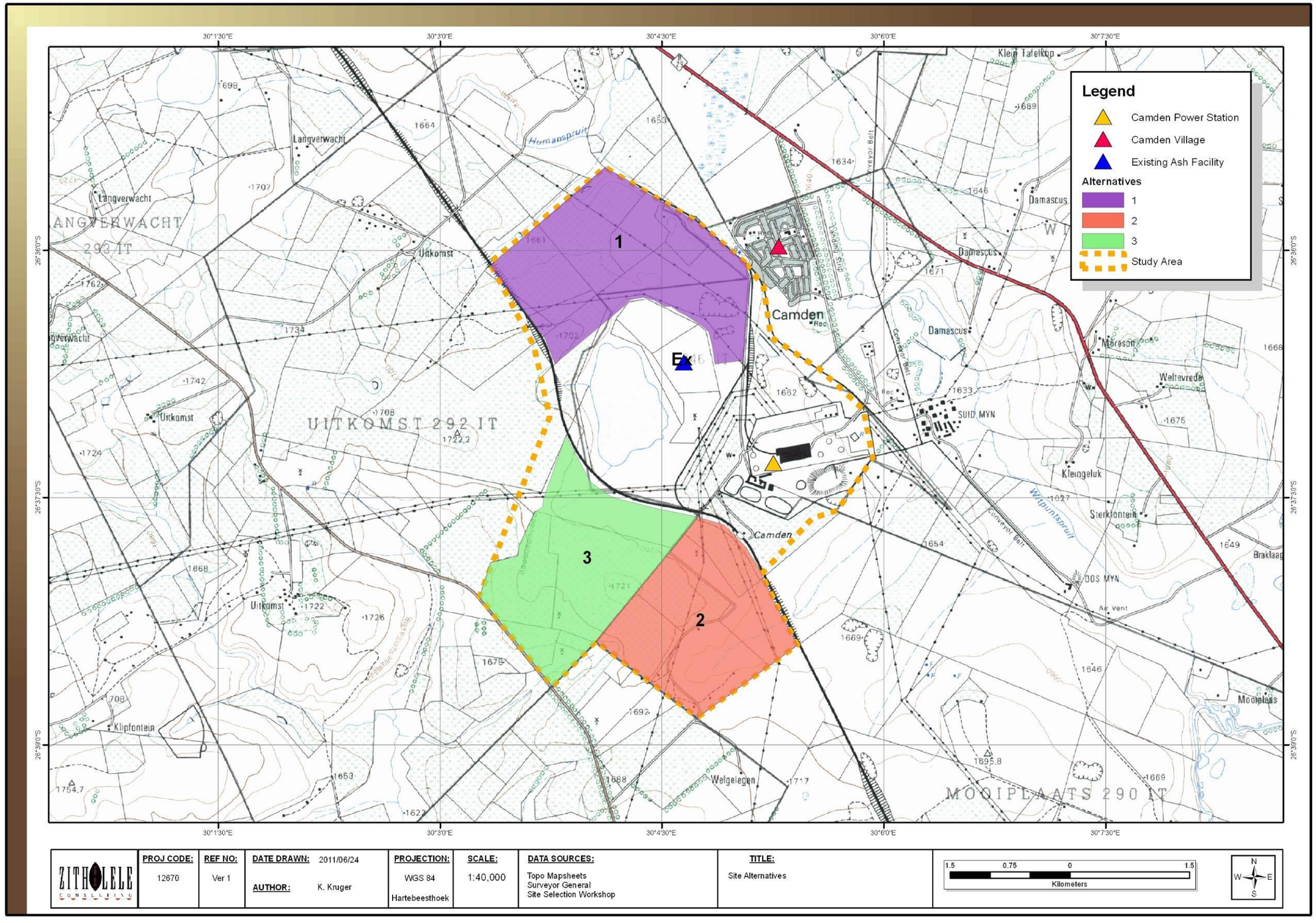


Figure 1-1: Proposed study area and sites for the ash facility.

1.2 Study Scope

Eskom's Generation Division has appointed Zitholele Consulting (Pty) Ltd, an independent company, to conduct an EIA to evaluate the potential environmental and social impacts of the proposed project. As part of the environmental impact assessment for the aforementioned project it is required that certain biophysical specialist investigations are undertaken. Zitholele Consulting undertook the following biophysical specialist studies:

- Topography and Visual Impact;
- Soils and Agricultural Potential;
- Wetland and Riparian Area Delineation; and
- Terrestrial Ecology.

1.3 Study Approach

Zitholele Consulting undertook the aforementioned specialist studies during several site visits conducted from October 2011 – March 2012. The wide spread of site visits during the year were undertaken to obtain a maximum cover of the seasonal variations. The study area encompasses the area delineated on the outer edge of the farm portions that the three alternatives were identified on, as shown in Figure 1-1. Transects were walked through the proposed alternatives, as well as potential infrastructure/services corridors in which wetland, flora, soil, fauna and land use characteristics were sampled.

1.4 Project Personnel

The following project team was involved in the compilation of this report.

Konrad Kruger graduated from the University of Pretoria with a BSc Environmental Science (Majors in Soils Science, Ecology, Geomorphology and Zoology) in 2002 and a BSc Honours in Geography in 2003. He has been involved in a variety of environmental projects in the last six years and has become specialised in undertaking a variety of environmental assessments, audits, environmental plans and specialist studies. He has undertaken a variety of specialist assessments including wetland delineations, ecological assessments, flora assessments, soil and agricultural potential assessments, GIS mapping and modelling and visual assessments. These projects have been completed for clients like Eskom, City Power, Harmony Gold, BHP Billiton, De Beers, Kruger National Park and Xstrata Coal.

1.5 Assumptions and Limitations

The following limitations were encountered during the assessment:

- The southernmost section of the site was not accessable due to landowner objections.

2 TOPOGRAPHY

2.1 Data Collection

The topography data was obtained from the Surveyor General's 1:50 000 toposheet data for the region. Contours were combined from the topographical mapsheets to form a combined contours layer. Using the Arcview GIS software the contour information was used to develop a digital elevation model of the region as shown below.

2.2 Regional Description

The study area ranges from 1,620 mamsl (metres above mean sea level) to 1,760 mamsl. The highest parts of the study area are northern west of the site and the lowest parts are in the south eastern portions of the study area, south of the Vaal River. The topography is undulating with shallow incised valleys where the main watercourses flow. Several pans are found throughout the area, especially on the sandstone geology. Figure 2-1 provides an illustration of the topography of the site.

2.3 Site Description

The overall site drains towards the southeast where the water is intercepted by the Vaal River. The topography at Alternative 1 is relatively flat and rolling, gently sloping to existing site in the south. Alternatives 2 and 3 are located south of the De Jagers Pan, which is a natural pan/depression in the landscape. Both Alternatives 2 and 3 drain northwards to the depression as they are located on relatively steep slopes.

2.4 Sensitivities

Sensitivities associated with the topography are mainly in the form of ridges, which do not occur on any of the alternatives. Other associated impacts include the visibility and drainage of the sites, which will be assessed in more detail in the following sections.

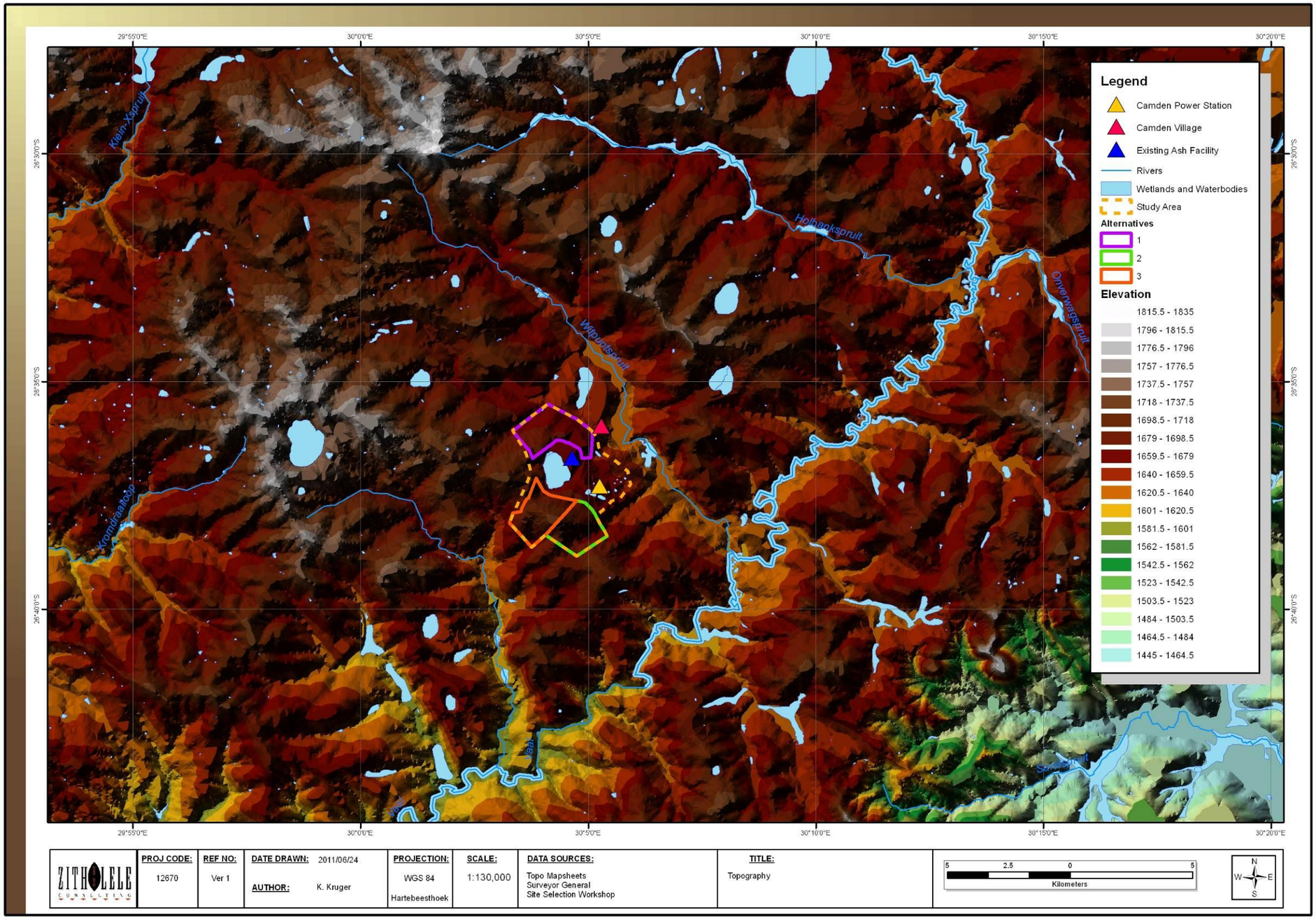


Figure 2-1: Topography of the site

3 SOILS

3.1 Data Collection

The site visit was conducted from October 2011 – February 2012. Soils were augered at 150m intervals over the proposed alternative sites using a 150 mm bucket auger, up to refusal or 1.2 m. Soils were identified according to Soil Classification; a taxonomic system for South Africa (Memoirs on the Natural Resources of South Africa, no. 15, 1991). The following soil characteristics were documented:

- Soil horizons;
- Soil colour;
- Soil depth;
- Soil texture (Field determination);
- Wetness;
- Occurrence of concretions or rocks; and
- Underlying material (if possible).

3.2 Regional Description

From the available literature as well as the observations during the site investigation, it is apparent that all three sites are underlain by siltstone, mudstone and sandstone that belong to the Vryheid Formation of the Ecca Group, Karoo Supergroup.

Generally these rocks will decompose in-situ, forming residual soils that may be silty and clayey, with the possibility of expansive soil being present. These soils are often blanketed by a considerable thickness of transported soils of colluvial origin that consist of silty and clayey fine sands.

3.3 Site Description

During the site visit large quantities of soil forms were identified. The soils forms were grouped into management units and are described in detail in the sections below and Figure 3-1 illustrates the location of the soil types. The land capability (agricultural potential) of the abovementioned soil form is described in more detail in Section 3.3.

The management units are broken up into:

- Agricultural Soils;
- Shallow Soils;
- Transitional and Poor Transitional Soils; and
- Disturbed Soils / Hard Rock.

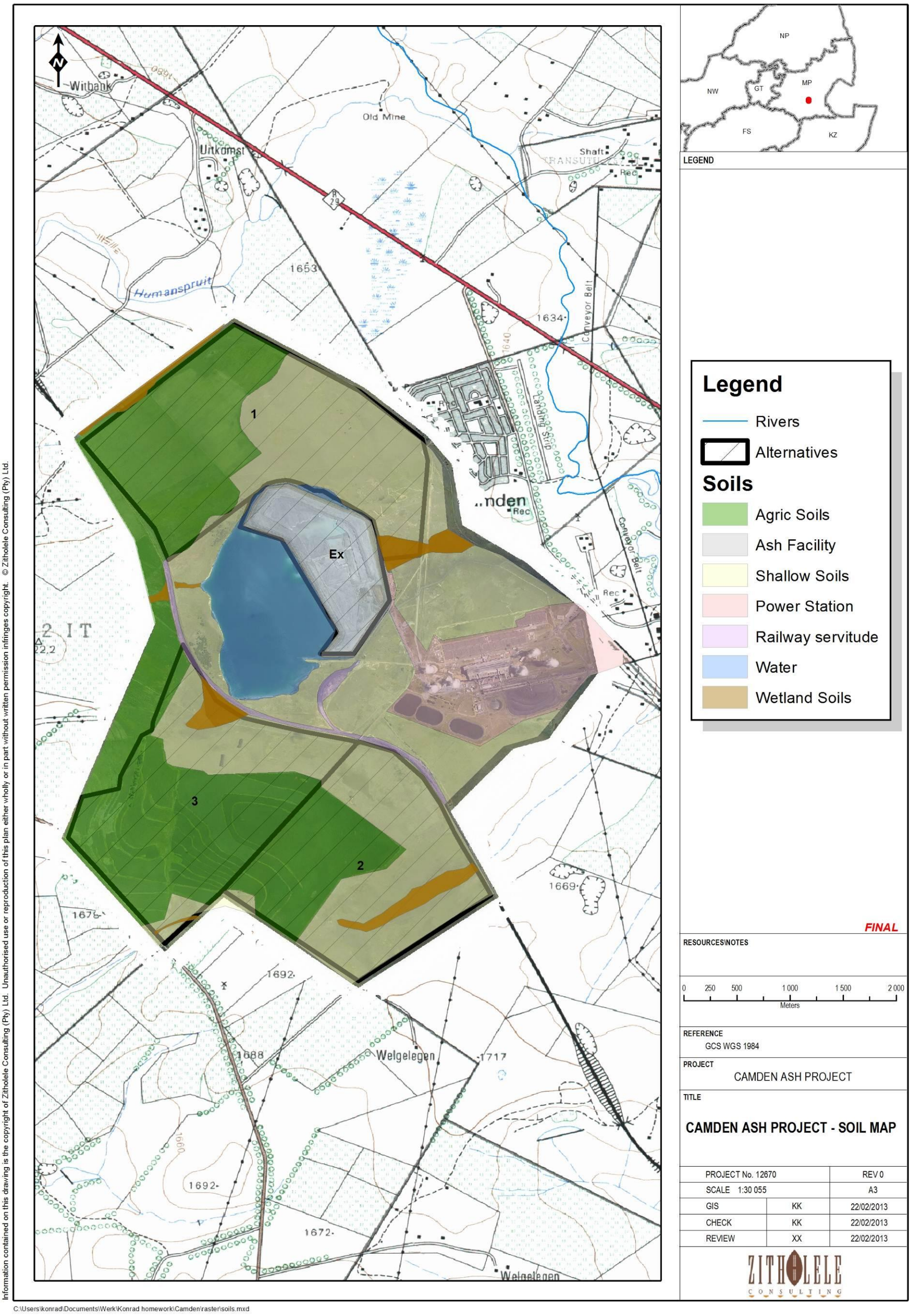


Figure 3-1: Soil Type Map

3.3.1 Shallow (Rocky) Soils

The rocky soils are generally shallow and overlie an impeding layer such as hard rock or weathering saprolite. These soils are not suitable for cultivation and in most cases are only usable as light grazing. The main soil form found in rocky soils was the Mispah and Dresden soil forms as described below.

Mispah soil form

The Mispah soil form is characterised by an Orthic A – horizon overlying hard rock. Mispah soil is horizontally orientated, hard, fractured sediments which do not have distinct vertical channels containing soil material. There is usually a red or yellow-brown apedal horizon with very low organic matter content. Please refer to Figure 3-2 for an illustration of a typical Mispah soil form.

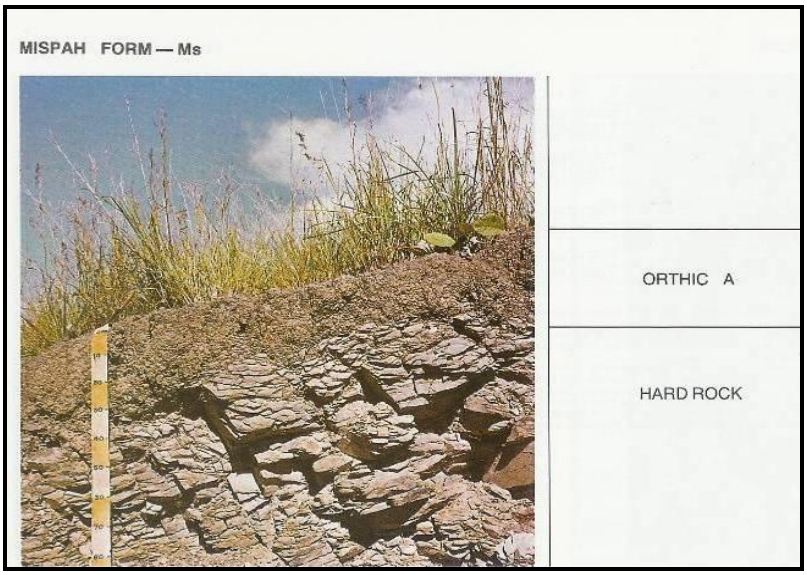


Figure 3-2: Mispah soil form (Soil Classification, 1991).

Dresden Soil Form

The Dresden soil form is typified by an Orthic A-horizon over a Hard Plinthic B-horizon. The Hard Plinthic B-horizon develops when a Soft Plinthic horizon is subjected to a prolonged dry period and the accumulated Fe and Mn colloidal matter hardens, almost irreversibly. This B-horizon has similar characteristics to hard rock and has a very low agricultural potential.

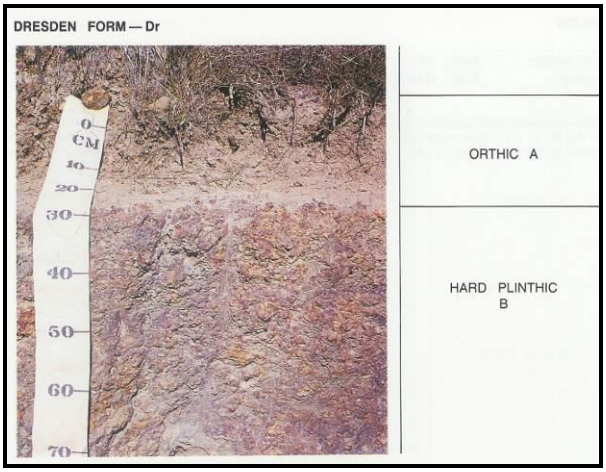


Figure 3-3: Dresden Soil Form (Soil Classification, 1991).

3.3.2 Agricultural Soils

The agricultural soils found on site support an industry of commercial maize/legume production. These soils include Hutton, Clovelly and Avalon. These soils have deep yellow-brown B-horizons with minimal structure. These soils drain well and provide excellent to moderate cultivation opportunities. Each of the soils is described in detail below.

Clovelly Soil Form

Clovelly soils can be identified as an apedal “yellow” B-horizon as indicated in Figure 3-4 below. These soils along with Hutton soils are the main agricultural soil found within South Africa, due to the deep, well-drained nature of these soils. The soils are found on the valley slopes of the site.

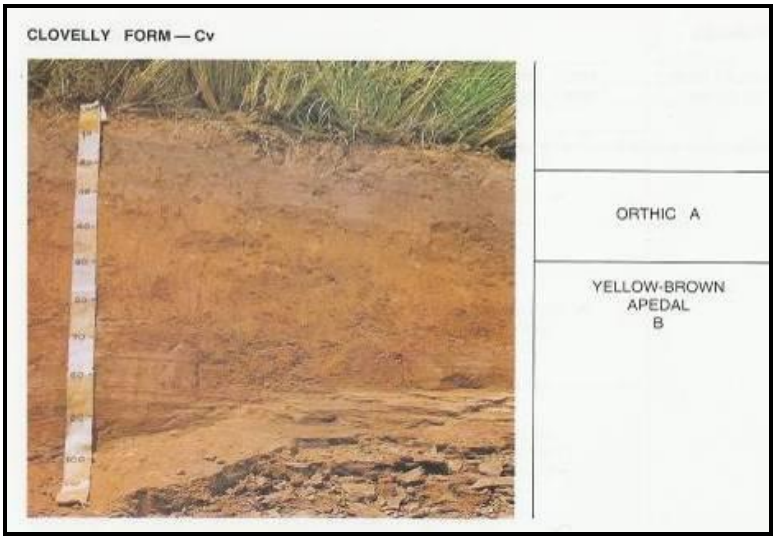


Figure 3-4: Clovelly soil form (Soil Classification, 1991)

Avalon Soil Form

The Avalon soil form is characterised by the occurrence of a yellow-brown apedal B-horizon over a soft plinthic B – horizon (See Figure 3-5). The yellow-brown apedal horizon is the same as described for the Clovelly soil form and the plinthic horizon has the following characteristics:

- Has undergone localised accumulation of iron and manganese oxides under conditions of a fluctuating water table with clear red-brown, yellow-brown or black strains in more than 10% of the horizon;
- Has grey colours of gleying in or directly underneath the horizon; and
- Does not qualify as a diagnostic soft carbonate horizon.

These soils are found between lower down the slopes than the Clovelly soils and indicate the start of the soils with clay accumulation.

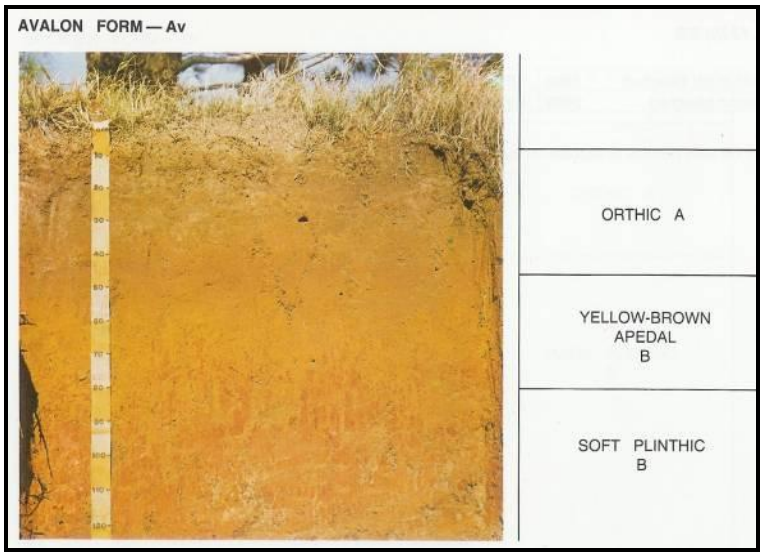


Figure 3-5: Avalon Soil Form (Soil Classification, 1991)

Hutton Soil Form

Hutton's are identified on the basis of the presence of an apedal (structureless) "red" B-horizon as indicated in Figure 3-6 below. These soils are the main agricultural soil found in South Africa, due to the deep, well-drained nature of these soils.

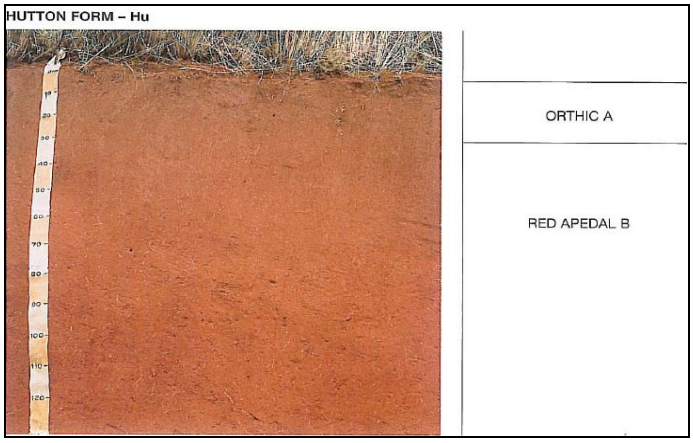


Figure 3-6: Hutton Soil Form (Soil Classification, 1991).

3.3.3 Transitional Soils

The transitional soil management unit comprises the soils found between clay soils and the agricultural soils. These soils often have signs of clay accumulation or water movement in the lower horizons. These soils are usually indicative of seasonal or temporary wetland conditions. The main soil forms found in transitional soils were Wasbank, Longlands and Westleigh, each form is described below.

Longlands Soil Form

The Longlands soil forms are all typified by an eluvial (E) horizon over a soft plinthic horizon (as described above). The E-horizon is a horizon that has been washed clean by excessive water movement through the horizon and the plinthic horizon as undergone local accumulation of colloidal matter (refer photo below). Please refer to Figure 3-7 and Figure 3-8 for an illustration of the soil form.

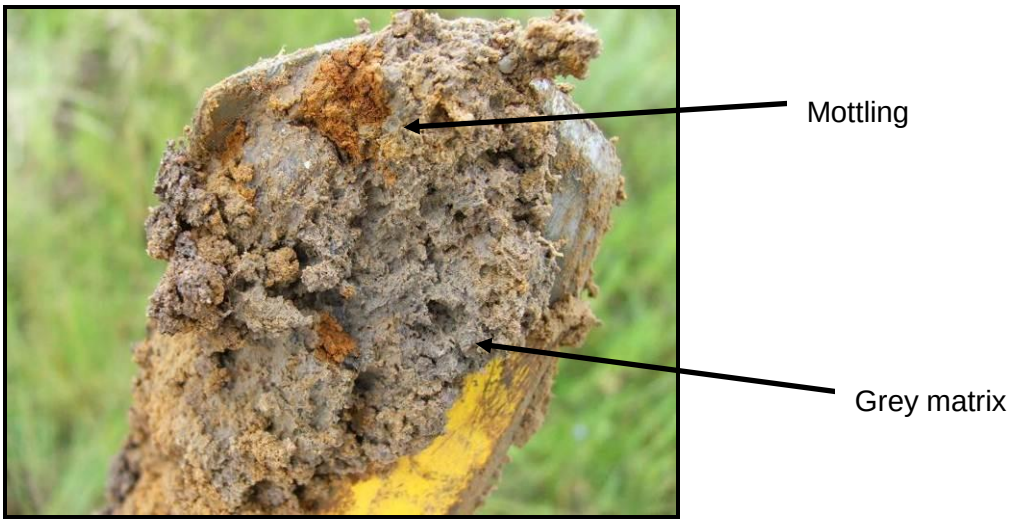


Figure 3-7: Soft plinthic B-horizon.

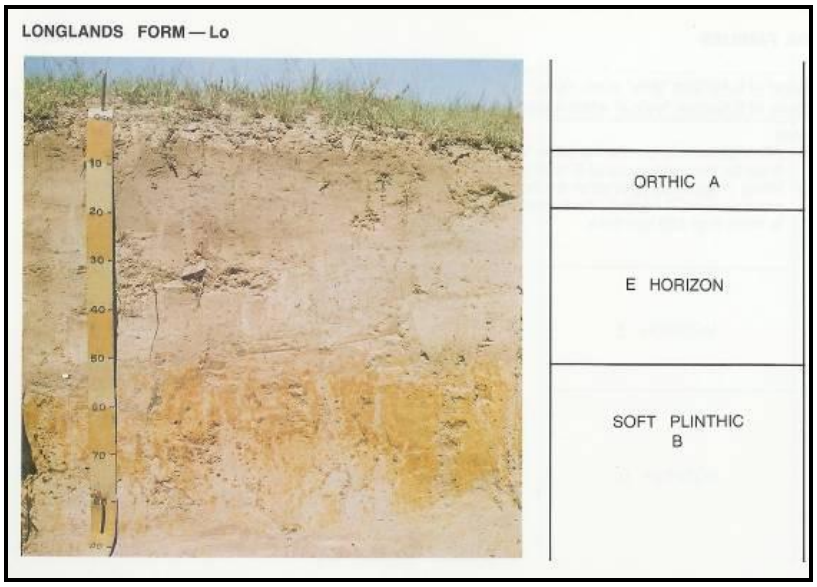


Figure 3-8: Longlands Soil Form (Soil Classification, 1991)

Wasbank Soil Form

The Wasbank soil form is found in close proximity to the Longlands soil form and is typified by an Orthic A-horizon over an E-horizon (as described above) over a Hard Plinthic B-horizon. The Hard Plinthic B-horizon develops when a Soft Plinthic horizon is subjected to a prolonged dry period and the accumulated colloidal matter hardens, almost irreversibly. The Wasbank soil form is illustrated in Figure 3-9 below.

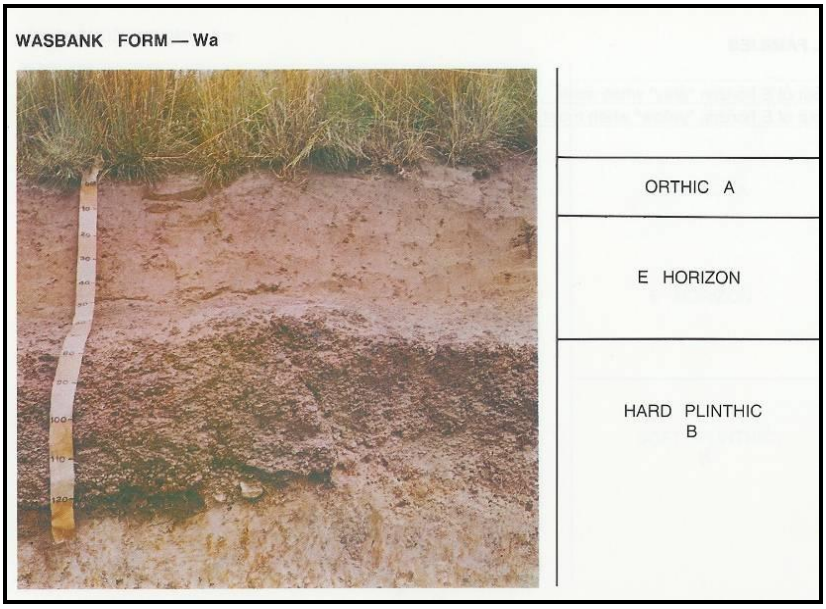


Figure 3-9: Wasbank Soil Form (Soil Classification, 1991)

Westleigh Soil Forms

Westleigh soils are characterised by an orthic A-horizon over a soft plinthic B-horizon and is found in areas between good agricultural soils and clay soils and the movement of water determines the characteristics of the soil.

Figure 3-10: Westleigh Soil Form (Soil Classification 1991)

3.3.4 Clay Soils

The clay soil management unit is found in areas where clays have accumulated to such an extent that the majority of the soil matrix is made up of clay particles. These soils are usually indicative of seasonal or permanent wetland conditions. The main soil forms found in clay soils were Katspruit and Willowbrook, each form is described below. These soils are saturated with water and must be noted to be unstable for construction and are sensitive. Although clay is required as part of the liner of the proposed ash facility, building on top of clay is never recommended as the material can shift, crack and is generally regarded as unstable.

Katspruit Soil Form

The Katspruit soil form is most commonly found in areas of semi-permanent wetness. The soil is made up of an Orthic A-horizon over a diagnostic G-horizon and is indicated in Figure 3-11 below. The G-horizon has several unique diagnostic criteria as a horizon, namely:

- It is saturated with water for long periods unless drained;
- Is dominated by grey, low chroma matrix colours, often with blue or green tints, with or without mottling;
- Has not undergone marked removal of colloid matter, usually accumulation of colloid matter has taken place in the horizon;
- Has a consistency at least one grade firmer than that of the overlying horizon;
- Lacks saprolitic character; and

- Lacks plinthic character.

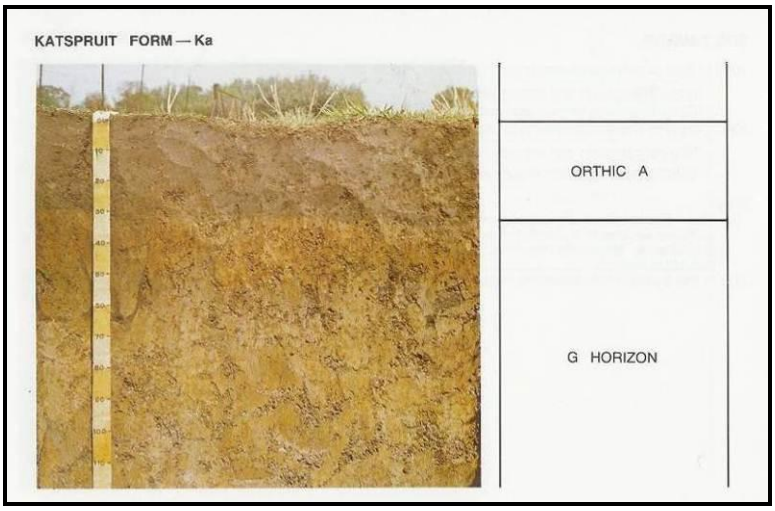


Figure 3-11: Katspruit Soil form (Soil Classification, 1991)

Willowbrook Soil Form

Willowbrook soils are characterised by Melanic A-horizon over a G-horizon. The G-horizon is invariably firm or very firm and its characteristics are described above. The Melanic horizon has several unique diagnostic criteria as a horizon, namely:

- Has dark colours in the dry state.
- Lack slickensides that are diagnostic of vertic horizons.
- Has less organic carbon than required for diagnostic organic O horizon.
- Has structure that is strong enough so that the major part of the horizon is not both massive and hard or very hard when dry.

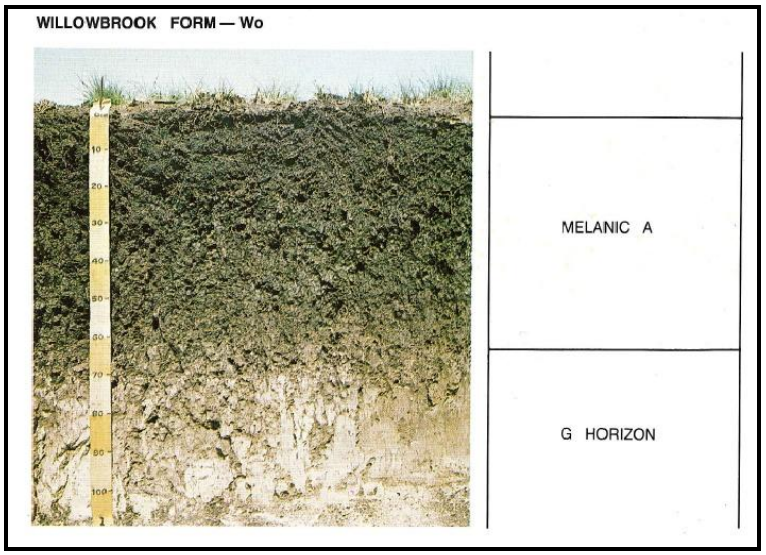


Figure 3-12: Willowbrook Soil Form (Soil Classification 1991)

3.3.5 Disturbed Soils

The disturbed soil management unit is found in areas where human disturbance has influenced the soil that developed on site. This is the case at dumping sites, roadsides, beneath buildings and mined areas.

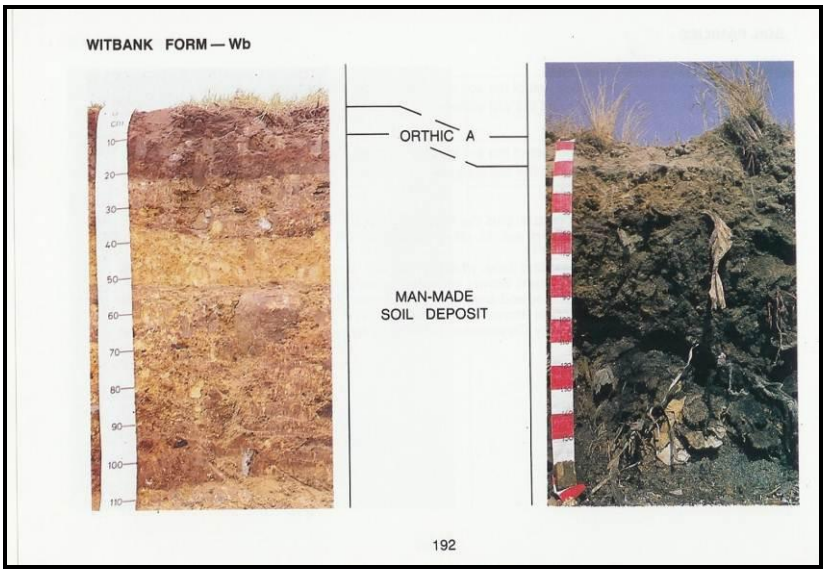


Figure 3-13: Witbank Soil Form (Soil Classification 1991)

4 AGRICULTURAL POTENTIAL (LAND CAPABILITY)

4.1 Data Collection

A literature review was conducted in order to obtain any relevant information concerning the area, including information from the Environmental Potential Atlas (ENPAT), Weather Bureau and Department of Agriculture. Results from the soil study were taken into account when determining the agricultural potential also known as the land capability of the site. The land capability assessment methodology as outlined by the National Department of Agriculture was used to assess the soil's capability to support agriculture on site.

4.2 Regional Description

The regional land capability is mostly Class II or IV soils with few limitations. This is evident in the large number of cultivated lands found in the region. In the areas where the soil is too shallow or too wet to cultivate, livestock are grazed.

4.3 Site Description

According to the land capability methodology, the potential for a soil to be utilised for agriculture is based on a wide number of factors. These are listed in the table below along with a short description of each factor.

Table 4-1: Agricultural Potential criteria

Criteria	Description
Rock Complex	If a soil type has prevalent rocks in the upper sections of the soil it is a limiting factor to the soil's agricultural potential
Flooding Risk	The risk of flooding is determined by the closeness of the soil to water sources.
Erosion Risk	The erosion risk of a soil is determined by combining the wind and water erosion potentials.
Slope	The slope of the site could potentially limit the agricultural use thereof.
Texture	The texture of the soil can limits its use by being too sandy or too clayey.
Depth	The effective depth of a soil is critical for the rooting zone for agricultural crops.
Drainage	The capability of a soil to drain water is important as most grain crops do not tolerate submergence in water.
Mechanical Limitations	Mechanical limitations are any factors that could prevent the soil from being tilled or ploughed.
pH	The pH of the soil is important when considering soil nutrients and hence fertility.
Soil Capability	This section highlights the soil type's capability to sustain agriculture.
Climate Class	The climate class highlights the prevalent climatic conditions that could influence the agricultural use of a site.
Land Capability / Agricultural Potential	The land capability or agricultural potential rating for a site combines the soil capability and the climate class to arrive at the sites potential to support agriculture.

The soils identified in Section 3 above were classified according to the methodology proposed by the Agricultural Research Council – Institute for Soil, Climate and Water (2002). The criteria mentioned above were evaluated in the table below. The site is made up of several land capability classes, namely Class II, III, IV, V, VI and VII. The Class II - III soils are suitable for cultivation and can be used for a range of agricultural applications in the case of Class II. Class IV – V soils have features that reduce their potential for agricultural use, this can be flood hazards, erosion risk, texture or drainage. The Class VI and VII soils have continuing limitations that cannot be corrected; in this case rock complexes, flood hazard, stoniness, and a shallow rooting zone constitute these limitations. Figure 4-1 illustrates the various land capability units on site.

Table 4-2: Land Capability of the soils within the study site

Soil	Agricultural	Poor Transitional	Shallow Soil	Disturbed
% on Site	30	8	50	12
Rock Complex	None	None	Yes	None
Flooding Risk	Moderate	Moderate	No	Very Limiting
Erosion Risk	Moderate	High	High	Very Low
Slope %	3.7	3.7	4.0	0.5
Texture	Loam	Clay/Clayey Loam	Sandy Loam	Rock/Sandy
Effective Depth	> 60 cm	< 60 cm	< 60 cm	< 10 cm
Drainage	Imperfect	Poor	Poorly drained	Poorly drained
Mech Limitations	None	None	Rocks	Rocks
pH	> 5.5	> 5.5	> 5.5	> 5.5
Soil Capability	Class III	Class V	Class VI	Class VIII
Climate Class	Mild	Mild	Mild	Mild
Land Capability	Class III – Moderately Arable Land	Class V – Good Grazing Land	Class VI – Moderately Grazing Land	Class VII – Wildlife

No limitation	Low	Moderate	High	Very Limiting

For an illustration of the land capabilities please refer to the figures below and a discussion on the preferred sites are highlighted in Section 8.

C:\Users\konrad\Documents\Werk\Konrad homework\Camden\raster\agric.mxd

Figure 4-1: Agricultural Potential Map

5 SURFACE WATER

5.1 Data Collection

The surface water data was obtained from the Department of Water Affairs National database of Freshwater Ecosystem Priority Areas (FEPAs) for river ecosystems and wetlands. The data used included catchments, wetlands, water bodies, river alignments and ecological status of these sources.

5.2 Regional Description

The main drainage features of the area are the Witpuntspruit which drains south-eastwards to the Vaal River, which is located some 6 km from Camden Power Station. Several unnamed tributaries are also found in the area. In addition to the streams, several wetlands and pans can also be found in the region as illustrated in Figure 5-1 below. The streams and their associated pans and wetlands support a number of faunal and floral species uniquely adapted to these aquatic ecosystems, and therefore all surface water bodies are earmarked as sensitive features and should be avoided as far as possible.

5.3 Site Description

From Figure 5-1 below, it is evident that there are water bodies or streams in close proximity to the study area. The De Jagers Pan is a natural depression/pan that is located adjacent to the existing ash disposal site. This pan is used as a return water dam as part of the approved water management system at the station. In addition to the pan there are small non-perennial drainage lines on all three alternative sites. In order to identify the exact location and status of these features a wetland and riparian delineation study was undertaken as described in Section 6 below.

5.4 Sensitivities

The design and final site layout will have to avoid all these features and also take them into consideration as part of the planning. All the water bodies are seen as sensitive and should be avoided by the ash disposal site, and the delineation exercise in Section 6 determined the buffer zones required around these sites. In addition to the buffer zones mentioned above, flood lines also need to be considered to ensure that the site is adequately located to avoid being impacted on in a flood event.

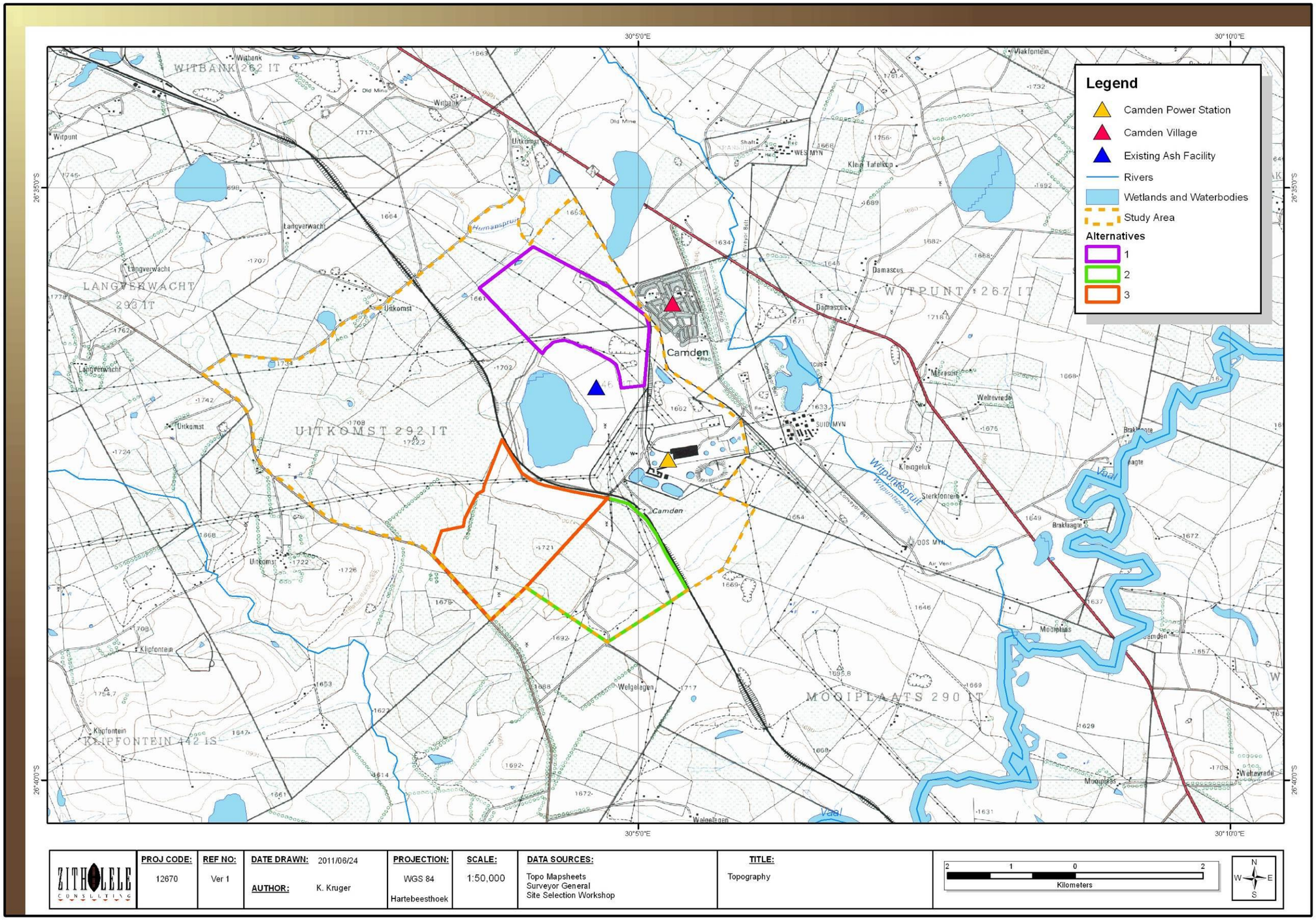


Figure 5-1: Surface water and drainage features

6 WETLAND AND RIPARIAN ZONE DELINEATION

6.1 Data Collection and Methodology

6.1.1 Riparian Zones vs. Wetlands

Wetlands

The riparian zone and wetlands were delineated according to the Department of Water Affairs (DWA, previously known as the Department of Water Affairs and Forestry -DWAF) guideline, 2003: A practical guideline procedure for the identification and delineation of wetlands and riparian zones. According to the DWA guidelines *a wetland* is defined by the National Water Act as:

"land which is transitional between terrestrial and aquatic systems where the water table is usually at or near surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil."

In addition the guidelines indicate that wetlands must have one or more of the following attributes:

- Wetland (hydromorphic) soils that display characteristics resulting from prolonged saturation;
- The presence, at least occasionally, of water loving plants (hydrophytes); and
- A high water table that results in saturation at or near surface, leading to anaerobic conditions developing in the top 50 centimetres of the soil.

During the site investigation the following indicators of potential wetlands were identified:

- Terrain unit indicator;
- Soil form indicator;
- Soil wetness indicator; and
- Vegetation indicator.

Riparian Areas

According to the DWA guidelines *a riparian area* is defined by the National Water Act as:

"Riparian habitat includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas"

The difference between Riparian Areas and Wetlands

According to the DWA guidelines the difference between a wetland and a riparian area is:

"Many riparian areas display wetland indicators and should be classified as wetlands. However, other riparian areas are not saturated long enough or often enough to develop wetland characteristics, but also perform a number of important functions, which need to be safeguarded… Riparian areas commonly reflect the high-energy conditions associated with the water flowing in a water channel, whereas wetlands display more diffuse flow and are lower energy environments."

6.2 Delineation

The site was investigated for the occurrence / presence of wetlands and riparian areas, using the methodology described above and described in more detail in the DWA guidelines.

6.2.1 Terrain Unit Indicator

The topography of the site is described in Section 2 of the report and is also shown in Figure 2-1. According to the DWA guidelines the valley bottom is the terrain unit where wetlands are most likely to occur, but the occurrence of wetlands is not excluded from any of the other terrain units.

The bulk of the area drains towards De Jager's Pan, which represents the valley bottom, and this is the area that most wetlands are expected.

6.2.2 Soil Form Indicator

Of the soils identified the clay and transitional soils could potentially be wetland soils as they have clay accumulation. The clay soils are mostly typical of the permanent and seasonal wetland zone while the transitional soils can be found in temporary wetland zones.

6.2.3 Soil Wetness Indicator

The soils on site were subjected to a soil wetness assessment. If soils showed signs of wetness within 50 cm of the soil surface, it was classified as a hydromorphic soil and divided into the following groups:

Temporary Zone

- Minimal grey matrix (<10%);
- Few high chroma mottles; and
- Short periods of saturation.

Seasonal Zone

- Grey matrix (>10%);
- Many low chroma mottles present; and
- Significant periods of wetness (>3 months / annum).

Permanent Zone

- Prominent grey matrix;
- Few to no high chroma mottles;
- Wetness all year round; and
- Sulphuric odour.

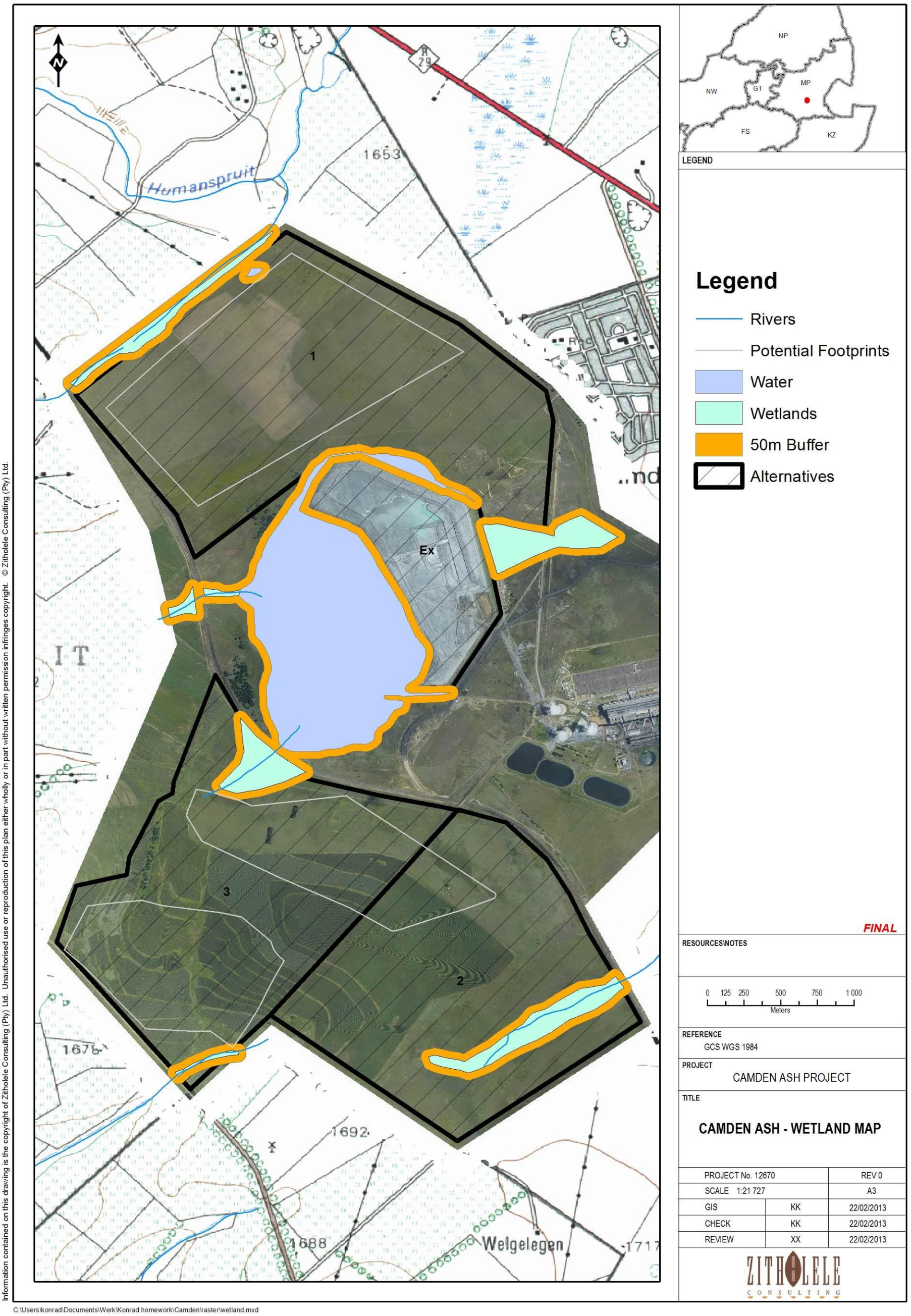
The soils that showed signs of wetness within the top 50 cm of the soil profile were identified and mapped as illustrated in Figure 6-1.

6.2.4 Vegetation Indicator

The vegetation units on site are described in Section 7 below and illustrated in Figure 7-1. The vegetation found in the moist grassland vegetation unit has species present to indicate the presence of wetlands

6.2.5 Delineated Wetlands and Buffer Zones

According to the methodology that was followed for delineation of wetlands by DWA, there are wetlands present on any of the sites. It should however be noted that several of the so-called wetlands could also be classified as riparian zones as they follow the drainage path of the perennial and non-perennial streams on each of the alternative sites. All the area's identified above perform critical ecosystem functions and also provide habitat for sensitive species. It is suggested that a 50m buffer be placed from the edge of the temporary zone in order to sufficiently protect the wetlands and riparian zones. Figure 6-1 below illustrates the various wetland and riparian zones as well as the buffers placed along the edge of the temporary zone.



C:\Users\konrad\Documents\Werk\Konrad homework\Camden\raster\wetland.mxd

Figure 6-1: Wetlands and Riparian Zones including buffer

7 TERRESTRIAL ECOLOGY

7.1 Data Collection

A literature review of the faunal and floral species that could occur in the area was conducted. C-Plan data provided from the Mpumalanga provincial department was used to conduct a desktop study of the area. This data consists of terrestrial components; ratings provide an indication as to the importance of the area with respect to biodiversity.

The study involved extensive fieldwork, a literature review and a desktop study utilizing GIS. Site investigations were conducted from October 2011 to March 2012, from spring to summer. The area within the servitude was sampled using transects placed at 100 m intervals. At random points along these transect an area of 20 m x 20 m was surveyed. All species within the 20 m x 20 m quadrant were identified, photographed and their occurrence noted. Sensitive features such as ridges or wetlands were sampled by walking randomly through the area concerned and identifying all species within the area.

The floral data below is taken from The Vegetation of South Africa, Lesotho and Swaziland (Mucina and Rutherford 2006). Also, while on site, the following field guides were used:

- Guide to Grasses of Southern Africa (Frits van Oudtshoorn, 1999);
- Field Guide to Trees of Southern Africa (Braam van Wyk and Piet van Wyk, 1997);
- Field Guide to the Wild Flowers of the Highveld (Braam van Wyk and Sasa Malan, 1998);
- Problem Plants of South Africa (Clive Bromilow, 2001); and
- Medicinal Plants of South Africa (Ben-Erik van Wyk, Bosch van Oudtshoorn and Nigel Gericke, 2002)

Species lists were obtained from the SIBIS (*South African National Biodiversity Institute - Accessed through the SIBIS portal, sibis.sanbi.org, 2012-01-25)*. In addition the following faunal guides were used on site and while compiling this report:

- Die Natuurlewe van Suider-Afrika, ‘n veldgids tot diere en plante van die streek (Vincent Carruthers, 1997);
- Birds of Southern Africa (Ian Sinclair, 1994);
- Smithers’ Mammals of Southern Africa, a field guide (Ed. Peter Apps, 2000);
- Sasol Owls and Owling in Southern Africa (Warwick Tarboton & Rudi Erasmus, 1998);
- Bats of Southern Africa (Peter John Taylor, 2000).

7.2 Vegetation

7.2.1 Regional Description

The area under investigation is located within the Grassland Biomes. Each biome comprises several bioregions which in turn has various vegetation types within the bioregion. The Grassland

Biome is represented by Mesic Highveld Grassland and Inland Azonal Vegetation bioregions as described below. These descriptions are adapted from Mucina and Rutherford, 2006.

Mesic Highveld Grassland

Mesic Highveld Grassland is found mainly in the eastern, high rainfall regions of the Highveld, extending all the way to the northern escarpment. These are considered to be “sour” grasslands and are dominated by primarily andropogonoid grasses. The different grassland types are distinguished on the basis of geology, elevation, topography and rainfall. Shrublands are found on outcrops of rock within the bioregion, where the surface topography creates habitat in which woody vegetation is favoured above grasses.

Inland Azonal Vegetation

The Azonal Vegetation bioregion is characterised by those vegetation units that is associated with inland water features such as riparian and wetland vegetation. Along the proposed route only one vegetation type was identified, namely Eastern Temperate Freshwater Wetlands.

7.2.2 Site Description

The vegetation types identified on site are indicated in Figure 7-1 below and described in detail below.

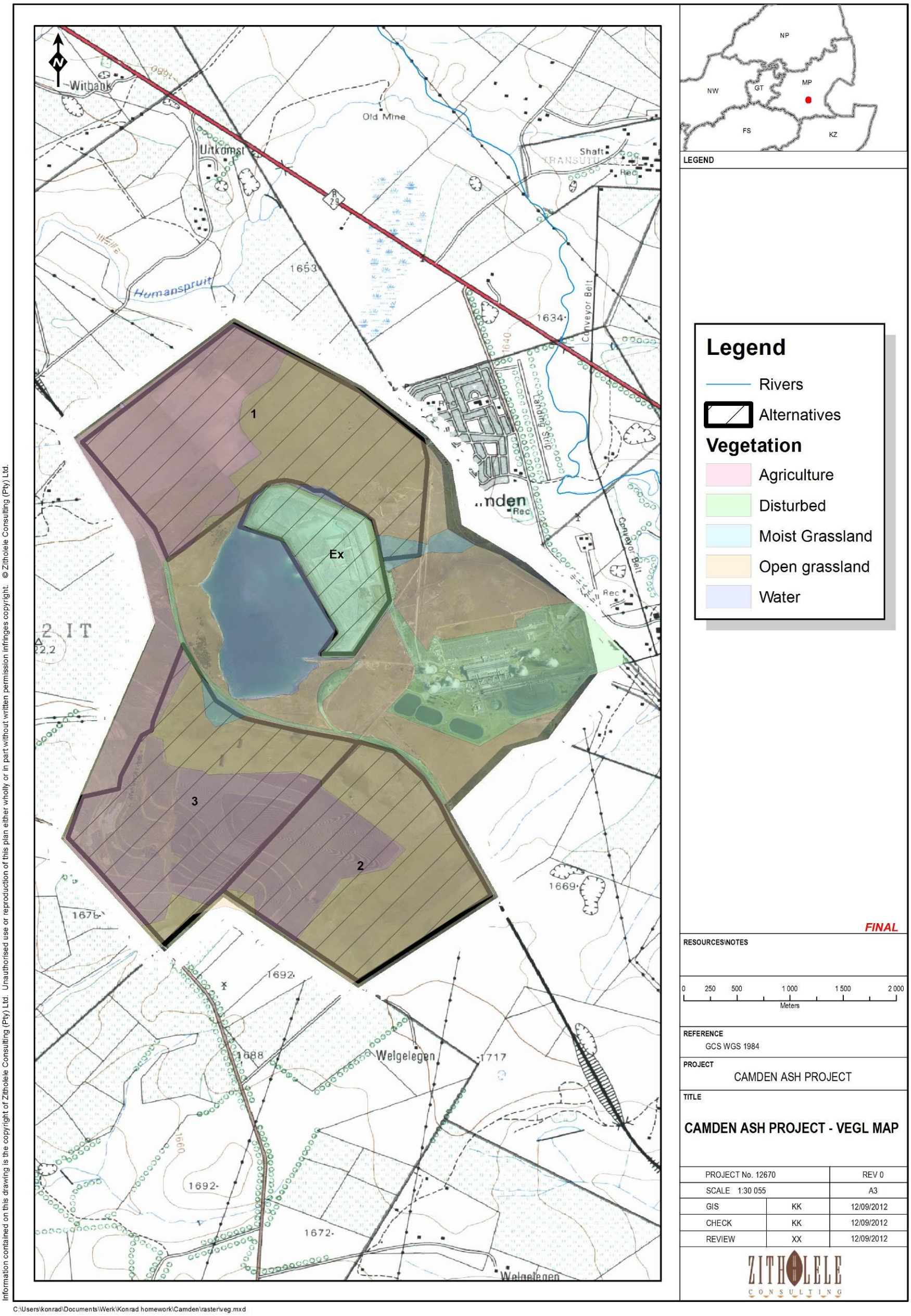


Figure 7-1: Vegetation Map the site.

Wetlands

Eastern Temperate Freshwater Wetlands

This vegetation unit is found throughout the Northern Cape, Eastern Cape, Free State, North-West, Gauteng, Mpumalanga and KwaZulu-Natal Provinces as well as in neighbouring Lesotho and Swaziland. It is based around water bodies with stagnant water (lakes, pans, periodically flooded vleis, and edges of calmly flowing rivers) and embedded within the Grassland Biome. These water bodies support zoned systems of aquatic and hygrophillous vegetation of temporary flooded grasslands and ephemeral herblands.

Due to the recent efforts of organisations such as Ramsar, this vegetation unit is now 4.6 % conserved and rated as least threatened. The following alien species are encountered in this type of wetland: *Bidens bidentata, Cirsium vulgare, Conyza bonariensis, Oenothera rosea, Physalis viscosa, Plantago lanceolata, Rumex crispus, Sesbania punicea, Schkuhria pinnata, Stenotaphrum secundatum* (native on South African coast, alien on Highveld*), Trifolium pratense, Verbena bonariensis, V. brasiliensis, and Xanthium strumarium*.

In terms of the vegetation within the larger study area, there are 3 distinct areas that fall into this vegetation unit. The first is De Jager's Pan, the large pan in the centre of the site. This pan is classified as a wetland and wetlands are of a more permanent nature and occur in low-lying areas such as tributaries of streams and rivers. Here hydrophytes are found. Typical plants are the Orange River Lily (*Crinum bulbispermum*), bulrush (*Typha capensis*) and reeds (*Phragmites australis*), sedges of the *Cyperus, Fuirena and Scirpus* genera also occur. Due to the use of the pan as a dirty water return dam for the power station over the 40 odd years of operation, the vegetation around the pan has been disturbed as the water quality was reduced.

Figure 7-2: De Jager's Pan with the existing ash facility in the foreground

The other two areas are the inflow into the pan from the south and the man-made outflow to the north-northeast of the pan and existing ash disposal site. These areas around drainage lines/seepage areas were also added to this unit because of the similar vegetation that occur in these areas. The Seepage area is seasonally wet and is found to the south of the site, where the bowl-shaped topography drains to a central point that enters under the Richard Bay railway line and drains into the pan. These areas are usually covered by hygrophytes such as sedges and reeds. The dominant sedge in the study area is *Juncus rigidus*. Sometimes bulrush (*Typha capensis*) and reeds (*Phragmites australis*) also occurs. The photos below show these areas.

Figure 7-3: Moist Grassland found at the bottom of the southern slopes prior to joining De Jager's Pan

The last area is found to the north and north-east of the existing ash disposal facility. This facility has built-in drainage channels around the facility to channel storm water from the ash disposal site into De Jager's Pan. High water levels in De Jager's Pan have resulted in these channels being filled with water on a semi-permanent basis as shown in the photo below. Furthermore there are several places where this water has seeped from the site to the east down the slope. These areas are mostly covered by sedges and reeds as described above.

Figure 7-4: Drainage around the existing ash facility

Eastern Highveld Grassland

The Eastern Highveld Grassland occurs in the Mpumalanga and the Gauteng provinces on the plains between Belfast in the east and the eastern side of Johannesburg in the west extending southwards to Bethal, Ermelo and west of Piet Retief. The landscape is made up of slightly to moderately undulating plains, including some low hills and pan depressions. The vegetation is short dense grassland dominated by the usual Highveld grass composition (*Aristida, Digitaria, Eragrostis, Themeda, Tristachya, etc*.) with small scattered rocky outcrops with wiry, sour grasses and some woody species (*Arcacia caffra, Celtis Africana, Diospyros luciodes subspecies lycioides, Parinari capensis, Protea caffra, P. Welwitschii and Rhus magalismontanum*).

This vegetation unit is considered endangered with a conservation target of 24%. Only a very small fraction is conserved in statutory reserves (Nooitgedacht dam and Jericho dam Nature Reserves) and in private reserves (Holkranse, Kransbank, Morgenstond). Approximately 44% is transformed primarily by cultivation, plantations, mines, urbanisation and by the building of dams. Cultivation may have had a more extensive impact, indicated by land-cover data. No serious alien invasions are reported, but *Acacia mearnsii* can become dominant in disturbed areas.

In terms of the grassland found on the aleternative sites there are several areas used for grazing where the grassland is in a decent condition, however some signs of overgrazing as well as invasion by alien *Acacia mearnsii* and *Eucalyptus spp* are evident. Large sections of the grassland have been converted to agriculture in the southern and eastern parts of the study area, while the development of the power station and its supporting infrastructures has also impacted on a large section of the grassland. Below are photographs of the vegetation unit.

Figure 7-5: Eastern Highveld Grassland found to the north (left) and south (right) of Camden Power Station.

Disturbance

A major factor found all over the study area is the disturbance of the natural vegetation. Large tracks of land have been changed by cultivation (maize and legumes), mining (coal and borrow pits), industry (power station) and urbanisation (Camden village). Figure 7-6 below provides examples of the source of disturbance across the study area.

Figure 7-6: Disturbances to natural vegetation found along the route

Red data Flora Species

No red data species were found. However species of importance noted on site include:

- *Boophone disticha*

7.3 Terrestrial Animal Species

Invertebrates

A total of 568 arthropods are recorded for the study area. The large number is mainly due to the wide range of habitat available and the large area covered by the various alternatives.

Reptilia

A total of 3 reptilian species were recorded for the study site.

Amphibia

One amphibian was recorded as occurring within the study area - *Rana angolense*. These species are not restricted in terms of habitat or distribution and none of the species recorded are classified as Red Data species.

Avifauna

Around 808 potential bird species are found in the quarter degree grid. Of these noted sensitive species include the Blue and Crowned Cranes that could occur in the area.

Mammalia

Mammal species diversity was low across the bulk of the study area, as very little natural habitat remains. Most of the mammals occur in small pockets of remaining natural vegetation, with a total of 6 species being recorded. Of these only the Aardvark is listed as vulnerable.

8 VISUAL IMPACT ASSESSMENT

8.1 Introduction

The proposed alternatives are all found in a mostly rural landscape that has been infiltrated by mining and industrial development around the power station. The bulk of the study area is utilised for agriculture and coal mining with a varying topography.

8.2 Methodology

The methodology adopted for the visual assessment includes the following tasks:

- Examine the baseline information (contours, building dimensions, vegetation, inter alia);
- Determine the area from which the proposed power line may be visible (viewshed);
- Identify the locations from which views of the proposed power line may be visible (observation sites), which include buildings and roads;
- Analyse the observation sites to determine the potential level of visual impact that may result from the proposed power line; and
- Identify measures available to mitigate the potential impacts.

Each component of the assessment process is explained in detail in the following sections of the Report.

The Viewshed

The viewshed represents the area from which the proposed site would potentially be visible. The extent of the viewshed is influenced primarily by the combination of topography and vegetation,

which determine the extent to which the site would be visible from surrounding areas. The viewshed was determined by Zitholele through the following steps and presumptions:

- The likely viewshed was determined by desktop study (ArcGIS) using contour plans (20 m interval); and
- An offset of 2 m (maximum) for the observer and an offset of 45 m (maximum) for the proposed ash facility were utilized during the spatial analysis.

Visibility Assessment

Site visibility is an assessment of the extent to which the proposed facility will potentially be visible from surrounding areas. It takes account of the context of the view, the relative number of viewers, duration of view and view distance.

The underlying rationale for this assessment is that if the proposed facility is not visible from surrounding areas then the development will not produce a visual impact. On the other hand if one or more parts of the facility are highly visible to a large number of people in surrounding areas then the potential visual impact is likely to be high.

Based on a combination of all these factors an overall rating of visibility was applied to each observation point. For the purpose of this report, categories of visibility have been defined as high (H), moderate (M) or low (L).

Assessment Criteria

For the purpose of this report, the quantitative criteria listed in Table 8-1 have been determined and used in the Visibility Assessment. The criteria are defined in more detail in the subsection following.

Table 8-1: Visual Impact Assessment Criteria

CRITERIA	DEFINITIONS
Category of Viewer	
Static	Farms, homesteads or industries
Dynamic	Travelling along road
View Elevation	
Above	Higher elevation then proposed power lines.
Level	Level view with power lines
Below	Lower elevation then power lines viewed
View Distance	
Long	> 5 km
Medium	1 – 5 km
Short	200 m – 1 000 m
Very Short	< 200 m
Period of View	

CRITERIA	DEFINITIONS
Long Term	> 120 minutes
Medium Time	1 – 120 minutes
Short Term	< 1 minute

Category Viewer

The visibility of the proposed facility will vary between static and dynamic view types. In the case of static views, such as views from a farmhouse or homestead, the visual relationship between the proposed facility and the landscape will not change. The cone of vision is relatively wide and the viewer tends to scan back and forth across the landscape.

In contrast views from a moving vehicle are dynamic as the visual relationship between the proposed facility is constantly changing as well as the visual relationship between the proposed power line and the landscape in which they it is seen. The view cone for motorists, particularly drivers, is generally narrower than for static views.

View Elevation

The elevation of the viewer relative to the object observed significantly influences the visibility of the object by changing the background and therefore the visual contrast. In situations where the viewer is at a higher elevation than the building/structure it will be seen against a background of landscape. The level of visual contrast between the proposed facility and the background will determine the level of visibility. A white/bright coloured structure seen against a background of dark/pale coloured tree-covered slopes will be highly visible compared to a background of light coloured slopes covered by yellow/brown dry vegetation.

In situations where the viewer is located at a lower elevation than the proposed facility it will mostly be viewed against the sky. The degree of visual contrast between white coloured structures will depend on the colour of the sky. Dark grey clouds will create a significantly greater level of contrast than for a background of white clouds. The photos below illustrate this effect, where the view from above is far less visible.

Figure 8-1: Difference in view from below (left) and above (right)

View Distance

The influence of distance on visibility results from two factors:

- With increasing distance the proportion of the view cone occupied by a visible structure will decline; and
- Atmospheric effects due to dust and moisture in the air reduce the visual contrast between the structure and the background against which they are viewed.

Period of View

The visibility of structures will increase with the period over which they are seen. The longer the period of view the higher the level of visibility. However, it is presumed that over an extended period the level of visibility declines as people become accustomed to the new element in the landscape.

Long term views of the proposed facility will generally be associated with farm houses, informal settlements and a couple of towns located within the viewshed. Short term and moderate term views will generally relate to commuters moving through the viewshed mostly by vehicle.

Site Visibility

The procedure followed by Zitholele to assess Site Visibility involved:

- Generate a viewshed analysis of the area utilizing ArcGIS 10.
- Determine the various categories of observation points (e.g. Static, Dynamic).

Impact Assessment Methodology

Visual impact is defined as the significance and/or severity of changes to visual quality of the area resulting from a development or change in land use that may occur in the landscape.

Significance or severity is a measure of the response of viewers to the changes that occur. It represents the interaction between humans and the landscape changes that they observe. The response to visible changes in the landscape may vary significantly between individuals.

Perception results from the combination of the extent to which the proposed facility is visible (level of visibility) and the response of individuals to what they see. A major influence on the perception of people/tourist in relation to the proposed facility will be the visual character and quality of the landscape in which it would be located. Natural landscape areas such as national parks, mountain areas or undeveloped sections of coast are valued for their high visual quality. The introduction of buildings and associated infrastructure may be seen as a negative impact on these areas of high visual quality. In the case of the ash disposal facilities some people perceive them in a positive

manner because they represent progress essential to the economy of South Africa and contributing the local and national economy. On the other hand some people perceive them negatively due to the large structures that impact on the unspoilt natural landscape.

The potential visual impact of the proposed facility will primarily result from changes to the visual character of the area within the viewshed. The nature of these changes will depend on the level of the visual contrast between buildings/structures and the existing landscape within which they would be viewed.

The degree of contrast between the proposed facility and the surrounding landscape will result from one or more of the following visual characteristics:

- Colour;
- Shape or form;
- Scale;
- Texture; and
- Reflectivity.

8.2.1 Visual Character

Landscape Character

The northern section of the study area can be described as an agricultural landscape with intermittent mining and power generation activities. The proposed Alternative 1 facility will be located on a slope starting at the existing Camden ash facility and moving down the slope over land that is mainly used for maize and grazing. This area has very little screening from topography or vegetation due to the relatively flat nature of the area and the mainly grassland vegetation. Please refer to Figure 2-1 for the topography of the site. This site is however located in a very similar position to the existing ash disposal facility and would represent a similar impact to the existing impact to viewers.

The Alternative 2 and 3 alignments are found to the south of Camden. This area is characterised by large agricultural field with a few patches of grassland. Here the agriculture will provide very small levels of screening however this will reduce even more due to the harvesting schedule.

The landscape surrounding the proposed facility Alternatives vary quite substantially and hence so does the screening for the proposed facility. There are also several existing infrastructures on site. Figure 8-2 below provides a view of some the existing power lines and facilities found on site. Note how the different structures and vegetation influence the visibility.

Figure 8-2: View of existing structures in the study area.

Viewshed

It should be noted that the viewsheds for each of the alternatives, which are plotted on the figures below, are an approximation that may vary in some locations. Potential views to the proposed alternatives are likely to be blocked in some localised situations by buildings, vegetation or local landform features at specific locations within the viewshed. Similarly, glimpses of the proposed facility may be available from some isolated high-elevation locations outside the plotted viewshed. The figures illustrate the visibility of each of the alternatives. The coloured areas indicate areas that are visible with the red areas having very high visibility and the green having lower visibility. It should be noted that the variations in visual impact between Alternatives 2 and 3 are relatively small, considering they are in a similar location.

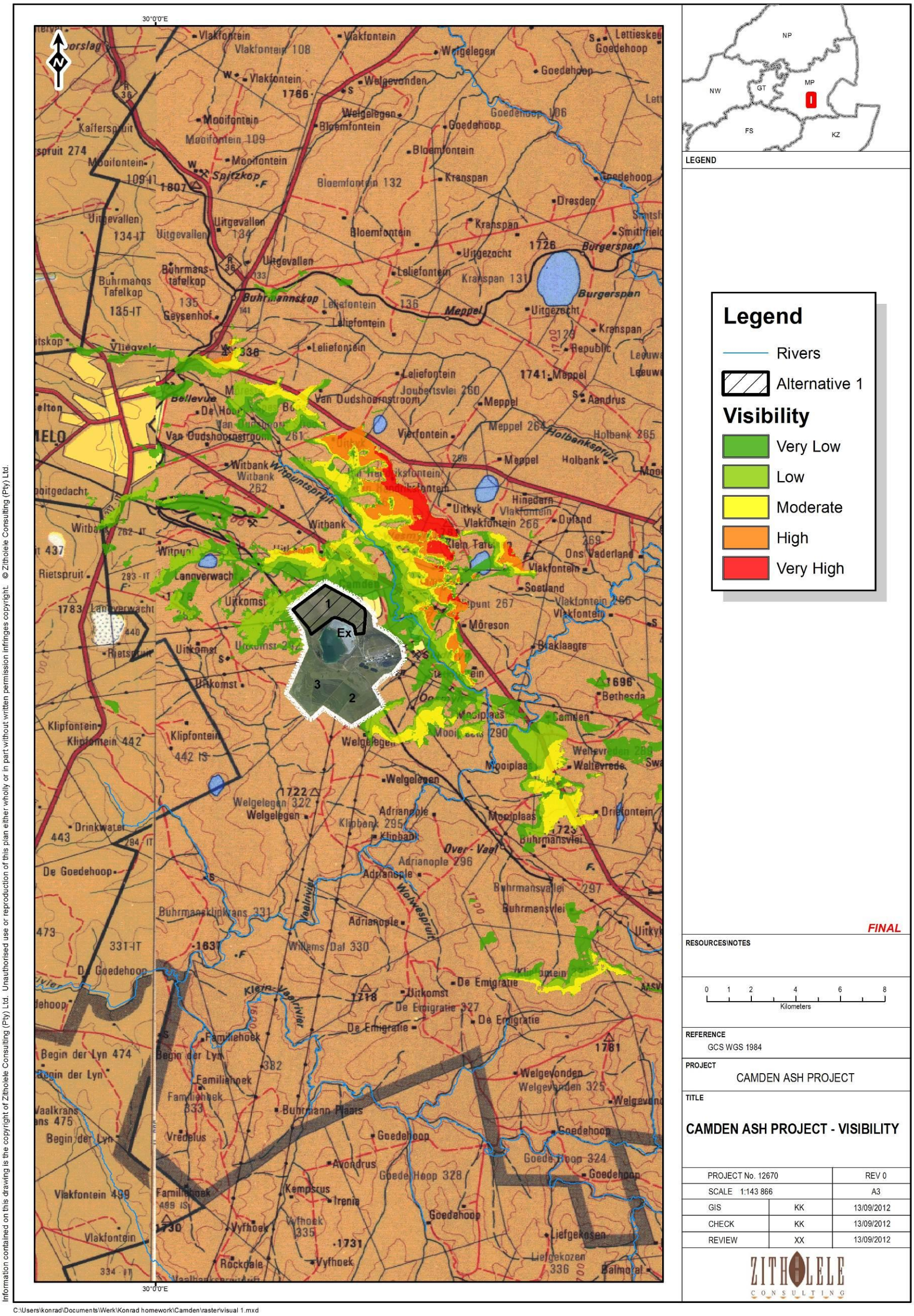


Figure 8-3: Visual Impact from the Alternative 1.

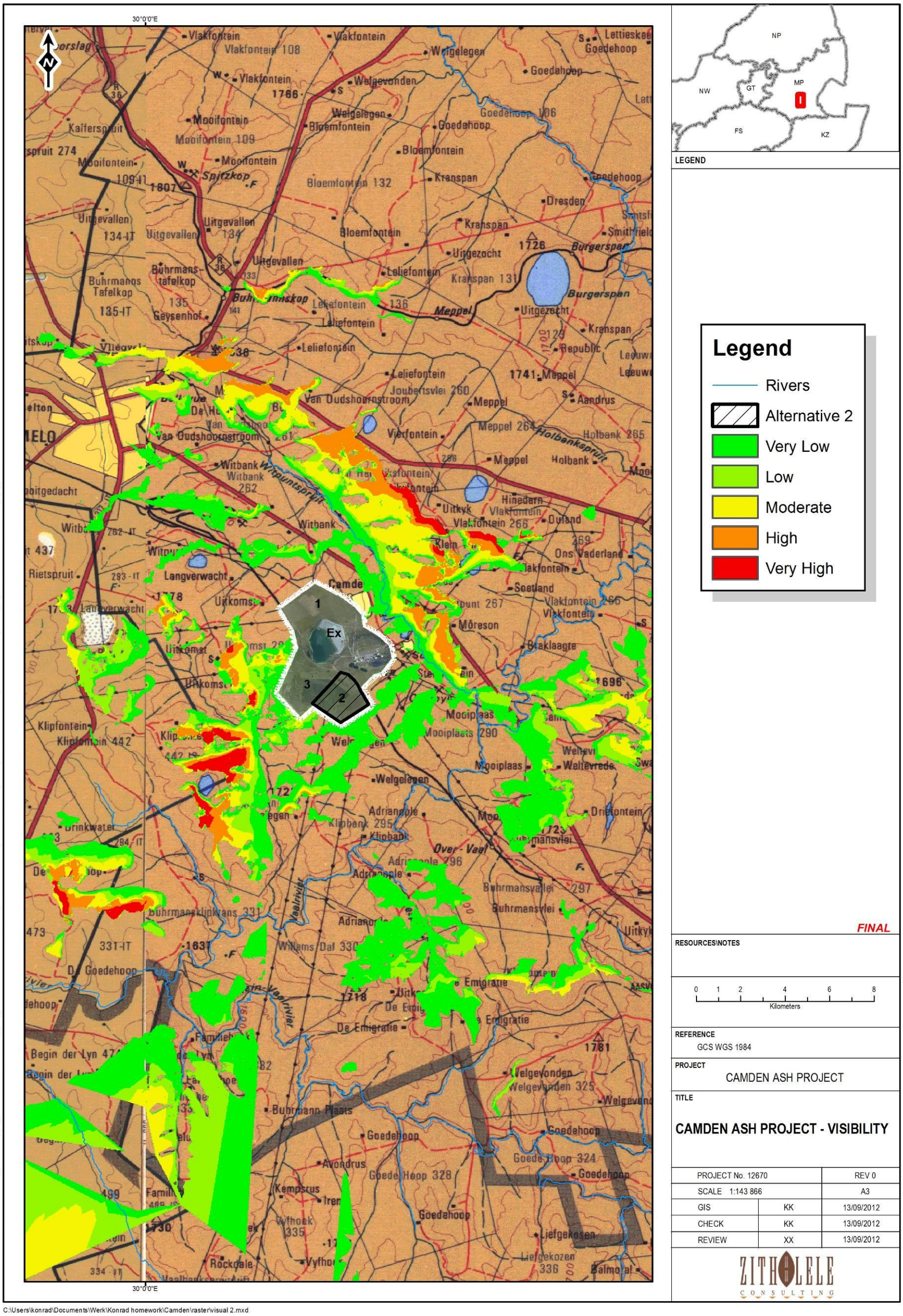


Figure 8-4: Visual Impact from the Alternative 2

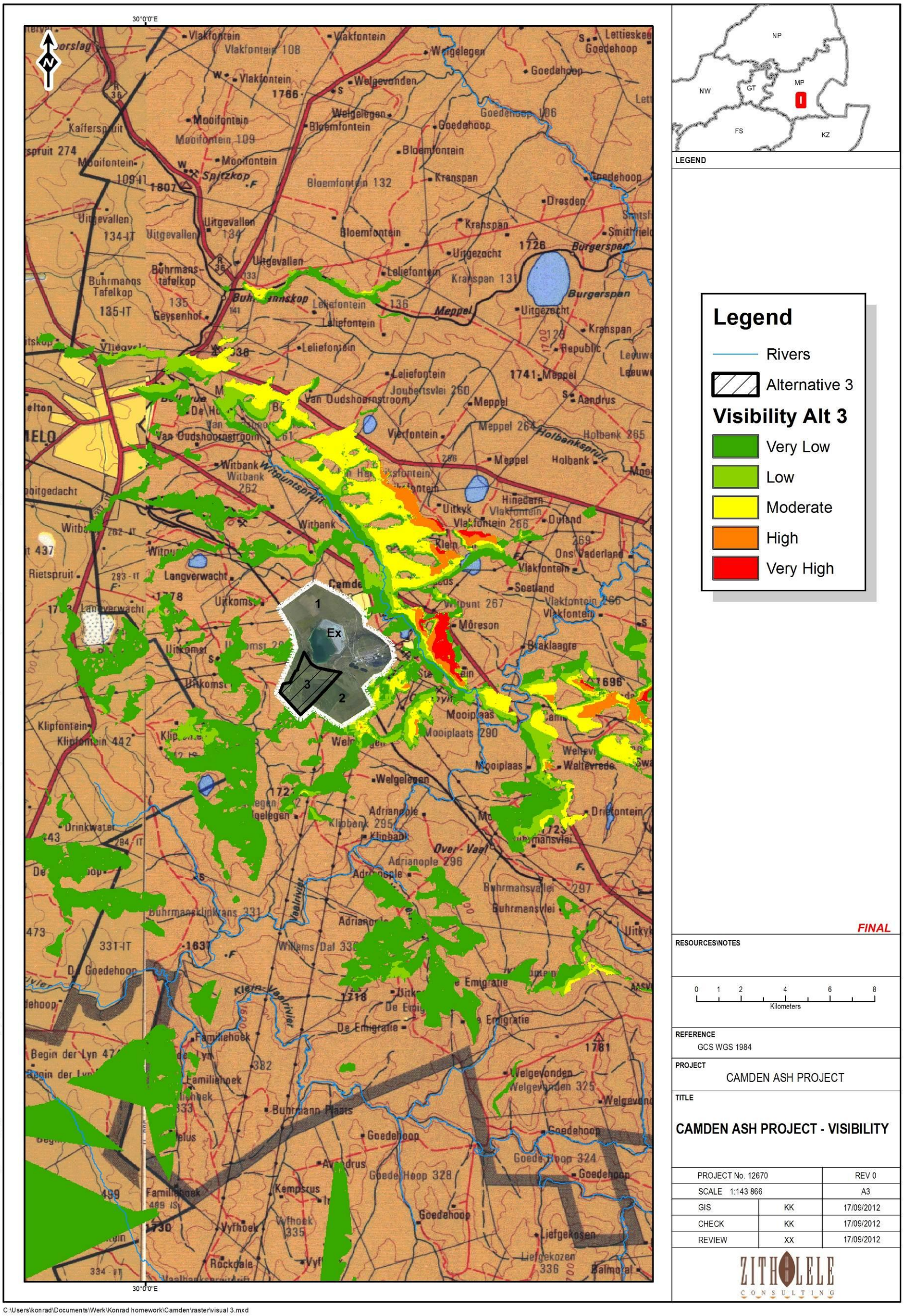


Figure 8-5: Visual Impact from the Alternative 3

9 PREFERRED SITE SELECTION

This section aims to identify the most suitable alternative available using each of the biophysical criteria discussed above. This will be done per criteria and the end result would be the best Alternative 1, 2 and 3 to take forward to the authorities.

9.1 Soils and Land Capability

In order to identify the most suitable site one must first identify what features are sensitive and should be avoided. In the case of soils and land capability the reasoning is that soil with a high agricultural potential and hence a potential to generate an income for the landowner is more valuable than land that can only be used for grazing or in extreme cases nothing. Therefore the site selection was based on the amount of agricultural soils present within the proposed alternatives. Each of the alternatives is discussed in detail below.

9.1.1 Alternative 1

Alternative 1 is located on soils with a limited depth for 50% of the alternative, 45% agricultural land and 5% wetland soils that are only suitable for grazing. The grazing land is mostly located on Eskom property and used by the Camden village residents as grazing for their livestock. The agricultural land is privately owned and used for the farming of maize.

9.1.2 Alternative 2

Alternative 2 comprises of 35% agricultural land and 65% grazing land. The agricultural sections mostly used for crops in the form of maize. The land is privately owned and it should be noted that the labourers that work on Alternatives 2 and 3 reside on this property.

9.1.3 Alternative 3

Alternative 3 comprises 65% agricultural land and 35% grazing land. Here the agricultural use dominates the alternative as a large private farming operation is found over the bulk of the site.

9.1.4 Preferred Alternative

Alternative 2 presents the smallest section of agricultural land, however it was noted that the site preliminary site footprints extend into Alternative 3. Alternative 2 and 3 is not recommended due to the large farming operation present on the bulk of the site. Alternative 1 also has a large agricultural footprint, however the area is big and a large section does not have agriculture present. It is recommended that if the design can avoid agricultural areas, then Alternative 1 should be considered. This was echoed by discussions with the farmers

on both the southern sites, who indicated they do not want the development within their farming land.

9.2 Ecology

The ecological rating considered the amount of natural habitat available on each alternative as well as the condition that the habitat is in. Each of the alternatives is described below.

9.2.1 Alternative 1

Alternative 1 has been disturbed by borrow pit excavations and some activities associated with the operations of the existing ash disposal facility. Approximately 50% of the site comprises of open grassland that supports some faunal and floral life. There is evidence of overgrazing on the site and some invasive species have recently been cleared from the site. The species diversity is average and there is evidence that sections of the site has been utilised as a borrow pit in the past.

9.2.2 Alternative 2

Alternative 2 has some 65% of the alternative being made up of grassland. The grassland has been used extensively for grazing and the species diversity is quite low.

9.2.3 Alternative 3

The majority of Alternative 3 has been disturbed by agriculture. There are also two large stands of Blue gum trees. However the small section of grassland that remains was very diverse and supported a variety of larger mammals including springbok and steenbok. This area although small, includes two vegetation types and this is why the area is more diverse than the other alternatives.

9.2.4 Preferred Alternative

In terms of the ecological rating, it would be preferred if the site could be located on the land that has been already disturbed by agriculture, if that is the case, either alternative 1 or 3 can be used. However in the view of sustainable development where agriculture, development and nature coexists, it is recommended that Alternative 1 be utilised as it is in the same vicinity as the existing ash disposal site.

9.3 Visual Impact

The visual impact to static observers as well as dynamic observers is described for each of the Alternatives below.

9.3.1 Alternative 1

The visual sensitivities along this alignment are the N2 highway, the Camden village and several small farm houses. The existing ash facility is to the south of this alternative and it is assumed that the visual observers are relatively used to the visual impact as they existing facility has been there for 40 years. Dynamic observers travelling on the N2 highway will have a clear view of the facility, although the recent mining developments to the north of Alternative 1 will provide screening once the mining operation is in place.

9.3.2 Alternative 2 and 3

The Alternative 2 and 3 are located so close together that their visual impact should almost be identical. This area is not as visible from dynamic observers as it is too far away from the N2 highway. However there are more static observers in the form of farm houses and worker accommodation. The visual impact assessment also noted that these alternatives will be visible much further to the south, to people who have not previously been impacted by the ash facilities at Camden.

9.3.3 Preferred alternative

It is recommended that the Alternative 1 option be utilised when considering only the visual impact, as it is located very close to the existing facility and numerous other existing impacts. This alternative will also result in the lowest number of new people being affected by the proposed development.

10 IMPACT ASSESSMENT METHODOLOGY

The impacts will be ranked according to the methodology described below. Where possible, mitigation measures will be provided to manage impacts. In order to ensure uniformity, a standard impact assessment methodology was utilised so that a wide range of impacts can be compared with each other. The impact assessment methodology makes provision for the assessment of impacts against the following criteria:

- Significance;
- Spatial scale;
- Temporal scale;
- Probability; and
- Degree of certainty.

A combined quantitative and qualitative methodology was used to describe impacts for each of the aforementioned assessment criteria. A summary of each of the qualitative descriptors along with the equivalent quantitative rating scale for each of the aforementioned criteria is given in Table 10-1.

Table 10-1: Quantitative rating and equivalent descriptors for the impact assessment criteria

Rating	Significance	Extent Scale	Temporal Scale
1	VERY LOW	*Isolated sites / proposed site*	Incidental
2	LOW	*Study area*	Short-term
3	MODERATE	*Local*	Medium-term
4	HIGH	*Regional / Provincial*	Long-term
5	VERY HIGH	*Global / National*	Permanent

A more detailed description of each of the assessment criteria is given in the following sections.

10.1 Significance Assessment

Significance rating (importance) of the associated impacts embraces the notion of extent and magnitude, but does not always clearly define these since their importance in the rating scale is very relative. For example, the magnitude (i.e. the size) of area affected by atmospheric pollution may be extremely large (1 000 km^2) but the significance of this effect is dependent on the concentration or level of pollution. If the concentration is great, the significance of the impact would be HIGH or VERY HIGH, but if it is diluted it would be VERY

LOW or LOW. Similarly, if 60 ha of a grassland type are destroyed the impact would be VERY HIGH if only 100 ha of that grassland type were known. The impact would be VERY LOW if the grassland type was common. A more detailed description of the impact significance rating scale is given in Table 10-2 below.

Table 10-2 : Description of the significance rating scale

Rating		Description
5	Very high	Of the highest order possible within the bounds of impacts which could occur. In the case of adverse impacts: there is no possible mitigation and/or remedial activity which could offset the impact. In the case of beneficial impacts, there is no real alternative to achieving this benefit.
4	High	Impact is of substantial order within the bounds of impacts, which could occur. In the case of adverse impacts: mitigation and/or remedial activity is feasible but difficult, expensive, time-consuming or some combination of these. In the case of beneficial impacts, other means of achieving this benefit are feasible but they are more difficult, expensive, time-consuming or some combination of these.
3	Moderate	Impact is real but not substantial in relation to other impacts, which might take effect within the bounds of those which could occur. In the case of adverse impacts: mitigation and/or remedial activity are both feasible and fairly easily possible. In the case of beneficial impacts: other means of achieving this benefit are about equal in time, cost, effort, etc.
2	Low	Impact is of a low order and therefore likely to have little real effect. In the case of adverse impacts: mitigation and/or remedial activity is either easily achieved or little will be required, or both. In the case of beneficial impacts, alternative means for achieving this benefit are likely to be easier, cheaper, more effective, less time consuming, or some combination of these.
1	Very low	Impact is negligible within the bounds of impacts which could occur. In the case of adverse impacts, almost no mitigation and/or remedial activity are needed, and any minor steps which might be needed are easy, cheap, and simple. In the case of beneficial impacts, alternative means are almost all likely to be better, in one or a number of ways, than this means of achieving the benefit. Three additional categories must also be used where relevant. They are in addition to the category represented on the scale, and if used, will replace the scale.
0	No impact	There is no impact at all - not even a very low impact on a party or system.

10.2 Spatial Scale

The spatial scale refers to the extent of the impact i.e. will the impact be felt at the local, regional, or global scale. The spatial assessment scale is described in more detail in Table 10-3.

Table 10-3 : Description of the significance rating scale

Rating		Description
5	Global/National	The maximum extent of any impact.
4	Regional/Provincial	The spatial scale is moderate within the bounds of impacts possible, and will be felt at a regional scale (District Municipality to Provincial Level).
3	Local	The impact will affect an area up to 5 km from the proposed alternatives.
2	Study Area	The impact will affect an area not exceeding the Eskom property.
1	Isolated Sites / proposed site	The impact will affect an area no bigger than the ash disposal facility.

10.3 Duration Scale

In order to accurately describe the impact it is necessary to understand the duration and persistence of an impact in the environment. The temporal scale is rated according to criteria set out in Table 10-4.

Table 10-4: Description of the temporal rating scale

Rating		Description
1	Incidental	The impact will be limited to isolated incidences that are expected to occur very sporadically.
2	Short-term	The environmental impact identified will operate for the duration of the construction phase or a period of less than 5 years, whichever is the greater.
3	Medium term	The environmental impact identified will operate for the duration of life of plant.
4	Long term	The environmental impact identified will operate beyond the life of operation.
5	Permanent	The environmental impact will be permanent.

10.4 Degree of Probability

Probability or likelihood of an impact occurring will be described as shown in Table 10-5 below.

Table 10-5 : Description of the degree of probability of an impact occurring

Rating	Description
1	Practically impossible
2	Unlikely
3	Could happen
4	Very Likely
5	It's going to happen / has occurred

10.5 Degree of Certainty

As with all studies it is not possible to be 100% certain of all facts, and for this reason a standard "degree of certainty" scale is used as discussed in Table 10-6. The level of detail for specialist studies is determined according to the degree of certainty required for decision-making. The impacts are discussed in terms of affected parties or environmental components.

Table 10-6 : Description of the degree of certainty rating scale

Rating	Description
Definite	More than 90% sure of a particular fact.
Probable	Between 70 and 90% sure of a particular fact, or of the likelihood of that impact occurring.
Possible	Between 40 and 70% sure of a particular fact or of the likelihood of an impact occurring.
Unsure	Less than 40% sure of a particular fact or the likelihood of an impact occurring.
Can't know	The consultant believes an assessment is not possible even with additional research.
Don't know	The consultant cannot, or is unwilling, to make an assessment given available information.

10.6 Quantitative Description of Impacts

To allow for impacts to be described in a quantitative manner in addition to the qualitative description given above, a rating scale of between 1 and 5 was used for each of the assessment criteria. Thus the total value of the impact is described as the function of significance, spatial and temporal scale as described below:

Impact Risk = (SIGNIFICANCE **+** *Spatial* **+** Temporal) X Probability

3 **5**

An example of how this rating scale is applied is shown below:

Table 10-7 : Example of Rating Scale

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
	LOW	*Local*	Medium-term	*Could Happen*	
Impact to air	**2**	***3***	**3**	**3**	**1.6**

Note: The significance, spatial and temporal scales are added to give a total of 8, that is divided by 3 to give a criteria rating of 2,67. The probability (3) is divided by 5 to give a probability rating of 0,6. The criteria rating of 2,67 is then multiplied by the probability rating (0,6) to give the final rating of 1,6.

The impact risk is classified according to five classes as described in the table below.

Table 10-8 : Impact Risk Classes

Rating	Impact Class	Description
0.1 – 1.0	**1**	**Very Low**
1.1 – 2.0	**2**	**Low**
2.1 – 3.0	**3**	**Moderate**
3.1 – 4.0	**4**	**High**
4.1 – 5.0	**5**	**Very High**

Therefore with reference to the example used for air quality above, an impact rating of 1.6 will fall in the Impact Class 2, which will be considered to be a low impact.

10.7 Cumulative Impacts

It is a requirement that the impact assessments take cognisance of cumulative impacts. In fulfilment of this requirement the impact assessment will take cognisance of any existing impact sustained by the operations, any mitigation measures already in place, any additional impact to environment through continued and proposed future activities, and the residual impact after mitigation measures.

It is important to note that cumulative impacts at the national or provincial level will not be considered in this assessment, as the total quantification of external companies on resources is not possible at the project level due to the lack of information and research documenting the effects of existing activities. Such cumulative impacts that may occur across industry boundaries can also only be effectively addressed at Provincial and National Government levels.

Using the criteria as described above an example of how the cumulative impact assessment will be done is shown below:

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Initial / Existing Impact (I-IA)	**2**	**2**	**2**	*1*	0.4
Additional Impact (A-IA)	**1**	***2***	**1**	*1*	0.3
Cumulative Impact (C-IA)	**3**	***4***	**2**	*1*	0.6
Residual Impact after mitigation (R-IA)	**2**	***1***	**2**	*1*	0.3

As indicated in the example above the Additional Impact Assessment (A-IA) is the amount that the impact assessment for each criterion will increase. Thus if the initial impact will not increase, as shown for temporal scale in the example above the A-IA will be 0, however, where the impact will increase by two orders of magnitude from 2 to 4 as in the spatial scale the A-IA is 2. The Cumulative Impact Assessment (C-IA) is thus the sum of the Initial Impact Assessment (I-IA) and the A-IA for each of the assessment criteria.

In both cases the I-IA and A-IA are assessed without taking into account any form of mitigation measures. As such the C-IA is also a worst case scenario assessment where no mitigation measures have been implemented. Thus a Residual Impact Assessment (R-IA) is also made which takes into account the C-IA with mitigation measures. The latter is the most probable case scenario, and for the purpose of this report is considered to be the final state Impact Assessment.

10.8 Notation of Impacts

In order to make the report easier to read the following notation format is used to highlight the various components of the assessment:

- Significance or magnitude- IN CAPITALS
- Temporal Scale – in underline
- Probability – *in italics and underlined*.
- Degree of certainty - **in bold**
- Spatial Extent Scale – *in italics*

11 IMPACT ASSESSMENT

The Impact Assessment will highlight and describe the impact to the environment following the above mentioned methodology and will assess the following components:

- Surface water and wetlands;
- Soils and land capability
- Flora and fauna; and
- Visual impact.

The impact of each alternative was assessed separately, however, where the impact was not significantly different, only one impact assessment was undertaken. At the time of writing it was assumed that a 125 ha area was required for the proposed ash disposal facility.

During the construction phase the ash facility footprint will be cleared. Once cleared the foundation / layer works required for any required barrier system will be constructed prior to the construction of the cells and the daywalls. In addition the construction phase will include the relocation of any services (power lines, pipelines and electrical services) requried for the operation of the ash facility. Earthmoving equipment will be the major activity on site.

Once operational the cells will be in place and the pumps will prepare the day-walls of the cells prior to the start of pumping the ash slurry into the facility. The facility will grow cell by cell and the ash facility will grow in height as the volume increases.

During closure the site will be capped and revegeted in order to prevent any further infiltration of water into the waste body. Drainge from the site will be finalised and left to be free-draining into natural features.

11.1.1 Soils and Land Capability

Soils and land capability need to be grouped together, because the type of soil will determine the capability of the land and what the land can be used for in the future. If the soil is arable, then it is suitable for farming and the land use will be farms.

Initial Impact

The study area is dominated by mining, agricultural land with patches of industry, rural and urban settlements. The bulk of the existing impacts to soils on the site comes in the form of the exising ash disposal facility, the power station footprint, Camden village as well as recent mining operations to the north of Alternative 1. In addition there are one existing and one decomissioned borrow pits on the area just to the north of the existing facility. It should be noted that most of these impacts are limited to the soils with a low agricultural capability.

The initial impact to soils and land capability is **probably** a LOW negative impact acting over the long term, and is *presently occurring* in the *study area*. As indicated in the table below the impact rating class is a Moderate Impact.

Table 11-1: Soil and Land Capability Initial Impact Assessment

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Const	LOW	*Study Site*	Long Term	*Is occurring*	Moderate
	2	**2**	**4**	**5**	**2.67**

Additional Impact

The additional impact from the ash disposal facility will be the removal and earthworks of the soils that will be under the proposed 125 ha footprint. The ash disposal facility will be a permanent feature in the landscape. The heavy vehicles traversing can compact the soils as the soils are excavated. At present it is unsure if the construction will require a barrier system that requires clay material. If this is indeed the case, then material will have to be purchased from a supplier or a borrow pit will have to be established to remove this material from a suitable source. If a borrow pit is required this will require a separate environmental authorisation.

No matter which alternative is chosen, there is a chance that some agricultural soils will be impacted upon and sterilised by the proposed development. The agricultural soils on Alternatives 1 and 2 are only a portion of the alternative, while almost the entire Alternative 3 comprises agricultural soils. Therefore the additional impact to agricultural soils and land capability is **probably** a HIGH negative impact acting over the long term, and *will definitely occur* at *isolated sites* at Alternatives 1 and 2, but throughout the whole *study area* for Alternative 3. As indicated in the table below the impact rating class is a High Impact.

Table 11-2: Soil and Land Capability Additional Impact Assessment

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Constr (Alt 1 and 2)	High	*Isolated Sites*	Long Term	*Will occur*	High
	4	**1**	**4**	**5**	**3**
Constr (Alt 3)	High	*Study Site*	Long Term	*Will occur*	High
	4	**2**	**4**	**5**	**3.33**
Operat	High	*Isolated Sites*	Permanent	*Will occur*	High
	4	**1**	**5**	**5**	**3.33**
Closure	High	*Isolated Sites*	Permanent	*Could happen*	Moderate
	4	**1**	**5**	**3**	**2**

During operations the ash will be disposed on the prepared foundations, barrier system and cells. During this phase the impact that started with the construction of the foundations will become permanent. In addition there is the potential spillage from the site, spillage from the pipelines carrying the ash to the site, and the potential contamination of the soils under the ash disposal site if no adequate barrier system (liner) is placed underneath the ash. As per the table above, this impact is rated as a High impact.

Once the power station closes the ash flow will cease, the slopes and top of the ash facility will be capped, covered in topsoil and vegetation established. However if the site is not capped and rehabilitated then there is a strong possibility that the site could still receive rainfall, and this water could leach through the ash body into the soils below. This is rated as a Moderate impact.

Cumulative Impact

The cumulative impact to soils over the larger study area remains as assessed for the initial assessment, i.e. a Moderate impact. This is mainly due to the fact that although the soils will be impacted on by this proposed development, there are large pieces of land still unaffected.

Mitigation Measures

- Avoid unnecessary removal of vegetation cover.
- Use existing access roads as far as possible;
- If a new road is constructed, ensure that some measure of erosion prevention is followed;
- Take land use into consideration when completing the design of the facility, it is recommended that cultivated areas be avoided if possible;
- Spread absorbent sand or drip trays on areas where oil spills are likely to occur, such as the refuelling area in the hard park;
- Oil-contaminated soils are to be removed to a contained storage area and bio-remediated or disposed of at a licensed facility;
- Use berms to minimise erosion where vegetation is disturbed, including hard parks, plant sites and office areas;
- Ensure that the waste body has a storm water drainage system that prevents dirty water from contaminating the adjacent soil;
- Ensure that the waste disposal site is lined and a leachate collection system is installed to prevent leachate from entering the underlying soil;
- Once operations cease, ensure that the site is properly capped, topsoiled and revegetated;

- If soils are excavated for the foundations, ensure that the soil is utilised elsewhere for rehabilitation/road building purposes; and
- Ensure that soil is stockpiled in such a way as to prevent erosion from storm water.

Residual Impact

The mitigation measures proposed above will not affect the impact rating during construction, which will remain a high as shown in the table below. However the installation of a barrier system, along with proper capping and rehabilitation of the facility will reduce the potential impacts such as polluted water entering the soil during operations and closure. These impacts will reduce to a Low impact during operations and a Very Low impact during closure.

Table 11-3: Soil and Land Capability Residual Impact Assessment

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Constr	High	*Isolated Sites*	Long Term	*Will occur*	High
	4	**1**	**4**	**5**	**3**
Operat	Low	*Isolated Sites*	Permanent	*Could happen*	Low
	2	**1**	**5**	**3**	**1.6**
Closure	Very Low	*Isolated Sites*	Incidental	*Could happen*	Very Low
	1	**1**	**1**	**3**	**0.6**

11.1.2 Flora and Fauna

Initial Impact

The vegetation in and around the study area has significantly been transformed by farming activities, mining, urbanisation and industrial activities. In addition, the remaining natural vegetation is being utilised for grazing and is being invaded by alien invasive species. The vegetation units present on site are rated as disturbed and not highly conserved.

The initial impacts to biodiversity include extensive grazing, cultivation and alien invasive colonisation. The initial impact to fauna and flora is **definitely** MODERATE negative impact acting over the long term, and is *presently occurring* in the *local area*. As indicated in the table above the impact rating class is a High Impact.

Table 11-4: Fauna and Flora Initial Impact Rating Scale

Impact	Significance	*Spatial Scale*	Temporal Scale	Probability	Rating
Impact to Fauna and Flora	MODERATE	*Local*	Long Term	*Is occurring*	High
	3	***3***	**4**	**5**	**3.3**

Additional Impact

Additional impacts will be the removal of vegetation within the proposed footprint of the facility. In this 125 ha area all vegetation will be stripped and the soil prepared for the foundations. Once the structures are in place the vegetation will not be able to re-establish itself. Any fauna present in this proposed footprint will be driven off onto the surrounding habitat. This impact is rated as a High impact.

Once operational the impact to biodiversity would be from potential spillage or leakage from the site. Contaminated water could seep into the freshwater bodies and impact on the health of animals and plants. In addition wading avifauna might try to land on the facility if they mistake the open water for potential habitat. In addition the proposed power line relocations could also expose animals to electrocution, although this was an existing impact that is merely relocated. Although this impact has a high significance, the probability is lower, resulting in a Low impact rating.

During the closure phase the ash flow will stop and operations will leave the site. If the facility is just left as is, there is again the potential for rainfall to land on the facility, leach through the ash and contaminate the water supplies and soil that the biodiversity life off. This potential impact is rated as a Moderate impact.

Table 11-5: Fauna and Flora Additional-Impact Rating

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Construct	HIGH	*Proposed site*	Long Term	*It's going to happen*	High
	4	***1***	**4**	**5**	**3**
Operate	HIGH	*Proposed site*	Long Term	*Could happen*	Low
	4	***1***	**4**	**3**	**1.8**
Closure	HIGH	*Proposed site*	Long Term	*Very likely*	Moderate
	4	***1***	**4**	**4**	**2.4**

Cumulative Impact

The cumulative impact will remain as assessed for the initial impact assessment, i.e. a High impact. The additional impact of the ash disposal facility in an area already impacted by mining, farming and industry is not deemed significant enough to change the rating.

Mitigation Measures

- All construction areas should be demarcated prior to construction to ensure that the footprint of the impacts are limited (including areas where vehicles may traverse);

- A suitable seedmix of indigenous plants should be used in all rehabilitation programmes on the site.
- All alien invasive species on site should be removed and follow up monitoring and removal programmes should be initiated once construction is complete
- The wetland vegetation unit should be avoided and construction limited to 50 m from the edge of the wetlands and streams;
- Install an authority approved barrier system to prevent contamination of the soils and water bodies;
- Once operations cease, ensure that the site is capped, topsoiled and revegetated prior to leaving the site;
- Ensure that only indigenous plants are utilised during revegation work;
- Adhere to the ESKOM transmission vegetation management guideline when relocating power lines; and
- Align ash disposal site designs and the relocation of power line routes to avoid sensitive habitats.

Residual Impact

The successful implementation of the mitigation measures proposed above will ensure that the impact during construction remains a Moderate impact. However the installation of the barrier system as well as proper capping and rehabilitation will see the impacts for operations and closure reduce to potentially Very Low impacts.

Table 11-6: Vegetation Residual-Impact Rating Scale

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Construct	MODERATE	*Proposed site*	Long Term	*It's going to happen*	Moderate
	3	***1***	**4**	**5**	**2.67**
Operate	Low	*Proposed site*	Incidental	*Could happen*	Very Low
	2	***1***	**1**	**3**	**0.8**
Closure	Low	*Proposed site*	Incidental	*Could happen*	Very Low
	2	***1***	**1**	**3**	**0.8**

11.1.3 Surface Water and Wetlands

Surface water and wetland features are demarcated as sensitive because of the high variety of fauna and flora that occur in such areas and the ecosystem function that they perform.

Initial Impact

The existing De Jager's Pan has been utilised as a dirty return water dam for over 40 years, resulting in significant reduction in the water quality and a long term impact. The seepage from the existing ash disposal facility has resulted in artificial wetlands being established in these areas of continued wetness. These areas are also contaminated with ash and silt from the current disposal facility. This is rated as a High initial impact as shown in the table below.

Table 11-7: Surface water /wetlands Initial Impact Rating

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Impact to Surface water	VERY HIGH	*Study Area*	Long Term	*Is occurring*	High
	5	***2***	**4**	**5**	**3.67**

Additional Impact

The construction of the proposed facility will alter the drainage pattern of which ever part of the site is chosen. If the site is developed too close to a surface water body or wetland, silt and dust from the activities can enter the water and contaminate the system. In addition the eart-moving equipment could also spill hydrocarbons or workers could litter and these impacts could also enter these systems. This potential impact is rated as a Low impact as shown in the table below.

Table 11-8: Surface water/wetlands Additional-Impact Rating

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Construct	MODERATE	*Isolated sites / proposed site*	Short Term	*Could Happen*	Low
	3	***1***	**2**	**3**	**1.2**
Operate	HIGH	*Local Area*	Medium Term	*It's going to happen*	High
	4	***3***	**3**	**5**	**3.3**
Closure	HIGH	*Local Area*	Medium Term	*It's going to happen*	High
	4	***3***	**3**	**5**	**3.3**

During operations the wet ash has the potential to leach contaminants into the water, as discussed in both sections above (without liner/barrier system installed). Whether this occurs under the proposed facility or en-route when a pipeline fails, there is a risk of this impact occurring. Without any barrier systems and storm water control systems this impact would be rated a High impact.

The same applies during closure. If the site is not capped, topsoiled and revegetated then the storm water coming into contact with the ash will be contaminated and then enter the natural systems. This is also rated a High impact.

Cumulative Impact

The initial impact to the features within the study area is so high that the potential additional impact does not change the impact rating. This impact remains a High impact.

Mitigation Measures

- No construction should take place within 50m from the edge of a surface water body/wetland.
- Demarcated areas where waste can be safely contained and stored on a temporary basis during the construction phase should be provided at the hard park;
- Waste is not to be buried on site;
- Hydro-carbons should be stored in a bunded storage area;
- All hazardous materials inter alia paints, turpentine and thinners must be stored appropriately to prevent these contaminants from entering the environment;
- Spill-sorb or similar type product must be used to absorb hydrocarbon spills in the event that such spills should occur;
- Care must be taken to ensure that in removing vegetation adequate erosion control measures are implemented;
- A storm-water management plan, including sufficient erosion-control measures, must be compiled in consultation with a suitably qualified environmental practitioner / control officer during the detailed design phase prior to the commencement of construction;
- Install a dirty-water collection system to prevent contaminated water entering the natural system. This water should be recycled or re-used in the existing power station processes;
- Demarcate the no-go areas with tape and ensure that the demarcation remains in place for the duration of the construction works;
- Install an authority approved barrier system to prevent contamination of the soils and water bodies;
- Once operations cease, ensure that the site is capped, topsoiled and revegetated prior to leaving the site;
- If the final site location is within 500m of a wetland or surface water body, ensure that a WULA application is submitted to DWA and approved prior to commencement of any work;

- Use existing river/wetland crossings where possible; and
- The propagation of low-growing dense vegetation suitable for the habitat such as grasses, sedges or reeds is the best natural method to reduce erosion potential in sensitive areas.

Residual Impact

The mitigation measures proposed will reduce the risk of the additional impact occurring during construction, but it will not reduce the residual impact class, which remains at a Low impact. During operations and closure however, the installation of the barrier system, the storm water control system and the capping and revegetation of the site during closure will reduce the potential impacts to a Low impact during each of these phases.

Table 11-9: Surface water/wetlands Additional-Impact Rating

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Construct	LOW	*Isolated sites / proposed site*	Short Term	*Could Happen*	Low
	2	***1***	**2**	**3**	**1.0**
Operate	LOW	*Study Area*	Incidental	*Could Happen*	Low
	2	***2***	**1**	**3**	**1.0**
Closure	LOW	*Study Area*	Incidental	*Could Happen*	Low
	2	***2***	**1**	**3**	**1.0**

11.1.4 Visual

Initial Impact

The visual character of each of the alternatives is described in Section 8. The present visual landscape is one dominated by agriculture with intermittent rural residences, urban areas and industrial or mining activities. The study site includes the Camden Power Station, Camden Village, the existing ash disposal facility and several existing high voltage power lines that impact on the visual character of the landscape. The initial visual impact is rated as a High impact.

Table 11-10: Visual Initial Rating

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Impact to Visual	MODERATE	*Local*	Long Term	*Has occurred*	High
	3	***3***	**4**	**5**	**3.33**

Additional Impact

The additional impact of the proposed development during construction will be from the earthworks that have to be undertaken. It is likely that dust as well as all the plant movements will be visible to observers. With this being a short term impact the impact is rated as a Moderate impact. Alternative 1 is more visible from the N2 highway than the other two alternatives, however this area is also much more developed with existing open cast mining activities surrounding the site, and hence the observers will be less inclined to notice the activities on the proposed site.

In addition the existing transmission lines on site will most likely require slight re-alignments to avoid the ash facility. Although the visual environment will be slightly modified on a site specific scale, the study area is criss-crossed by more than 18 power lines and the potential impact from a re-alignment is regarded as negligible.

Table 11-11: Visual Visual Additional Impact Rating

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
Construct	LOW	*Local*	Short Term	*It's going to happen*	Moderate
	2	***3***	**2**	**5**	**2.33**
Operate	MODERATE	*Local*	Long Term	*It's going to happen*	High
	3	***3***	**4**	**5**	**3.33**
Closure	MODERATE	*Local*	Long Term	*It's going to happen*	High
	3	***3***	**4**	**5**	**3.33**

During operations the ash disposal site will slowly increase in size over the life of the facility and gradually become more and more visible. In addition there is a chance that as the ash material dries out on the facility, the wind can mobilise the dust and result a visible impact unless appropriately rehabilitated.

During closure the potential impact from wind-blown dust is increased as there is no more moisture coming onto the facility and without capping and revegetation this impact is rated as a High impact as well.

Cumulative Impact

With the large number of visual impacts ocurring within the study area including opencast mining, the existing power station and its assiciated infrastructure and the Camden Village, the addition of the ash facility will not increase the existing visual impact beyond a High impact.

Mitigation Measures

- Only the footprint of the proposed site should be exposed. In all other areas, the natural vegetation should be retained;
- Dust suppression techniques should be in place at all times during the construction phase;
- Access roads should be minimised to prevent unnecessary dust;
- Ensure that dust is monitored as part of the air quality management plan;
- Utilise non-shiny structures for the hard park and toilets, i.e. avoid unpainted roofs; and
- Ensure that the site is capped, topsoiled and revegetated at closure to resemble the natural landscape.

Residual Impact

The visual impact of the proposed ash disposal site can not be mitigated and therefore the mitigation measures merely ensure that the additional impact is managed responsibly. The residual impact remains a Moderate impact during construction and a High impact during operations. However the proper capping, topsoiling and vegetating of the facility once operations cease will create a feature that resembles the natural landscape. This rehabilitation will reduce the impact rating to a Moderate impact after closure.

12 CONCLUSION

In conclusion the proponent proposes to construct and operate an ash disposal facility at Camden Power Station. Zitholele Consulting was appointed to screen the biophysical aspects and stakeholder sensitivities of the proposed routes. The aspects investigated include soils, agricultural potential, wetland, surface water, terrestrial ecology and visual impacts.

It was found that the major areas of concern were the wetlands and associated biodiversity, visual impact and loss of agricultural land. Most of the elements analysed indicate that the impacts from Alternatives 1 could be less as this part of the site is surrounded by existing development and structures.

If the facility is constructed, operated and closed with the mitigation measures proposed in this report the development will have impacts that are within the acceptable range. The need for the development is clear, but to ensure the placement of the facility in the position with the smallest environmental impact is essential.

ZITHOLELE CONSULTING (PTY) LTD

Konrad Kruger Warren Kok

C:\USERS\KONRAD\DOCUMENTS\WERK\KONRAD HOMEWORK\CAMDEN\BIOPHYSICAL\12670_CAMDEN SPES REPORT.DOC

Appendix 1: Species Lists

Family Name	Species Name
ACANTHACEAE	Chaetacanthus costatus
ACANTHACEAE	Crabbea acaulis
ACANTHACEAE	Justicia anagalloides
ACANTHACEAE	Thunbergia atriplicifolia
AMARYLLIDACEAE	Boophone disticha
AMARYLLIDACEAE	Crinum bulbispermum
AMARYLLIDACEAE	Haemanthus humilis subsp. hirsutus
AMARYLLIDACEAE	Scadoxus puniceus
ANACARDIACEAE	Searsia dentata
ANACARDIACEAE	Searsia pyroides var. gracilis
ANEMIACEAE	Mohria nudiuscula
ANTHERICACEAE	Chlorophytum cooperi
ANTHERICACEAE	Chlorophytum haygarthii
APIACEAE	Conium chaerophylloides
APIACEAE	Pimpinella transvaalensis
APOCYNACEAE	Asclepias aurea
APOCYNACEAE	Aspidoglossum glanduliferum
APOCYNACEAE	Brachystelma foetidum
APOCYNACEAE	Carissa bispinosa
APOCYNACEAE	Miraglossum davyi
APOCYNACEAE	Miraglossum pulchellum
APOCYNACEAE	Parapodium costatum
APOCYNACEAE	Raphionacme hirsuta
APOCYNACEAE	Schizoglossum stenoglossum subsp. latifolium
APOCYNACEAE	Sisyranthus imberbis
AQUIFOLIACEAE	Ilex mitis var. mitis
ARACEAE	Zantedeschia aethiopica
ARACEAE	Zantedeschia albomaculata subsp. macrocarpa
ASPARAGACEAE	Asparagus asparagoides
ASPARAGACEAE	Asparagus cooperi
ASPARAGACEAE	Asparagus virgatus
ASPHODELACEAE	Bulbine abyssinica
ASPHODELACEAE	Trachyandra asperata var. carolinensis
ASPHODELACEAE	Trachyandra saltii var. saltii
ASPLENIACEAE	Asplenium aethiopicum
ASPLENIACEAE	Asplenium platyneuron
ASTERACEAE	Adenanthellum osmitoides
ASTERACEAE	Aster bakerianus
ASTERACEAE	Aster lydenburgensis
ASTERACEAE	Berkheya setifera
ASTERACEAE	Bidens pilosa

Family Name	Species Name
ASTERACEAE	Callilepis lancifolia
ASTERACEAE	Conyza pinnata
ASTERACEAE	Denekia capensis
ASTERACEAE	Dicoma anomala subsp. anomala
ASTERACEAE	Euryops transvaalensis subsp. setilobus
ASTERACEAE	Euryops transvaalensis subsp. transvaalensis
ASTERACEAE	Felicia hispida
ASTERACEAE	Felicia muricata subsp. muricata
ASTERACEAE	Gerbera piloselloides
ASTERACEAE	Gymnanthemum corymbosum
ASTERACEAE	Haplocarpha scaposa
ASTERACEAE	Helichrysum aureonitens
ASTERACEAE	Helichrysum callicomum
ASTERACEAE	Helichrysum cephaloideum
ASTERACEAE	Helichrysum chionosphaerum
ASTERACEAE	Helichrysum miconiifolium
ASTERACEAE	Helichrysum nudifolium var. nudifolium
ASTERACEAE	Helichrysum nudifolium var. pilosellum
ASTERACEAE	Helichrysum oreophilum
ASTERACEAE	Helichrysum pallidum
ASTERACEAE	Helichrysum rugulosum
ASTERACEAE	Helichrysum splendidum
ASTERACEAE	Hilliardiella aristata
ASTERACEAE	Hilliardiella hirsuta
ASTERACEAE	Othonna natalensis
ASTERACEAE	Pseudognaphalium luteo-album
ASTERACEAE	Schistostephium rotundifolium
ASTERACEAE	Senecio breviscapus
ASTERACEAE	Senecio bupleuroides
ASTERACEAE	Senecio coronatus
ASTERACEAE	Senecio erubescens var. erubescens
ASTERACEAE	Senecio hieracioides
ASTERACEAE	Senecio subcoriaceus
BALSAMINACEAE	Impatiens hochstetteri subsp. hochstetteri
BARTRAMIACEAE	Philonotis falcata
BLECHNACEAE	Blechnum australe subsp. australe
BRASSICACEAE	Cardamine africana
BRASSICACEAE	Heliophila rigidiuscula
BRASSICACEAE	Rorippa nudiuscula
BUDDLEJACEAE	Buddleja auriculata
CAMPANULACEAE	Wahlenbergia undulata
CAMPANULACEAE	Wahlenbergia virgata
CAPPARACEAE	Cleome monophylla

Family Name	Species Name
CARYOPHYLLACEAE	Corrigiola litoralis subsp. litoralis var. litoralis
COLCHICACEAE	Colchicum striatum
COLCHICACEAE	Gloriosa modesta
COLCHICACEAE	Littonia modesta
COMMELINACEAE	Commelina africana var. africana
COMMELINACEAE	Commelina africana var. lancispatha
COMMELINACEAE	Cyanotis speciosa
CONVOLVULACEAE	Ipomoea crassipes var. crassipes
CRASSULACEAE	Crassula compacta
CUCURBITACEAE	Cucumis hirsutus
CUCURBITACEAE	Trochomeria hookeri
CUCURBITACEAE	Zehneria scabra subsp. scabra
CYPERACEAE	Abildgaardia ovata
CYPERACEAE	Bulbostylis oritrephes
CYPERACEAE	Cyperus congestus
CYPERACEAE	Cyperus cyperoides subsp. cyperoides
CYPERACEAE	Cyperus obtusiflorus var. flavissimus
CYPERACEAE	Cyperus obtusiflorus var. obtusiflorus
CYPERACEAE	Cyperus sp.
CYPERACEAE	Cyperus sphaerospermus
CYPERACEAE	Fimbristylis complanata
CYPERACEAE	Fuirena pubescens var. pubescens
CYPERACEAE	Isolepis costata
CYPERACEAE	Kyllinga melanosperma
CYPERACEAE	Mariscus uitenhagensis
CYPERACEAE	Scirpoides burkei
CYPERACEAE	Scleria bulbifera
DENNSTAEDTIACEAE	Pteridium aquilinum subsp. aquilinum
DIOSCOREACEAE	Dioscorea retusa
DIOSCOREACEAE	Dioscorea sylvatica var. rehmannii
DROSERACEAE	Drosera collinsiae
DRYOPTERIDACEAE	Dryopteris inaequalis
DRYOPTERIDACEAE	Polystichum transvaalense
EBENACEAE	Diospyros lycioides subsp. guerkei
EBENACEAE	Diospyros whyteana
EBENACEAE	Euclea crispa subsp. crispa
EBENACEAE	Euclea sp.
EQUISETACEAE	Equisetum ramosissimum subsp. ramosissimum
ERICACEAE	Erica cerinthoides var. cerinthoides
ERICACEAE	Erica oatesii var. oatesii
ERIOSPERMACEAE	Eriospermum cooperi var. cooperi
ERIOSPERMACEAE	Eriospermum flagelliforme
EUPHORBIACEAE	Acalypha angustata

Family Name	Species Name
EUPHORBIACEAE	Acalypha depressinerva
EUPHORBIACEAE	Acalypha sp.
EUPHORBIACEAE	Acalypha wilmsii
EUPHORBIACEAE	Adenocline acuta
EUPHORBIACEAE	Clutia hirsuta var. hirsuta
EUPHORBIACEAE	Clutia monticola var. monticola
EUPHORBIACEAE	Clutia pulchella var. pulchella
EUPHORBIACEAE	Erythrococca menyharthii
EUPHORBIACEAE	Euphorbia epicyparissias
EUPHORBIACEAE	Euphorbia natalensis
EUPHORBIACEAE	Euphorbia pseudotuberosa
EUPHORBIACEAE	Euphorbia striata var. cuspidata
FABACEAE	Argyrolobium stipulaceum
FABACEAE	Eriosema cordatum
FABACEAE	Eriosema kraussianum
FABACEAE	Eriosema salignum
FABACEAE	Erythrina zeyheri
FABACEAE	Indigofera krookii
FABACEAE	Indigofera oxytropis
FABACEAE	Lotononis foliosa
FABACEAE	Lotononis pottiae
FABACEAE	Lotus discolor subsp. discolor
FABACEAE	Otholobium wilmsii
FABACEAE	Rhynchosia effusa
FABACEAE	Rhynchosia nervosa var. nervosa
FABACEAE	Rhynchosia reptabunda
FABACEAE	Rhynchosia sordida
FABACEAE	Rhynchosia totta var. totta
FABACEAE	Trifolium africanum var. africanum
FABACEAE	Vigna unguiculata subsp. unguiculata var. unguiculata
FABACEAE	Vigna vexillata var. vexillata
GENTIANACEAE	Sebaea repens
GERANIACEAE	Geranium multisectum
GERANIACEAE	Pelargonium alchemilloides
GERANIACEAE	Pelargonium luridum
GESNERIACEAE	Streptocarpus pentherianus
GUNNERACEAE	Gunnera perpensa
HYACINTHACEAE	Albuca baurii
HYACINTHACEAE	Dipcadi gracillimum
HYACINTHACEAE	Dipcadi sp.
HYACINTHACEAE	Ledebouria cooperi
HYACINTHACEAE	Ornithogalum monophyllum subsp. monophyllum
HYACINTHACEAE	Ornithogalum tenuifolium subsp. tenuifolium

Family Name	Species Name
HYPOXIDACEAE	Empodium elongatum
HYPOXIDACEAE	Hypoxis argentea var. argentea
HYPOXIDACEAE	Hypoxis filiformis
HYPOXIDACEAE	Hypoxis galpinii
HYPOXIDACEAE	Hypoxis rigidula var. pilosissima
HYPOXIDACEAE	Hypoxis rigidula var. rigidula
HYPOXIDACEAE	Hypoxis villosa var. obliqua
IRIDACEAE	Aristea torulosa
IRIDACEAE	Dietes iridioides
IRIDACEAE	Gladiolus crassifolius
IRIDACEAE	Gladiolus longicollis subsp. platypetalus
IRIDACEAE	Watsonia pulchra
LAMIACEAE	Ajuga ophrydis
LAMIACEAE	Ocimum obovatum subsp. obovatum var. obovatum
LAMIACEAE	Premna mooiensis
LAMIACEAE	Pycnostachys reticulata
LAMIACEAE	Rotheca hirsuta
LAMIACEAE	Syncolostemon concinnus
LOBELIACEAE	Lobelia erinus
LOBELIACEAE	Monopsis decipiens
LYTHRACEAE	Nesaea sagittifolia var. sagittifolia
MALVACEAE	Corchorus confusus
MALVACEAE	Hermannia cristata
MALVACEAE	Hibiscus trionum
MALVACEAE	Malva verticillata var. verticillata
MALVACEAE	Sparrmannia ricinocarpa var. ricinocarpa
MENISPERMACEAE	Stephania abyssinica var. tomentella
MENYANTHACEAE	Nymphoides thunbergiana
MESEMBRYANTHEMACEAE	Delosperma sutherlandii
MYRSINACEAE	Myrsine africana
OLEACEAE	Jasminum streptopus var. transvaalensis
ORCHIDACEAE	Disa chrysostachya
ORCHIDACEAE	Disa stachyoides
ORCHIDACEAE	Eulophia hians var. hians
OROBANCHACEAE	Graderia scabra
OROBANCHACEAE	Striga bilabiata subsp. bilabiata
OROBANCHACEAE	Striga elegans
OXALIDACEAE	Oxalis corniculata
OXALIDACEAE	Oxalis obliquifolia
POACEAE	Agrostis eriantha var. eriantha
POACEAE	Alloteropsis semialata subsp. eckloniana
POACEAE	Andropogon appendiculatus
POACEAE	Andropogon eucomus

Family Name	Species Name
POACEAE	Andropogon schirensis
POACEAE	Aristida junciformis subsp. galpinii
POACEAE	Brachiaria bovonei
POACEAE	Brachiaria serrata
POACEAE	Brachiaria subulifolia
POACEAE	Bromus leptoclados
POACEAE	Ctenium concinnum
POACEAE	Cynodon dactylon
POACEAE	Digitaria diagonalis var. diagonalis
POACEAE	Digitaria monodactyla
POACEAE	Digitaria tricholaenoides
POACEAE	Diheteropogon filifolius
POACEAE	Echinochloa jubata
POACEAE	Elionurus muticus
POACEAE	Eragrostis capensis
POACEAE	Eragrostis chloromelas
POACEAE	Eragrostis patentissima
POACEAE	Eragrostis plana
POACEAE	Eragrostis planiculmis
POACEAE	Eragrostis racemosa
POACEAE	Festuca caprina
POACEAE	Festuca costata
POACEAE	Festuca longipes
POACEAE	Harpochloa falx
POACEAE	Heteropogon contortus
POACEAE	Hyparrhenia dregeana
POACEAE	Imperata cylindrica
POACEAE	Koeleria capensis
POACEAE	Leersia hexandra
POACEAE	Melinis nerviglumis
POACEAE	Microchloa caffra
POACEAE	Microchloa kunthii
POACEAE	Monocymbium ceresiiforme
POACEAE	Panicum ecklonii
POACEAE	Pennisetum thunbergii
POACEAE	Rendlia altera
POACEAE	Sacciolepis typhura
POACEAE	Setaria nigrirostris
POACEAE	Setaria sphacelata var. sphacelata
POACEAE	Stiburus conrathii
POACEAE	Themeda triandra
POACEAE	Trachypogon spicatus
POACEAE	Tristachya leucothrix

Family Name	Species Name
POLYGALACEAE	Polygala gerrardii
POLYGALACEAE	Polygala houtboshiana
POLYGALACEAE	Polygala leendertziae
POLYGONACEAE	Rumex acetosella subsp. angiocarpus
POLYGONACEAE	Rumex dregeanus subsp. montanus
POLYGONACEAE	Rumex steudelii
POLYGONACEAE	Rumex woodii
POLYPODIACEAE	Pleopeltis macrocarpa
PROTEACEAE	Protea roupelliae subsp. roupelliae
PTERIDACEAE	Adiantum capillus-veneris
PTERIDACEAE	Adiantum poiretii
PTERIDACEAE	Cheilanthes quadripinnata
PTERIDACEAE	Cheilanthes viridis var. glauca
PTERIDACEAE	Cheilanthes viridis var. viridis
PTERIDACEAE	Pteris cretica
PTERIDACEAE	Pteris dentata
RANUNCULACEAE	Ranunculus multifidus
RANUNCULACEAE	Thalictrum rhynchocarpum
RHAMNACEAE	Ziziphus mucronata subsp. mucronata
ROSACEAE	Cliffortia nitidula subsp. pilosa
ROSACEAE	Rubus apetalus var. apetalus
RUBIACEAE	Anthospermum rigidum subsp. pumilum
RUBIACEAE	Canthium ciliatum
RUBIACEAE	Galium spurium subsp. africanum
RUBIACEAE	Kohautia amatymbica
RUBIACEAE	Oldenlandia herbacea var. herbacea
RUBIACEAE	Pachystigma macrocalyx
RUBIACEAE	Pachystigma pygmaeum
RUBIACEAE	Pavetta cooperi
RUBIACEAE	Pentanisia angustifolia
RUBIACEAE	Pentanisia prunelloides subsp. latifolia
RUBIACEAE	Pentanisia prunelloides subsp. prunelloides
RUBIACEAE	Pygmaeothamnus chamaedendrum var. chamaedendrum
SALICACEAE	Trimeria grandifolia subsp. grandifolia
SALICACEAE	Trimeria trinervis
SANTALACEAE	Thesium asterias
SANTALACEAE	Thesium racemosum
SCROPHULARIACEAE	Chaenostoma floribundum
SCROPHULARIACEAE	Manulea rhodantha subsp. aurantiaca
SCROPHULARIACEAE	Nemesia rupicola
SCROPHULARIACEAE	Selago densiflora
SCROPHULARIACEAE	Veronica anagallis-aquatica
SELAGINELLACEAE	Selaginella dregei

Family Name	Species Name
SOLANACEAE	Physalis peruviana
SOLANACEAE	Solanum aculeatissimum
SOLANACEAE	Solanum capense
SOLANACEAE	Solanum lichtensteinii
THYMELAEACEAE	Dais cotinifolia
THYMELAEACEAE	Gnidia kraussiana var. kraussiana
THYMELAEACEAE	Gnidia nodiflora
THYMELAEACEAE	Gnidia sp.
VERBENACEAE	Verbena venosa
VITACEAE	Rhoicissus tridentata subsp. tridentata
WOODSIACEAE	Cystopteris fragilis
XYRIDACEAE	Xyris gerrardii
CYPERACEAE	Isolepis costata var. costata

Family Name	Species Name	Category	Group
Ranidae	Rana angolense	Amphibians	Frogs
ACCIPITRIDAE	Accipiter tachiro	Birds	Eagles and Hawks
ACCIPITRIDAE	Buteo rufofuscus	Birds	Eagles and Hawks
ACCIPITRIDAE	Buteo vulpinus	Birds	Eagles and Hawks
ACCIPITRIDAE	Circus ranivorus	Birds	Eagles and Hawks
ACCIPITRIDAE	Elanus caeruleus	Birds	Eagles and Hawks
ACCIPITRIDAE	Haliaeetus vocifer	Birds	Eagles and Hawks
ACCIPITRIDAE	Polyboroides typus	Birds	Eagles and Hawks
Accipitridae	Circus aeruginosus	Birds	Eagles and Hawks
ACCIPITRIDAE	Milvus migrans migrans	Birds	Eagles and Hawks
ACCIPITRIDAE	Milvus migrans parasitus	Birds	Eagles and Hawks
Alaudidae	Calandrella cinerea	Birds	Larks
Alaudidae	Certhilauda curvirostris	Birds	Larks
Alaudidae	Chersomanes albofasciata	Birds	Larks
Alaudidae	Eremopterix leucotis	Birds	Larks
Alaudidae	Mirafra apiata	Birds	Larks
Anatidae	Alopochen aegyptiaca	Birds	Ducks and Geese
Anatidae	Anas erythrorhyncha	Birds	Ducks and Geese
Anatidae	Anas hottentota	Birds	Ducks and Geese
Anatidae	Anas smithii	Birds	Ducks and Geese
Anatidae	Anas sparsa	Birds	Ducks and Geese
Anatidae	Anas undulata	Birds	Ducks and Geese
Anatidae	Dendrocygna viduata	Birds	Ducks and Geese
Anatidae	Netta erythrophthalma	Birds	Ducks and Geese
Anatidae	Oxyura maccoa	Birds	Ducks and Geese
Anatidae	Plectropterus gambensis	Birds	Ducks and Geese
Anatidae	Sarkidiornis melanotos	Birds	Ducks and Geese
Anatidae	Tadorna cana	Birds	Ducks and Geese
Anatidae	Thalassornis leuconotus	Birds	Ducks and Geese
Anhingidae	Anhinga rufa	Birds	Darters
Apodidae	Apus affinis	Birds	Swifts
Apodidae	Apus apus	Birds	Swifts
Apodidae	Apus barbatus	Birds	Swifts
Apodidae	Apus caffer	Birds	Swifts
Apodidae	Apus horus	Birds	Swifts
Apodidae	Cypsiurus parvus	Birds	Swifts
ARDEIDAE	Ardea cinerea	Birds	Herons
ARDEIDAE	Ardea goliath	Birds	Herons
ARDEIDAE	Ardea melanocephala	Birds	Herons
ARDEIDAE	Ardea purpurea	Birds	Herons
ARDEIDAE	Ardeola ralloides	Birds	Herons

Family Name	Species Name	Category	Group
ARDEIDAE	Bubulcus ibis	Birds	Herons
ARDEIDAE	Egretta alba	Birds	Herons
ARDEIDAE	Egretta garzetta	Birds	Herons
ARDEIDAE	Egretta intermedia	Birds	Herons
ARDEIDAE	Ixobrychus minutus	Birds	Herons
ARDEIDAE	Nycticorax nycticorax	Birds	Herons
Burhinidae	Burhinus capensis	Birds	Dikkops
Capitonidae	Lybius torquatus	Birds	Barbets
Capitonidae	Tricholaema leucomelas	Birds	Barbets
Charadriidae	Charadrius pecuarius	Birds	Lapwings
Charadriidae	Charadrius tricollaris	Birds	Lapwings
Charadriidae	Vanellus armatus	Birds	Lapwings
Charadriidae	Vanellus coronatus	Birds	Lapwings
Charadriidae	Vanellus melanopterus	Birds	Lapwings
Charadriidae	Vanellus senegallus	Birds	Lapwings
Ciconiidae	Ciconia abdimii	Birds	Storks
Ciconiidae	Ciconia ciconia	Birds	Storks
Coliidae	Colius striatus	Birds	Mousebirds
Coliidae	Urocolius indicus	Birds	Mousebirds
COLUMBIDAE	Columba guinea	Birds	Pigeons and Doves
COLUMBIDAE	Columba livia	Birds	Pigeons and Doves
COLUMBIDAE	Oena capensis	Birds	Pigeons and Doves
COLUMBIDAE	Streptopelia capicola	Birds	Pigeons and Doves
COLUMBIDAE	Streptopelia semitorquata	Birds	Pigeons and Doves
COLUMBIDAE	Streptopelia senegalensis	Birds	Pigeons and Doves
Coraciidae	Coracias caudatus	Birds	Rollers
Corvidae	Corvus albus	Birds	Crows
Corvidae	Corvus capensis	Birds	Crows
Cuculidae	Chrysococcyx caprius	Birds	Cuckoos
Cuculidae	Cuculus clamosus	Birds	Cuckoos
Cuculidae	Cuculus solitarius	Birds	Cuckoos
Dicruridae	Dicrurus adsimilis	Birds	Drongos
Estrildidae	Amadina erythrocephala	Birds	Finches
Estrildidae	Estrilda astrild	Birds	Finches
Estrildidae	Lagonosticta rubricata	Birds	Finches
Estrildidae	Ortygospiza atricollis	Birds	Finches
Falconidae	Falco amurensis	Birds	Falcons
Falconidae	Falco biarmicus	Birds	Falcons
Falconidae	Falco rupicolis	Birds	Falcons
Falconidae	Falco rupicoloides	Birds	Falcons
Fringillidae	Crithagra atrogularis	Birds	Finches
Fringillidae	Crithagra mozambicus	Birds	Finches
Fringillidae	Emberiza capensis	Birds	Finches

Family Name	Species Name	Category	Group
Fringillidae	Emberiza tahapisi	Birds	Finches
Fringillidae	Serinus canicollis	Birds	Finches
Glareolidae	Cursorius temminckii	Birds	Courser
Glareolidae	Glareola nordmanni	Birds	Pratincole
Gruidae	Anthropoides paradiseus	Birds	Cranes
Gruidae	Balearica regulorum	Birds	Cranes
Halcyonidae	Alcedo cristata	Birds	Kingfishers
Halcyonidae	Ceryle rudis	Birds	Kingfishers
Halcyonidae	Megaceryle maximus	Birds	Kingfishers
Hirundinidae	Delichon urbicum	Birds	Swallows and Martins
Hirundinidae	Hirundo albigularis	Birds	Swallows and Martins
Hirundinidae	Hirundo cucullata	Birds	Swallows and Martins
Hirundinidae	Hirundo fuligula	Birds	Swallows and Martins
Hirundinidae	Hirundo rustica	Birds	Swallows and Martins
Hirundinidae	Hirundo spilodera	Birds	Swallows and Martins
Hirundinidae	Riparia cincta	Birds	Swallows and Martins
Hirundinidae	Riparia paludicola	Birds	Swallows and Martins
Hirundinidae	Riparia riparia	Birds	Swallows and Martins
Jacanidae	Actophilornis africanus	Birds	Jacana
Jyngidae	Jynx ruficollis	Birds	Woodpecker
Laniidae	Lanius collaris	Birds	Shrikes
Laniidae	Lanius collurio	Birds	Shrikes
Laniidae	Lanius minor	Birds	Shrikes
Laridae	Chlidonias hybrida	Birds	Shrikes
Laridae	Chlidonias leucopterus	Birds	Shrikes
Malaconotidae	Telophorus zeylonus	Birds	Bush-shrikes
Motacillidae	Anthus cinnamomeus	Birds	Wagtails, longclaws and pipits
Motacillidae	Macronyx capensis	Birds	Wagtails, longclaws and pipits
Motacillidae	Motacilla capensis	Birds	Wagtails, longclaws and pipits
Muscicapidae	Batis capensis	Birds	Flycatchers
Muscicapidae	Sigelus silens	Birds	Flycatchers
Muscicapidae	Stenostira scita	Birds	Flycatchers
Muscicapidae	Terpsiphone viridis	Birds	Flycatchers
Nectariniidae	Nectarinia famosa	Birds	Sunbirds

Family Name	Species Name	Category	Group
Numididae	Numida meleagris	Birds	Guineafowl
Oriolidae	Oriolus larvatus	Birds	Orioles
Otididae	Eupodotis caerulescens	Birds	Bustards
Otididae	Eupodotis senegalensis	Birds	Bustards
Pandionidae	Pandion haliaetus	Birds	Osprey
Pelecanidae	Pelecanus onocrotalus	Birds	Pelecan
Phalacrocoracidae	Phalacrocorax africanus	Birds	Cormorant
Phalacrocoracidae	Phalacrocorax lucidus	Birds	Cormorant
Phasianidae	Coturnix coturnix	Birds	Pheasants and partridges
Phasianidae	Pternistis swainsonii	Birds	Pheasants and partridges
Phasianidae	Scleroptila levaillantii	Birds	Pheasants and partridges
Phoenicopteridae	Phoenicopterus minor	Birds	Flamingoes
Phoenicopteridae	Phoenicopterus ruber	Birds	Flamingoes
Picidae	Geocolaptes olivaceus	Birds	Woodpeckers
Plataleidae	Bostrychia hagedash	Birds	Ibis
Plataleidae	Geronticus calvus	Birds	Ibis
Plataleidae	Platalea alba	Birds	Ibis
Plataleidae	Plegadis falcinellus	Birds	Ibis
Plataleidae	Threskiornis aethiopicus	Birds	Ibis
PLOCEIDAE	Euplectes afer	Birds	Weavers
PLOCEIDAE	Euplectes ardens	Birds	Weavers
PLOCEIDAE	Euplectes axillaris	Birds	Weavers
PLOCEIDAE	Euplectes orix	Birds	Weavers
PLOCEIDAE	Euplectes progne	Birds	Weavers
PLOCEIDAE	Passer diffusus	Birds	Weavers
PLOCEIDAE	Passer domesticus	Birds	Weavers
PLOCEIDAE	Passer melanurus	Birds	Weavers
PLOCEIDAE	Ploceus capensis	Birds	Weavers
PLOCEIDAE	Ploceus velatus	Birds	Weavers
PLOCEIDAE	Quelea quelea	Birds	Weavers
Podicipedidae	Tachybaptus ruficollis	Birds	Grebes
Pycnonotidae	Pycnonotus tricolor	Birds	Bulbul
Rallidae	Amaurornis flavirostris	Birds	Crates and coots
Rallidae	Fulica cristata	Birds	Crates and coots
Rallidae	Gallinula chloropus	Birds	Crates and coots
Rallidae	Porphyrio madagascariensis	Birds	Crates and coots
Rallidae	Sarothrura rufa	Birds	Crates and coots
Recurvirostridae	Himantopus himantopus	Birds	Avocets and stilts
Recurvirostridae	Recurvirostra avosetta	Birds	Avocets and stilts
Sagittariidae	Sagittarius serpentarius	Birds	Secretary Bird
Scolopacidae	Actitis hypoleucos	Birds	Sandpipers

Family Name	Species Name	Category	Group
Scolopacidae	Calidris ferruginea	Birds	Sandpipers
Scolopacidae	Calidris minuta	Birds	Sandpipers
Scolopacidae	Gallinago nigripennis	Birds	Sandpipers
Scolopacidae	Tringa glareola	Birds	Sandpipers
Scolopacidae	Tringa nebularia	Birds	Sandpipers
Scolopacidae	Tringa ochropus	Birds	Sandpipers
Scolopacidae	Tringa stagnatilis	Birds	Sandpipers
Scopidae	Scopus umbretta	Birds	Hamerkop
Strigidae	Asio capensis	Birds	Owls
Strigidae	Bubo africanus	Birds	Owls
Sturnidae	Acridotheres tristis	Birds	Starlings
Sturnidae	Onychognathus morio	Birds	Starlings
Sturnidae	Spreo bicolor	Birds	Starlings
SYLVIIDAE	Acrocephalus baeticatus	Birds	Warblers
SYLVIIDAE	Acrocephalus gracilirostris	Birds	Warblers
SYLVIIDAE	Acrocephalus palustris	Birds	Warblers
SYLVIIDAE	Acrocephalus schoenobaenus	Birds	Warblers
SYLVIIDAE	Apalis thoracica	Birds	Warblers
SYLVIIDAE	Bradypterus baboecala	Birds	Warblers
SYLVIIDAE	Cisticola ayresii	Birds	Warblers
SYLVIIDAE	Cisticola cinnamomeus	Birds	Warblers
SYLVIIDAE	Cisticola fulvicapilla	Birds	Warblers
SYLVIIDAE	Cisticola juncidis	Birds	Warblers
SYLVIIDAE	Cisticola lais	Birds	Warblers
SYLVIIDAE	Cisticola textrix	Birds	Warblers
SYLVIIDAE	Cisticola tinniens	Birds	Warblers
SYLVIIDAE	Hippolais icterina	Birds	Warblers
SYLVIIDAE	Prinia flavicans	Birds	Warblers
SYLVIIDAE	Prinia hypoxantha	Birds	Warblers
SYLVIIDAE	Prinia subflava	Birds	Warblers
SYLVIIDAE	Sphenoeacus afer	Birds	Warblers
TURDIDAE	Cossypha caffra	Birds	Thrush
TURDIDAE	Monticola rupestris	Birds	Thrush
TURDIDAE	Myrmecocichla formicivora	Birds	Thrush
TURDIDAE	Oenanthe bifasciata	Birds	Thrush
TURDIDAE	Oenanthe monticola	Birds	Thrush
TURDIDAE	Psophocichla litsipsirupa	Birds	Thrush
TURDIDAE	Saxicola torquatus	Birds	Thrush
TURDIDAE	Thamnolaea cinnamomeiventris	Birds	Thrush
TURDIDAE	Turdus olivaceus	Birds	Thrush
Tytonidae	Tyto alba	Birds	Barn Owls
Upupidae	Upupa africana	Birds	Hoopoe
Viduidae	Vidua macroura	Birds	Whydahs

Family Name	Species Name	Category	Group
Zosteropidae	Zosterops pallidus	Birds	White-eyes
Potamonautidae	Potamonautes sidneyi	Crustacean	Crabs
Potamonautidae	Potamonautes sp.	Crustacean	Crabs
Gyrinidae	Aulonogyrus abdominalis	Insects	Whirligig beetles
Gyrinidae	Aulonogyrus alternatus	Insects	Whirligig beetles
Gyrinidae	Aulonogyrus caffer	Insects	Whirligig beetles
Gyrinidae	Aulonogyrus marginatus	Insects	Whirligig beetles
Gyrinidae	Gyrinus natalensis	Insects	Whirligig beetles
Gyrinidae	Orectogyrus polli	Insects	Whirligig beetles
Gyrinidae	Aulonogyrus sp.	Insects	Whirligig beetles
Gyrinidae	Orectogyrus sp.	Insects	Whirligig beetles
Aeshnidae	Aeshna minuscula	Insects	Dragonflies
Aeshnidae	Aeshna rileyi	Insects	Dragonflies
Aeshnidae	Aeshna sp.	Insects	Dragonflies
Aeshnidae	Anax sp.	Insects	Dragonflies
Arrenuridae	Arrenurus longigenitalis	Insects	Water Mite
Axonopsidae	Axonopsis pusilla	Insects	Water Mite
Baetidae	Acentrella sp.	Insects	Mayflies
Baetidae	Afroptilum parvum	Insects	Mayflies
Baetidae	Afroptilum sp.	Insects	Mayflies
Baetidae	Baetis glaucus	Insects	Mayflies
Baetidae	Baetis sp.	Insects	Mayflies
Baetidae	Cloeon sp.	Insects	Mayflies
Baetidae	Pseudocloeon maculosum	Insects	Mayflies
Ceratopogonidae	Atrichopogon sp.	Insects	Midges
Ceratopogonidae	Bezzia sp.	Insects	Midges
Ceratopogonidae	Culicoides sp.	Insects	Midges
Chironomidae	Ablabesmyia dusoleili	Insects	Midges
Chironomidae	Chironomus caffrarius	Insects	Midges
Chironomidae	Chironomus formosipennis	Insects	Midges
Chironomidae	Cricotopus scottae	Insects	Midges
Chironomidae	Dicrotendipes pilosimanus	Insects	Midges
Chironomidae	Paratrichocladius micans	Insects	Midges
Chironomidae	Stictochironomus puripennis	Insects	Midges
Chironomidae	Chironomus calipterus	Insects	Midges
Chironomidae	Cryptochironomus nudiforceps	Insects	Midges
Chironomidae	Nanocladius vitellinus	Insects	Midges
Chironomidae	Pentaneura octomaculata	Insects	Midges
Chironomidae	Polypedilum natalense	Insects	Midges
Chironomidae	Procladius apicalis	Insects	Midges
Chironomidae	Psectrocladius viridescens	Insects	Midges
Chlorocyphidae	Chlorocypha caligata	Insects	Damselflies
Chlorocyphidae	Chlorocypha sp.	Insects	Damselflies

Family Name	Species Name	Category	Group
Chrysomelidae	Sphaeroderma capensis	Insects	Leaf Beetles
Chydoridae	Acroperus sp.	Insects	Waterfleas
Chydoridae	Alona sp.	Insects	Waterfleas
Chydoridae	Rhynchotalona rostrata	Insects	Waterfleas
Coenagrionidae	Pseudagrion salisburyense	Insects	Damselflies
Daphniidae	Ceriodaphnia sp.	Insects	Waterfleas
Daphniidae	Daphnia longispina	Insects	Waterfleas
Dipseudopsidae	Dipseudopsis sp.	Insects	Caddisflies
Dytiscidae	Bidessus ovoideus	Insects	Diving Beetles
Dytiscidae	Bidessus sharpi	Insects	Diving Beetles
Dytiscidae	Laccophilus ampliatus	Insects	Diving Beetles
Dytiscidae	Potamonectes vagrans	Insects	Diving Beetles
Dytiscidae	Uvarus peringueyi	Insects	Diving Beetles
Dytiscidae	Yola grandicollis	Insects	Diving Beetles
Dytiscidae	Yola subopaca	Insects	Diving Beetles
Dytiscidae	Yola swierstrai	Insects	Diving Beetles
Dytiscidae	Clypeodytes coarcticollis	Insects	Diving Beetles
Dytiscidae	Guignotus infirmus	Insects	Diving Beetles
Dytiscidae	Guignotus lineolatus	Insects	Diving Beetles
Dytiscidae	Laccophilus pellucidus	Insects	Diving Beetles
Ecnomidae	Ecnomus kimminsi	Insects	Caddisflies
Ecnomidae	Ecnomus sp.	Insects	Caddisflies
Elmidae	Helminthocharis cristula	Insects	Riffle Beetles
Elmidae	Helminthopsis bifida	Insects	Riffle Beetles
Elmidae	Helminthopsis ciliata	Insects	Riffle Beetles
Elmidae	Helminthopsis elongata	Insects	Riffle Beetles
Elmidae	Leptelmis fragilis	Insects	Riffle Beetles
Elmidae	Lobelmis harrisoni	Insects	Riffle Beetles
Elmidae	Microdinodes sp.	Insects	Riffle Beetles
Elmidae	Microdinodes transvaalicus	Insects	Riffle Beetles
Elmidae	Microdinodes vaalensis	Insects	Riffle Beetles
Elmidae	Pachyelmis convexa	Insects	Riffle Beetles
Elmidae	Pachyelmis rufomarginata	Insects	Riffle Beetles
Elmidae	Stenelmis thusa	Insects	Riffle Beetles
Eylaidae	Eylais degenerata	Insects	Water Mite
Gomphidae	Paragomphus cognatus	Insects	Clubtail Dragonflies
Heptageniidae	Afronurus barnardi	Insects	Mayflies
Heptageniidae	Afronurus harrisoni	Insects	Mayflies
Heptageniidae	Compsoneuria sp.	Insects	Mayflies
Hydrachnidae	Hydrachna mirifica	Insects	Water Mite
Hydraenidae	Hydraena accurata	Insects	Water Mite
Hydraenidae	Parasthetops aeneus	Insects	Water Mite
Hydraenidae	Hydraena sp.	Insects	Water Mite

Family Name	Species Name	Category	Group
Hydraenidae	Ochthebius sp.	Insects	Water Mite
Hydraenidae	Parasthetops angustatus	Insects	Water Mite
Hydraenidae	Parasthetops pearcei	Insects	Water Mite
Hydraenidae	Parasthetops rubidus	Insects	Water Mite
Hydraenidae	Parhydraena seriata	Insects	Water Mite
Hydrophilidae	Berosus sp.	Insects	Water Scavenger Beetles
Hydrophilidae	Derallus sp.	Insects	Water Scavenger Beetles
Hydrophilidae	Helophorus sp.	Insects	Water Scavenger Beetles
Hydrophilidae	Hydrochus lucidus	Insects	Water Scavenger Beetles
Hydrophilidae	Hydrochus niloticus	Insects	Water Scavenger Beetles
Hydrophilidae	Laccobius sp.	Insects	Water Scavenger Beetles
Hydropsychidae	Cheumatopsyche afra	Insects	Caddisflies
Hydropsychidae	Macrostemum capense	Insects	Caddisflies
Hydroptilidae	Hydroptila sp.	Insects	Caddisflies
Hydroptilidae	Oxyethira sp.	Insects	Caddisflies
Hygrobatidae	Hygrobates soari	Insects	Water Mite
Hygrobatidae	Hygrobates spathuliferus	Insects	Water Mite
Leptoceridae	Athripsodes sp.	Insects	Caddisflies
Leptoceridae	Ceraclea sp.	Insects	Caddisflies
Leptoceridae	Homilia knysnaensis	Insects	Caddisflies
Leptoceridae	Leptocerina spinigera	Insects	Caddisflies
Leptoceridae	Oecetis portalensis	Insects	Caddisflies
Leptoceridae	Oecetis sp.	Insects	Caddisflies
Leptoceridae	Parasetodes maguirus	Insects	Caddisflies
Leptoceridae	Triaenodes sp.	Insects	Caddisflies
Leptoceridae	Trichosetodes sp.	Insects	Caddisflies
Leptoceridae	Trichosetodes triangularis	Insects	Caddisflies
Leptophlebiidae	Choroterpes sp.	Insects	Mayflies
Lestidae	Lestes sp.	Insects	Damselflies
Libellulidae	Sympetrum fonscolombii	Insects	Dragonflies
Libellulidae	Trithemis dorsalis	Insects	Dragonflies
Libellulidae	Trithemis sp.	Insects	Dragonflies
Libellulidae	Unidentified Libellulidae	Insects	Dragonflies
Naucoridae	Laccocoris limigenus	Insects	Creeping Water Bugs
Naucoridae	Laccocoris sp.	Insects	Creeping Water Bugs
Nepidae	Ranatra parvipes	Insects	Waterscorpion
Nepidae	Ranatra sp.	Insects	Waterscorpion
Perlidae	Neoperla sp.	Insects	Stonefly
Philopotamidae	Chimarra sp.	Insects	Caddisflies

Family Name	Species Name	Category	Group
Polycentropodidae	Nyctiophylax sp.	Insects	Caddisflies
Polymitarcyidae	Ephoron savignyi	Insects	Mayflies
Prosopistomatidae	Prosopistoma guernei	Insects	Mayflies
Prosopistomatidae	Prosopistoma sp.	Insects	Mayflies
Psephenidae	Eubrianax sp.	Insects	Water-penny beetles
Sisyridae	Sisyra sp.	Insects	Sponge flies
Tipulidae	Unidentified Tipulidae	Insects	Crane Fly
Torrenticolidae	Torrenticola harrisoni	Insects	Water mite
Tricorythidae	Tricorythus discolor	Insects	Mayflies
Tricorythidae	Tricorythus sp.	Insects	Mayflies
Veliidae	Microvelia major	Insects	Water-striders
Corbiculidae	Corbicula sp.	Molluscs	Basket Clam
Sphaeriidae	Pisidium langleyanum	Molluscs	Clams
Actinolaimidae	Actinca intermedia	Nematodes	Worms
Dorylaimidae	Dorylaimus afghanicus	Nematodes	Worms
Dorylaimidae	Laimydorus gazella	Nematodes	Worms
Mononchidae	Mylonchulus polonicus	Nematodes	Worms
Naididae	Chaetogaster diaphanus	Ringed Worms	Sludge Worms
Naididae	Aulodrilus pigueti	Ringed Worms	Sludge Worms
Naididae	Branchiura sowerbyi	Ringed Worms	Sludge Worms
Gerbillinae	Tatera brantsii	Mammals	Gerbils
Leporidae	Lepus saxatilis	Mammals	Hares and rabbits
Bovidae	Antidorcas marsupialis	Mammals	Antelope
Bovidae	Raphicerus campestris	Mammals	Antelope
Viverridae	Cynictis penicillata	Mammals	Mongooses
Orycteropodidae	Orycteropus afer	Mammals	Aardvark
Serpentes	Hemachatus haemachatus	Reptiles	Snakes
Serpentes	Bitis arietans	Reptiles	Snakes
Scincidae	Mabuya striata	Reptiles	Skinks