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WETLAND IMPACT ASSESSMENT

PROPOSED JUNO-GROMIS 400 KV POWER LINE CORRIDOR PROJECT, NORTHERN CAPE AND WESTERN CAPE PROVINCES

MAY 2016

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Declaration

I **Rowena Harrison,** declare that -

- I act as the independent specialist in this matter;
- I do not have and will not have any vested interest (either business, financial, personal or other) in the undertaking of the proposed activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2014;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the National Environmental Management Act (Act 107 of 1998)(NEMA), regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the NEMA Act, regulations and all other applicable legislation;
- As a registered member of the South African Council for Natural Scientific Professions in terms of the Natural Scientific Professions Act, 2003 (Act No. 27 of 2003), I will undertake my professional duties in accordance with the Code of Conduct of the Council, as well as any other societies of which I am a member; and
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority; all the particulars furnished by me in this report are true and correct.

Signature of the specialist:

Date: 24/04/2016

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Declaration

I **Paige Potter,** declare that -

- I act as the independent specialist in this matter;
- I do not have and will not have any vested interest (either business, financial, personal or other) in the undertaking of the proposed activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2014;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the National Environmental Management Act (Act 107 of 1998)(NEMA), regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the NEMA Act, regulations and all other applicable legislation;
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- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority; all the particulars furnished by me in this report are true and correct.

Signature of the specialist:

Date:

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Executive summary

Afzelia Environmental Consultants (Pty) Ltd was appointed by Nsovo Environmental Consulting to undertake a wetland and watercourse assessment for wetland or watercourse systems identified during a walk down of the Juno-Gromis 400kv power line corridor in the Northern and Western Cape provinces.

The scope of work for this assessment includes:

- Conduct a walk down of the entire 230km length of the Juno-Gromis 400kv power line corridor in order to identify and delineate wetland or watercourse systems along the route which may be affected by the proposed project;
- Assess the status quo of the identified wetlands, the impact on these wetlands of the existing land uses within the catchment, existing topography, existing surface soil conditions, and surface substrata forms;
- Assess the projected impact of the project on the current functional integrity of the wetland areas; and
- Provide recommended mitigation and remedial measures to lower the significance of any negative impacts identified.

The main findings of this report have been summarised below:

i. Five wetland areas were identified within a 500m buffer surrounding the proposed power line corridor. The wetlands were classified into separate hydrogeomorphic (HGM) units, comprising of five separate depressions/pan systems.
ii. Numerous 'A' Section and 'B' Section channels were delineated along the power line corridor and are associated with seasonal non-perennial rivers as well as temporary drainage systems.
iii. The proposed tower positions in closest proximity to each wetland/watercourse identified along the route were recorded to be used in finalising the position of each tower.
iv. A health assessment was conducted for the delineated wetlands according to the WET-Health methods. The depression systems can be categorised as generally moderately modified (PES Category C), with one depression (HGM 3) being <u>largely natural</u> (PES Category B).
v. Modifications to all depression systems stem from surrounding agricultural activities. Grazing activities are causing the removal of basal cover within the wetland systems and adjacent areas, amplifying the deposition of sediment into the depressions.
vi. All depression systems have been classified as having a medium ecological sensitivity and importance. These systems are utilised during the wetter season by a number of aquatic, avifaunal and faunal species for protection, feeding and breeding. The presence of seasonal water within these depressions particularly in this arid environment is considered paramount to the survival of the species that utilise these systems.
vii. Buffers were calculated to determine the minimum zone of protection that must be placed around the wetland systems. A number of different factors determine the buffer width including the risk of the proposed activity on the water resource, the threat assessment, climatic factors and the sensitivity of the water resource. A 21m buffer width is recommended to protect the depressions. This buffer must be enforced during the construction and operational phases of the proposed project. All towers must be placed outside of this buffer and access to these towers must not be established within these buffer areas
viii. A number of potential impacts have been identified relating to soil erosion and sedimentation, alteration to the hydrological flow entering the wetland areas, pollution of wetlands and soil as a result of construction and operational activities and the spread of alien invasive species.
ix. Mitigation measures are key to limiting the negative effects on the wetlands and watercourses and must be included in an Environmental Management Programme for the proposed project.

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1. INTRODUCTION

1.1 Background and Locality of the assessment

Afzelia Environmental Consultants (Pty) Ltd was appointed by Nsovo Environmental Consulting to undertake a wetland assessment for any wetland systems identified during a walk down as part of the EMPr of the Juno-Gromis 400kv power line corridor in the Northern and Western Cape provinces.

The proposed power line will run south along the west coast of South Africa from Gromis substation in Kleinsee, Northern Cape to the Juno substation in the vicinity of Vredendal, Western Cape (**Figure 1**). From the Juno substation there are existing 400kV power lines to carry the load to Cape Town. The proposed power line will require an estimated servitude of 55m and a length of approximately 230km.

1.2 Scope of work

The scope of work entailed the following:

- Conduct a walk down of the entire length of the Juno-Gromis 400kv power line corridor in order to identify and delineate wetland or watercourse systems along the route which may be affected by the proposed project.
- Delineate the outer boundary of wetland/riparian habitats within a 500m buffer from the proposed power line corridor according to the methods contained in the manual 'A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas' (DWAF, 2005);
- Assess and describe the health of any wetland units identified, through evaluation of indicators based on geomorphology, hydrology and vegetation as per the WET-Health methods;
- Assess and describe the Ecological Importance and Sensitivity of any wetlands identified, based on the presence of red data species; variety of habitats for faunal diversity; the health of the wetland and ecosystem benefits the wetland provides as per the Health Index of Habitat Integrity (DWAF, 2007);
- Identify potential negative impacts on the wetland(s) from the proposed project and assess the significance of these impacts;
- Provide recommended mitigation measures for the identified impacts in order to avert or lower the significance of the negative impacts.

1.3 Assumptions and Limitations

It is difficult to apply pure scientific methods within a natural environment without limitations, and consequentially assumptions need to be made. The following constraints may have affected this assessment –

- The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information regarding the perceived impacts on the wetlands and watercourses.
- A hand held Garmin eTrex 20x was used to delineate the wetland areas and this has an accuracy of 3-5m;
- The assessment of the wetland's present ecological state (PES), functionality (Ecosystem good and services) and ecological importance and sensitivity (EIS) was based on field investigations undertaken in one season from the 29th February to the 16th March and then the 11th April to the 14th April 2016. Site visits should ideally be conducted over differing seasons in order to better understand the hydrological and geomorphologic processes governing wetland systems as well as the use of the wetlands by both the surrounding communities and faunal species.
- Phase 2 of the field survey involved the use of a helicopter due mainly to the inaccessibility of portions of the power line corridor. In these areas soil wetness, soil form as well as vegetation dynamics could not be relied upon to determine boundaries of wetlands and watercourses; the terrain unit indicator was

applied Due to the arid nature of the larger study area and the lack of soil hydric properties and lack of hydrophytic vegetation the use of the helicopter is not expected to limit the reliability of the results obtained.

- No data regarding positioning, design and the construction of access roads has been provided. This aspect of the project has therefore not been assessed.

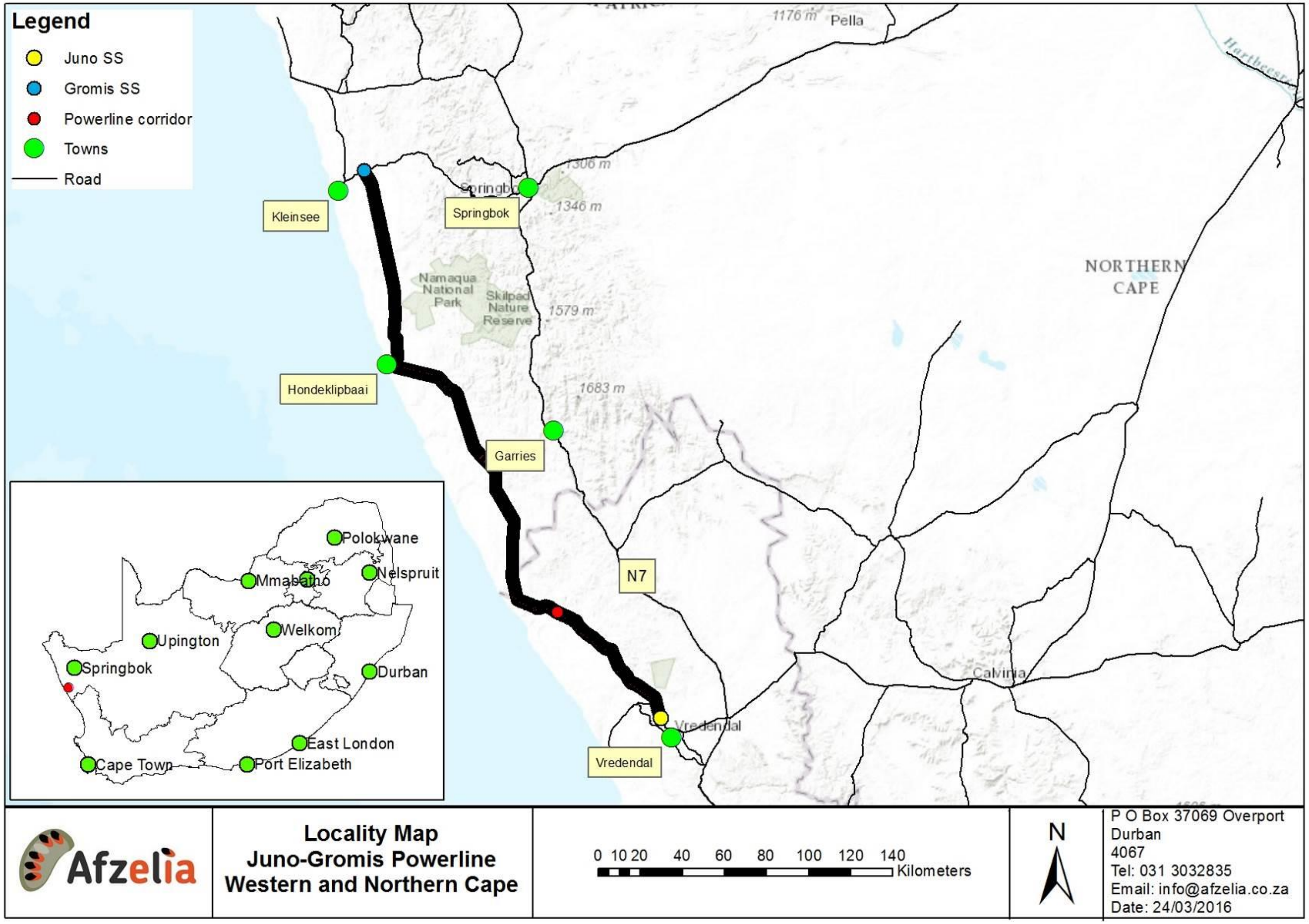

Figure 1: Locality of the proposed power line corridor

2. METHODOLOGY

2.1 Assessment techniques and tools

An initial desktop review of the study site was undertaken before the site visit using data from a variety of sources (this list is detailed under 2.2 Sources of Information). The walk-down was then undertaken during a seventeen day field investigation from the 29th February to the 16th March 2016. The power line corridor was assessed on the ground during this visit and wetlands and watercourses delineated. Due to limitations experienced as a result of poor access to portions of the power line corridor a second phase site visit was undertaken from the 11th to the 15th April using a helicopter to survey these areas for wetlands and watercourses systems.

2.2 Sources of information

The following information and datasets were used to support the desktop and infield assessment of the study area as well as the compilation of this report:

i. Google Earth ™ satellite imagery was used at the desktop level to delineate desktop wetlands and watercourses;
ii. Relief dataset from the Surveyor General was used to calculate slope and in the desktop mapping of wetlands and watercourses;
iii. The NFEPA dataset (Driver, *et al*., 2011) was used in determining any priority wetlands;
iv. Climatic data was obtained from Shulze, (1997); and Mucina and Rutherford, (2006;
v. Geology dataset was obtained from AGIS[1] as well as the Agricultural Impact Assessment for the Proposed Eskom Kudu 400Kv Transmission Power-line from Oranjemund Substation to Juno Substation by Lambrechts, Ellis & Kunneke (2005); and
vi. Vegetation type dataset from the South African National Biodiversity Institute (SANBI) 2012 Vegetation map; and Mucina & Rutherford (2006) was used in determining the vegetation type of the study area.

2.3 Wetland Definition & Delineation Technique

For the purpose of this assessment, wetlands are considered as those ecosystems 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 the 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."*

The wetland delineations were conducted as per the procedures described in 'A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas – Edition 1' (Department of Water Affairs, 2005). This document requires the delineator to give consideration to four indicators in order to find the outer edge of the wetland zone:

- The Terrain Unit Indicator helps to identify those parts of the landscape where wetlands are more likely to occur.
- The Soil Form Indicator identifies the soil forms, as defined by the Soil Classification Working Group (1991), which are associated with prolonged and frequent saturation.
- The Soil Wetness Indicator identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation. Signs of wetness are characterised by a variety of aspects. These include marked variations in the colours of various soil components, known as mottling; a gleyed

[1] Land type information was obtained from the Department of Agriculture's Global Information Service (AGIS) January 2014 – www.agis.agric.za

soil matrix or the presence of Fe/Mn concretions. It should be noted that the presence of signs of wetness within a soil profile is sufficient to classify an area as a wetland area despite the lack of other indicators.

- The Vegetation Indicator identifies hydrophilic vegetation associated with frequently saturated soils.

In assessing whether an area is a wetland, the boundary of a wetland should be considered to be the point where the above indicators are no longer present. An understanding of the hydrological processes active within the area is also considered important when undertaking a wetland assessment. Indicators should be 'combined' to determine whether an area is a wetland, to delineate the boundary of that wetland and to assess its level of functionality and health.

2.4 Wetland Health and Functional Integrity Assessment

As per the requirements of the Environmental Impact Assessment (EIA) process and Water Use Authorisation Application (WULA) for the proposed project a Level 2 Wet-Health Assessment to determine the Present Ecological State (PES) as well as a Level 2 Wet-EcoServices Assessment to determine the Functional Integrity of each wetland unit was undertaken. Further to this the Ecological Importance and Sensitivity (EIS) of each delineated wetland unit was determined.

3. BACKGROUND INFORMATION OF THE STUDY AREA

3.1 Climate

The West Coast of South Africa is characterised by a low winter rainfall pattern with extreme summer aridity. The mean annual precipitation ranges between 20 mm and 290 mm per year. The area receives the lowest rainfall in February (0 mm) and the highest in June (49 mm). The average daily maximum temperatures range from 16.4 °C in July to 30.1 °C in February. The region is the coldest in June with minimum temperatures of 8.0 °C (Schulze, 1997; Mucina and Rutherford 2006).

3.2 Vegetation

The power line corridor traverses through the Succulent Karoo and Fynbos biomes. The vegetation is dominated by succulent shrubs including Mesembryanthemaceae and Crassulaceae with very few trees present. Less than 0.5% of the Succulent Karoo Biome has been formally conserved.

Ten vegetation types occur along the power line corridor; Namaqualand Strandveld being the most dominant vegetation type located along the corridor and the Namaqualand Sand Fynbos the next most dominant. These vegetation types occupy large portions of the area within the southern section of the corridor. The Namaqualand Strandveld consists of low, species rich shrubland dominated by both succulents (*Cephalophyllum* and *Didelta spp*.) and non-succulent shrubs (*Eriocephalus* and *Lebeckia spp.*).

Namaqualand Sand Fynbos vegetation type consists of both isolated streets and dune fields. This vegetation has scattered 1 – 1.5 m tall scrubs dominated by Restionaceae in between Asteraceous fynbos with localised pockets of Proteoid fynbos predominates. Both vegetation types are considered Least Threatened with at least 10% and 2% transformed mostly by cultivation and coastal mining for heavy metals and overgrazing respectively.

Several outcrops of Namaqualand Inland Duneveld are located along the central section of the corridor. This vegetation type is taller shrubland dominated by nonsucculent shrubs (Berkheya and *Eriocephalu spp.*), grasses and restoids. Namaqua Heuweltjiveld vegetation traverses the eastern boundary and consists of low shrubland dominated by leaf-succulent shrubs. Both vegetation types are considered Least Threatened with various areas transformed by cultivation and intensive grazing land respectively (Mucina and Rutherford, 2006).

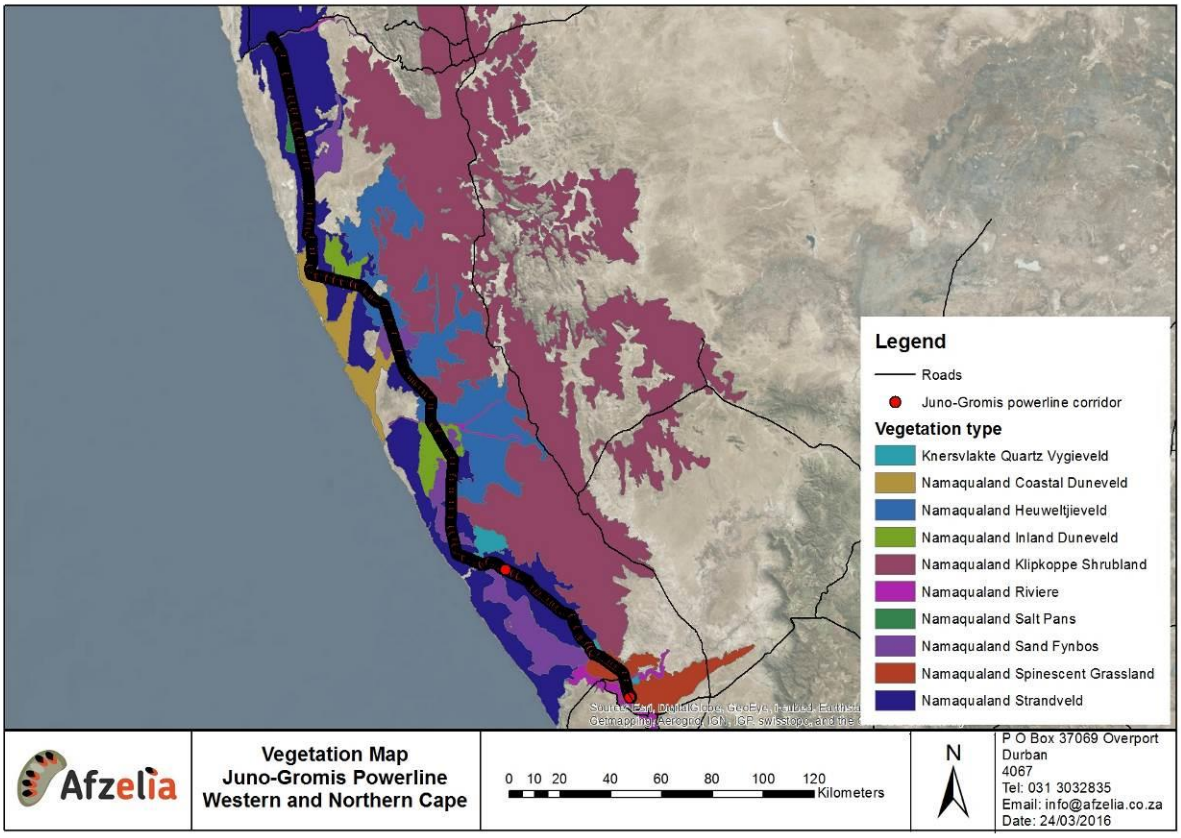

Figure 2: Vegetation map of the study area

3.3 Geology

The larger study area can be described as a broad coastal plain which is covered by a variety of tertiary marine sediments with deep red and yellow-red stable sand dune deposits of varying thickness. The dominant pedological materials throughout this coastal plain are subsoil hardpans which are cemented by sepiolite (sepiocrete), silica and lime (calcrete). The area is furthermore dominated by old termite mounds which are very dense on the higher lying grounds and decrease in density towards the coast. The soils associated with these termite mounds generally contain lime and/or silica either as soft calcareous material or cemented as a hardpan.

East of the coastal plain the landscape changes abruptly to rolling hills. Deep loamy soils dominate the area on granites and gneisses of the Namaqualand Metamorphic Complex of the Mokolian age (AGIS; Mucina and Rutherford, 2006; Lambrechts, Ellis & Kunneke, 2005).

3.4 Catchment characteristics

The proposed power line falls within Quaternary Catchments E33E, F60D, F60A, F50G, F40H, F40F, F40D, F40A, F40E, F30G, E33G, E33H and F60E. The vast majority of the surrounding areas of these catchments have remained unchanged but patches of the land are currently utilised for as agricultural purposes, mining and industry as well as dotted infrastructure relating to commercial and residential areas.

The main water sources that the proposed power line traverses are the Hol River, Moedverloor River, Droekraal se River, Sout River, Brak River, Groen River, Outseep River, Bitter River, Spoeg River, Swartlintjies River and Buffels River.

3.5 NFEPA

Examination of the National Freshwater Ecosystem Priority Areas (NFEPA)'s database was undertaken for the proposed project. The NFEPA project aims to produce maps which provide strategic spatial priorities for conserving South Africa's freshwater ecosystems and supporting sustainable use of water resources. They are identified based on a range of criteria dealing with the maintenance of key ecological processes and the conservation of ecosystem types and species associated with rivers, wetlands and estuaries (Macfarlane *et al*., 2009).

Numerous channelled valley bottom wetlands associated with river systems as well as depressions systems and flats were identified. The wetlands are categorised as largely natural to moderately modified. However ground-truthing the existence and condition of FEPA wetlands is important to understand local conditions which have an impact on the wetland systems, their functional integrity and health.

This assessment does not concur with the NFEPA classification as due to the arid nature of the study site no wetland systems were identified adjacent to the river systems. Classification of the wetlands and watercourses for the purposes of this "on-the-ground" assessment relied upon the ground-truthed results obtained.

4. RESULTS

4.1 Wetland indicators

4.1.1 Soil wetness and soil form indicator

Soil wetness and soil form could not be relied upon to determine wetland areas due to the arid nature of the study site. Soils identified in the broader area were identified as a vast mosaic of deep apedal soils of the Hutton and Clovelly forms (**Photograph 1 and 2**) as well as other cohesionless, quartzitic sands of aeolian origin (**Photograph 3**). These soils were generally devoid of any organic matter due to the highly aerated conditions, which tends to oxidise organic matter and hence carbon in the soil (Brady, 1974).

Soils identified in the depression/pan systems were characterised by a soft carbonate horizon or a hardpan calcrete (**Photograph 4**). These soils are often found in depression systems and are moderately deep to deep, overlaying soft or hard calcrete. Hydric properties were not observed in the soil profile associated with these depression systems. Soil properties recorded on site are summarised in **Table 1.**

Table 1: Information used to inform the wetland assessment

<table>
<tr><th colspan="2">Soil Form and Horizons</th><th>Soil colour</th><th>Soil Texture</th><th>Observations</th></tr>
<tr><th colspan="5">Soils associated with depression systems and watercourses</th></tr>
<tr><td rowspan="2">Brandvlei</td><td>Orthic A</td><td rowspan="2">10YR 8/2</td><td rowspan="2">Sand</td><td rowspan="2">No mottling observed within the soil profile, however soil saturation increased with profile depth. At approximately 800mm water was noted within the core sample taken.</td></tr>
<tr><td>Soft Carbonate Horizon</td></tr>
</table>

<table>
<tr><td rowspan="4">Gamoep</td><td>Orthic A</td><td rowspan="4">10YR 8/2</td><td rowspan="4">Sand</td><td rowspan="4">Hard soils identified in the depression systems. The soil auger could not penetrate through the hardpan carbonate horizon.</td></tr>
<tr><td>Neocutanic B</td></tr>
<tr><td></td></tr>
<tr><td>Hardpan Carbonate Horizon</td></tr>
<tr><td>Alluvial soils</td><td></td><td>10YR 6/3</td><td>Sand</td><td>Identified in and adjacent to dry river beds along the power line corridor.</td></tr>
<tr><td colspan="5">Terrestrial soils</td></tr>
<tr><td rowspan="2">Clovelly</td><td>Orthic A</td><td rowspan="2">7.5YR 4/6</td><td rowspan="2">Loamy sand/Sand</td><td rowspan="4">Terrestrial deep apedal soils identified outside of any wetlands or watercourses systems</td></tr>
<tr><td>Yellow brown apedal</td></tr>
<tr><td rowspan="2">Hutton</td><td>Orthic A</td><td rowspan="2">5YR 6/3</td><td rowspan="2">Loamy sand/Sand</td></tr>
<tr><td>Red apedal</td></tr>
</table>

Photograph 1: Deep Hutton soils

Photograph 2: Clovelly soil form

Photograph 3: Dunes of cohesionless quartzitic sands

Photograph 4: Soft carbonate soils identified in some of the depression systems

Photograph 5: Alluvial soils in channel

4.1.2 Vegetation indicator

According to DWAF (2005), vegetation is regarded as a key component to be used in the delineation procedure for wetlands. Vegetation also forms a central part of the wetland definition in the National Water Act, Act 36 of 1998. However, using vegetation as a primary wetland indicator requires undisturbed conditions as well as a natural gradient from terrestrial areas into saturated areas in order for the plant composition to change (DWAF, 2005). Due to the arid nature of the study area vegetation changes from terrestrial species to hydrophytic species were not seen making it difficult to rely on vegetation as a wetland indicator. No hydrophytic species were identified along any of the corridor alternatives or substation site alternatives investigated.

Vegetation density was however utilised to determine the boundaries of riparian zones associated with 'B' Section or non-perennial rivers through which the power line corridor traversed.

Photograph 6: General vegetation along the power line corridor and associated with the Namaqualand Strandveld

Photograph 7: Riparian vegetation along a riverine system

4.1.3 Terrain Unit Indicator

The topography of an area is generally a good practical indicator for identifying those parts in the landscape where wetlands are likely to occur. Generally, wetlands occur as a valley bottom unit, however wetlands can also occur on steep to mid slopes where groundwater discharge is taking place through seeps (DWAF, 2005). In order to classify a wetland, the localised landscape setting must be taken into consideration through ground-truthing of the study site after initial desktop investigations (Ollis *et al*., 2014).

The terrain unit indicator was the primary determinant of the depression systems which were identified along the proposed power line corridor (**Photograph 8**). An investigation of the aerial photography of the site revealed a number of depressions characterised as:

- Endorheic pans; these are relatively easily defined ecosystems, having a distinctive range of shapes and usually being less than 3 m deep, even when fully inundated (Allan *et al*. 1995)
- Although there is slight variability in shape, a characteristic of all pans is a flat basin floor within the depression (Shaw 1988) or a closed contour shape
- The lack of external drainage provides another crucial factor in distinguishing endorheic ecosystems.

The areas identified during the desktop assessment were then assessed in more detail during the field investigation and confirmed to be endorheic depression systems.

Photograph 8: Depression/Pan system identified during the walk down

4.2 Wetland and watercourse delineation

All wetlands were categorised according to the National Wetland Classification System for South Africa (SANBI, 2009) and were classified into five different hydrogeomorphic (HGM) units (**Figure 3**). An HGM unit is a recognisable physiographic wetland-unit based on the geomorphic setting, water source of the wetland and the water flow patterns (Macfarlane *et al*., 2008).

Five depression/pan wetlands were delineated along the proposed power line corridor.

Table 2: Wetland hydrogeomorphic (HGM) types (Kotze *et al*., 2008; Ollis *et al*., 2013)

HGM Unit	Description	Source of water maintaining the wetland[2]	
		Surface	**Subsurface**
Depression 	A basin shaped area with a closed elevation contour that allows for the accumulation of surface water (i.e. it is inward draining). It may also receive sub-surface water. An outlet is usually absent, and therefore this type is usually isolated from the stream channel network.	*/ ***	*/ ***

Numerous drainage channels associated with non-perennial river systems were also identified along the power line corridor based on topographic setting, vegetative indicators and the presence or absence of alluvial soils as described in 'A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas – Edition 1' (DWAF, 2005) requirements. This manual separates the classification of watercourses into three (3) separate types of channels or sections defined by their position relative to the zone of saturation in the riparian area. The classification system separates channels into:

- those that do not have baseflow ('A' Sections).
- those that sometimes have baseflow ('B' Sections) or are classified as non-perennial.
- those that always have baseflow ('C' Sections) or are classified as perennial.

'A' Section and 'B' Section channels were identified along the power line corridor (**Photograph 9 and Figure 3)**. The 'B' Section channels are non-perennial river systems through which the power line will traverse. The 'A' Section channels are associated with very temporary drainage channels that will convey stormwater into the larger non-perennial rivers.

All wetlands and watercourses are classified and described in relation to the tower position in **Table 3** below. The approximate distance to the proposed tower position is also provided. It must be noted that this position is to the GPS coordinate provided by Eskom indicating the central position of the entire tower structure.

Appendix A depicts the wetlands and watercourses within a 500m buffer surrounding the proposed power line corridor. The figures do not show the entire watercourse system which in the majority of cases is much larger than that shown.

[2] Precipitation is an important water source and evapotranspiration an important output in all of the above settings
Water source:
* Contribution usually small
*** Contribution usually large
*/ *** Contribution may be small or important depending on the local circumstances

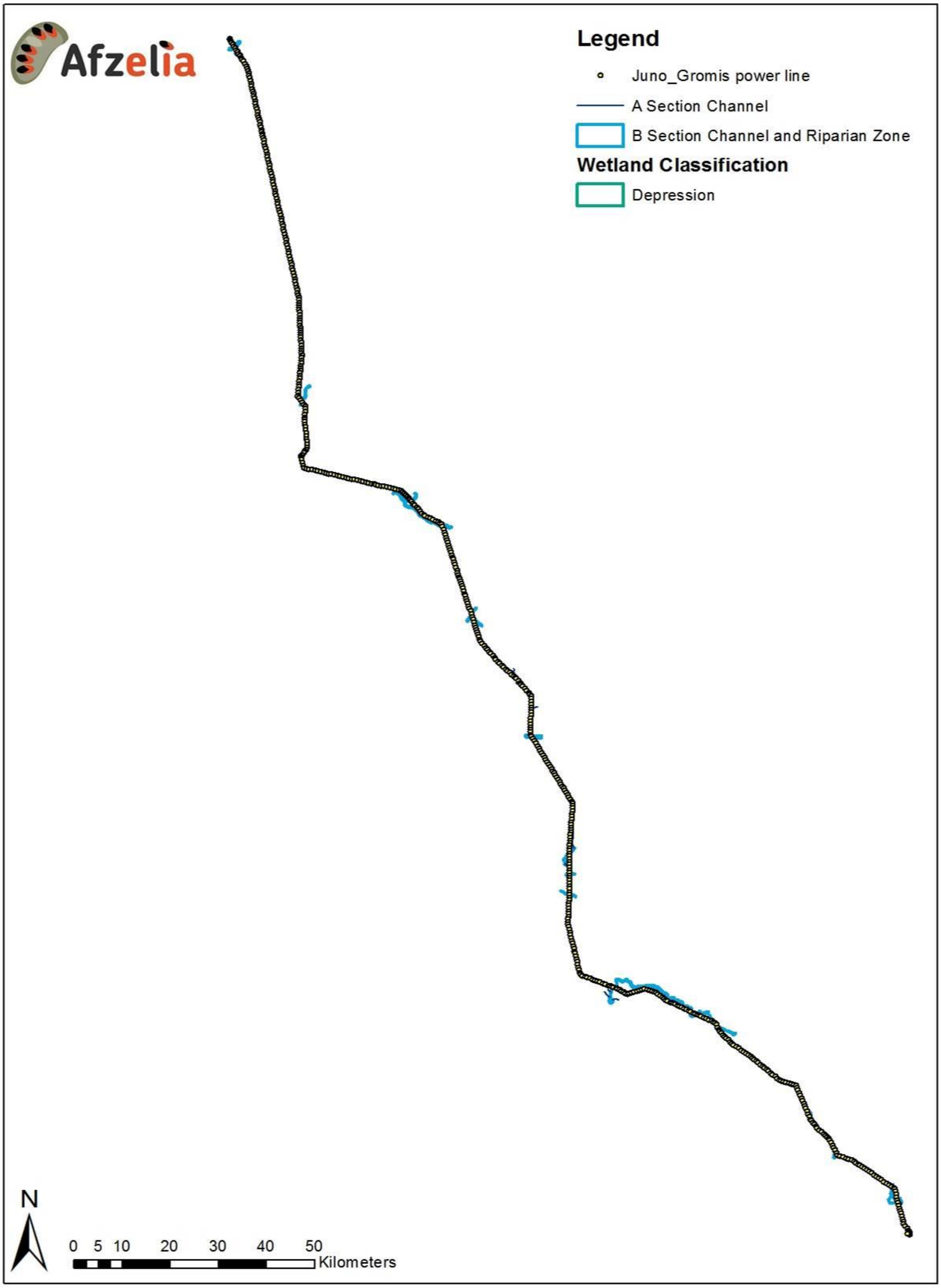

Figure 3: All watercourse and wetland systems identified along the power line corridor. More detailed aerial imagery is presented in Appendix A

Photograph 9: Aerial photograph taken during the helicopter survey of a 'B' Section channel

Table 3: Wetland and Watercourses identified along the proposed power line corridor during the walk-down assessment

<table>
<tr><th>Wetland or Watercourse Classification</th><th>Tower Number</th><th>Approximate distance to tower centre point (m)</th></tr>
<tr><td>Depression/Pan</td><td>585</td><td>14</td></tr>
<tr><td>Depression/Pan</td><td>579</td><td>50</td></tr>
<tr><td>Depression/Pan</td><td>573</td><td>141</td></tr>
<tr><td rowspan="3">A Section Channel</td><td>573</td><td>100</td></tr>
<tr><td>572</td><td>53</td></tr>
<tr><td>571</td><td>235</td></tr>
<tr><td rowspan="2">B Section Channel (Hol River)</td><td>570</td><td>90</td></tr>
<tr><td>569</td><td>23m from channel edge however the tower is situated in the alluvial floodplain</td></tr>
<tr><td rowspan="7">B Section Channel (Moedverloor River)</td><td>568</td><td>393</td></tr>
<tr><td>566</td><td>336</td></tr>
<tr><td>565</td><td>285</td></tr>
<tr><td>564</td><td>120</td></tr>
<tr><td>563</td><td>76</td></tr>
<tr><td>562</td><td>185</td></tr>
<tr><td>561</td><td>326</td></tr>
<tr><td>A Section Channel</td><td>543</td><td>344</td></tr>
</table>

Wetland or Watercourse Classification	Tower Number	Approximate distance to tower centre point (m)
	542	126
	541	137
B Section Channel (Droekraal Se River)	540	112
	539	200
B Section Channel	531	277
A Section Channel	530	37
A Section Channel	529	365
	528	254
B Section Channel	525	302
	524	62
	523	277
	522	329
	521	454
A Section Channel	520	72
Depression/Pan	519	70
B Section	519	100
	518	25
	517	220
Depression/Pan	509	382
	508	131
	473	486
B Section Channel	472	212
	471	25
	470	110
	469	10
	468	270
	467	484
	466	465
	465	95
B Section Channel (Groot-Goerap River)	464	262
	463	356
	462A	40
	462	190
	461	261
	460	197
	459	445
	458	440
	457	305
	456	406
	450	313
	449	400
	448	463
	438	400
	437	438

Wetland or Watercourse Classification	Tower Number	Approximate distance to tower centre point (m)
B Section Channel (Sout River)	426	290
	425	80
	424	106
	423	364
B Section Channel	381	232
	380	322
B Section Channel	373	158
	372	277
A Section Channel	372	430
A Section Channel	371	303
	370	176
A Section Channel	369	405
	368	166
B Section Channel (Brak River)	366	475
	365	146
	364	425
A Section Channel	361	411
B Section Channel (Groen River)	319	406
	318	151
	317	68
	316	237
A Section Channels	306	191
	305	388
	303	78
	302	213
	295	26
	294	91
	293	232
	292	246
	291	119
	290	379
	265	356
B Section Channel (Bitter River and Outeep River) - towers positioned at the confluence of the 2 rivers	264	189 to Outeep
	263	158m to Bitter
		279 to Outeep
	262	206m to Bitter
	261	472 to Bitter
B Section Channel (Spoeg River)	227	200
	226	110
	225	242
	224	250
	223	165

Wetland or Watercourse Classification	Tower Number	Approximate distance to tower centre point (m)
	222	427
	221	465
	220	342
	219	194
	218	186
	217	348
	216	291
	215	258
	214	260
	213	273
	204	490
	203	350
B Section Channel (Horees River)	212	485
	211	118
	210	98
	209	265
B Section Channel (Swartlintjies River)	144	410
	143	50
	142	254
A Section Channel	9	302
	8	199
	7	60
B Section Channel (Buffels River)	6	485
	5	104
	4	125
	3	483

5. WETLAND FUNCTIONAL AND HEALTH ASSESSMENT

5.1 Assessment of the Wetland's Functional Integrity

Wetlands within the study area serve to improve habitat within and potentially downstream of the study area through the provision of various ecosystem services. These ecosystem services relate to:

- Flood attenuation;
- Streamflow regulation;
- Water purification (including sediment trapping and the assimilation of phosphates, nitrates and toxicants);
- Carbon storage;
- Maintenance of biodiversity;
- Provision of water for human and agricultural use;
- Cultural benefits (including tourism, recreation and cultural heritage).

Wetlands therefore affect the quantity and quality of water within a catchment (Mitsch and Gosselink, 1993). The importance of wetland conservation and sustainable management is directly related to the value of the functions provided by a wetland (Smathkin and Batchelor, 2005); An indication of the functions and ecosystem services provided by wetlands is assessed through the WET-EcoServices manual (Kotze *et al*., 2008) and is based on a number of characteristics that are relevant to the particular benefit provided by the wetland. The tool uses biophysical characteristics of the wetland as well as the level of disturbance within the wetland and its catchment to estimate the level of supply of ecosystem goods and services. A Level 2 WET-EcoServices assessment was undertaken for the wetlands delineated along the proposed power line corridor. A Level 2 assessment is the highest WET-EcoServices assessment that can be undertaken and involves an on-site assessment as well as desktop work.

All depression systems were grouped in order to determine the level of goods and services these wetlands provide i.e. give an indication of their functional integrity. This is to stop the repetition of results as the wetlands are subjected to the same impacts within their respective catchments.

As can be seen in **Figure 4** the depression systems received generally low scores. This is as a result of their inward draining and isolated nature. The depressions contribute predominantly to sediment trapping; phosphate, nitrate and toxicant removal (i.e. filtration properties) and the maintenance of biodiversity within their immediate catchment areas.

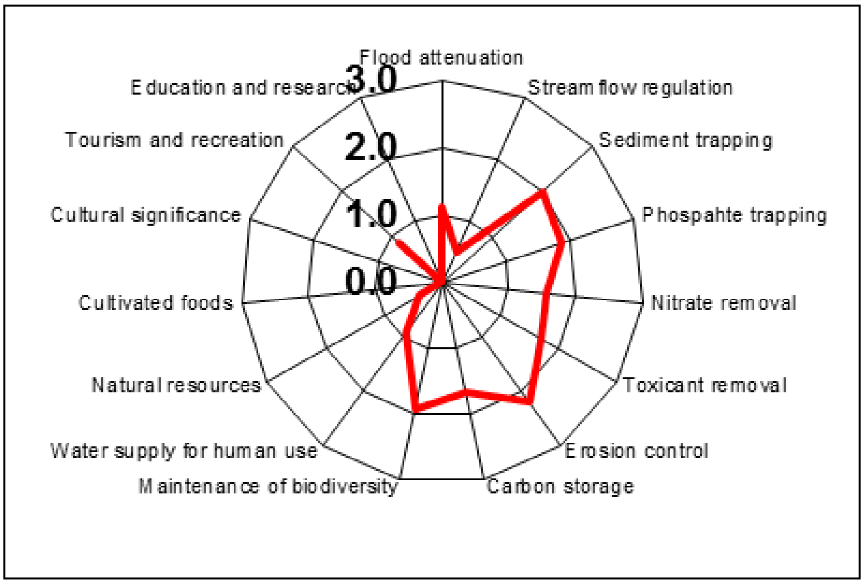

Figure 4: Wet-EcoServices results for the depression systems

5.2 Assessment of the Wetland's Present Ecological State (PES)

The Present Ecological State (PES) for wetlands which is defined as '*a measure of the extent to which human impacts have caused the wetland to differ from the natural reference condition'* is also an indication of each wetland's ability to contribute to ecosystem services within the study area. This was assessed according to the methods contained in the Level 2 WET-Health: *A technique for rapidly assessing wetland health* (Macfarlane, *et al*., 2009).

This document assesses the health status of a wetland through evaluation of three main factors -

- ***Hydrology:*** *defined as the distribution and movement of water through a wetland and its soils.*

- ***Geomorphology:*** *defined as the distribution and retention patterns of sediment within the wetland.*
- ***Vegetation:*** *defined as the vegetation structural and compositional state.*

The WET-Health tool evaluates the extent to which anthropogenic changes have impacted upon the functional integrity or health of a wetland through assessment of the above-mentioned three factors. The deviation from the natural condition is given a rating based on a score of 0-10 with 0 indicating no impact and 10 indicating modifications have reached a critical level. Since hydrology, geomorphology and vegetation are interlinked their scores are then aggregated to obtain an overall PES health score. These scores are then used to place the wetland into one of six health classes (A – F; with A representing completely unmodified/natural and F representing severe/complete deviation from natural as depicted in **Table 4**.

Table 4: Health categories used by WET-Health for describing the integrity of wetlands

DESCRIPTION	IMPACT SCORE	HEALTH CATEGORY
Unmodified, natural.	0 – 1.0	A
Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1.1 - 2.0	B
Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact	2.1 - 4.0	C
Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4.1 - 6.0	D
The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6.1 - 8.0	E
Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8.1 - 10.0	F

Due to differences in the pattern of water flow through various hydro-geomorphic (HGM) types, the tool requires that the wetlands are divided into distinct HGM units at the outset (**Figures 5, 6, 7 and 8**). Ecosystem services for each HGM unit are then assessed separately and the results are provided in **Table 5.**

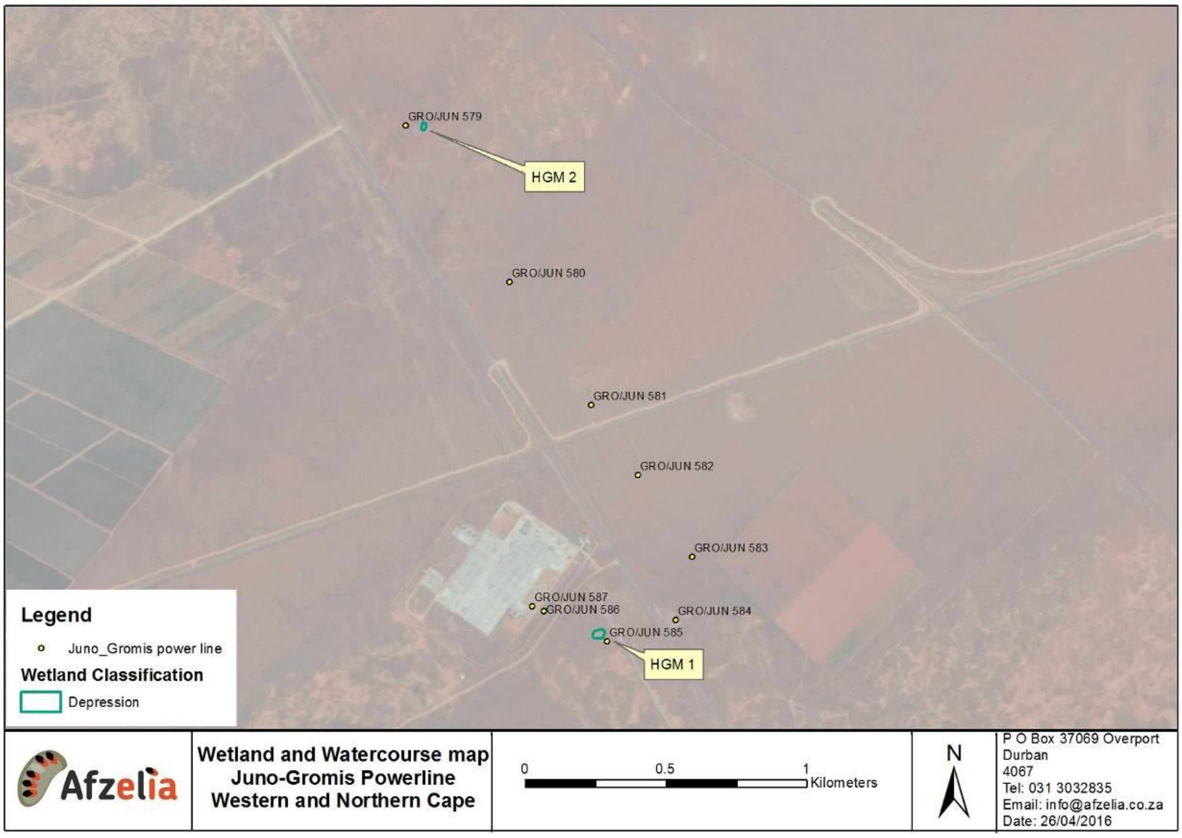

Figure 5: Depression systems at tower 585 (HGM 1) and tower 579 (HGM 2)

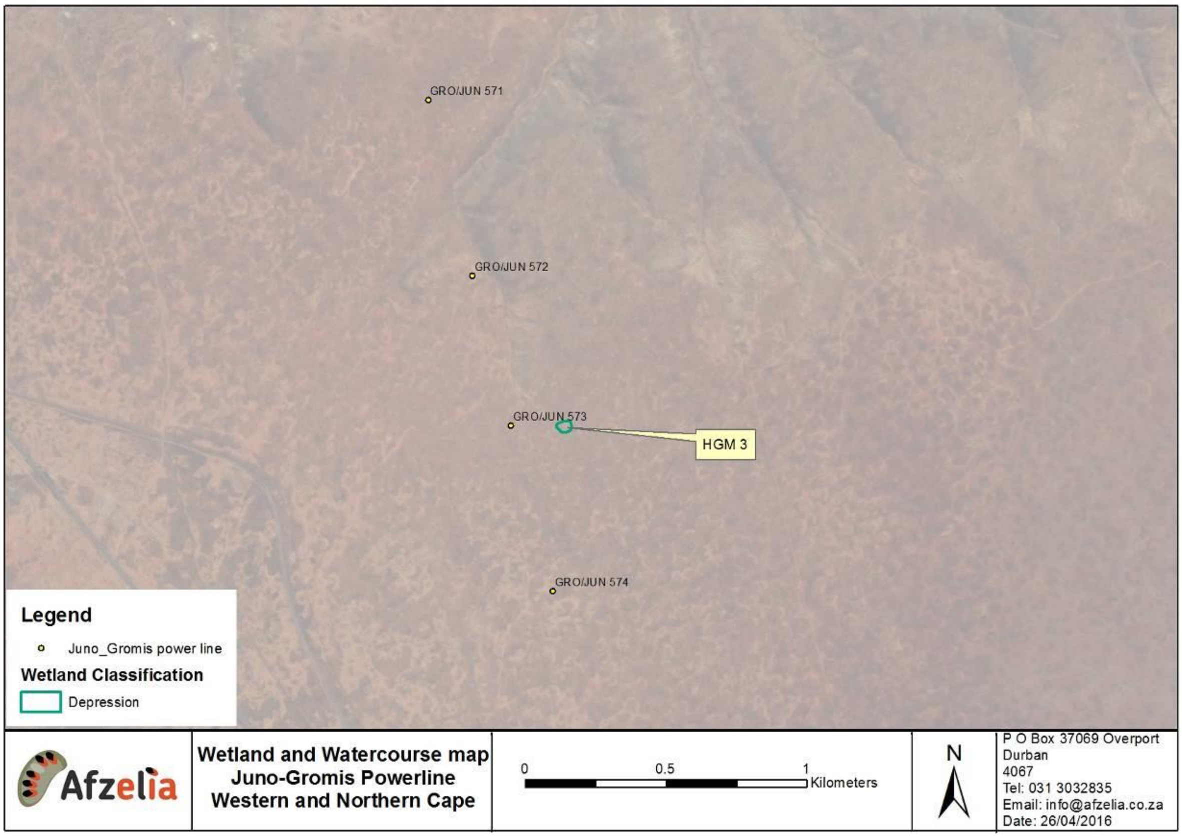

Figure 6: Depression system at tower 573 (HGM 3)

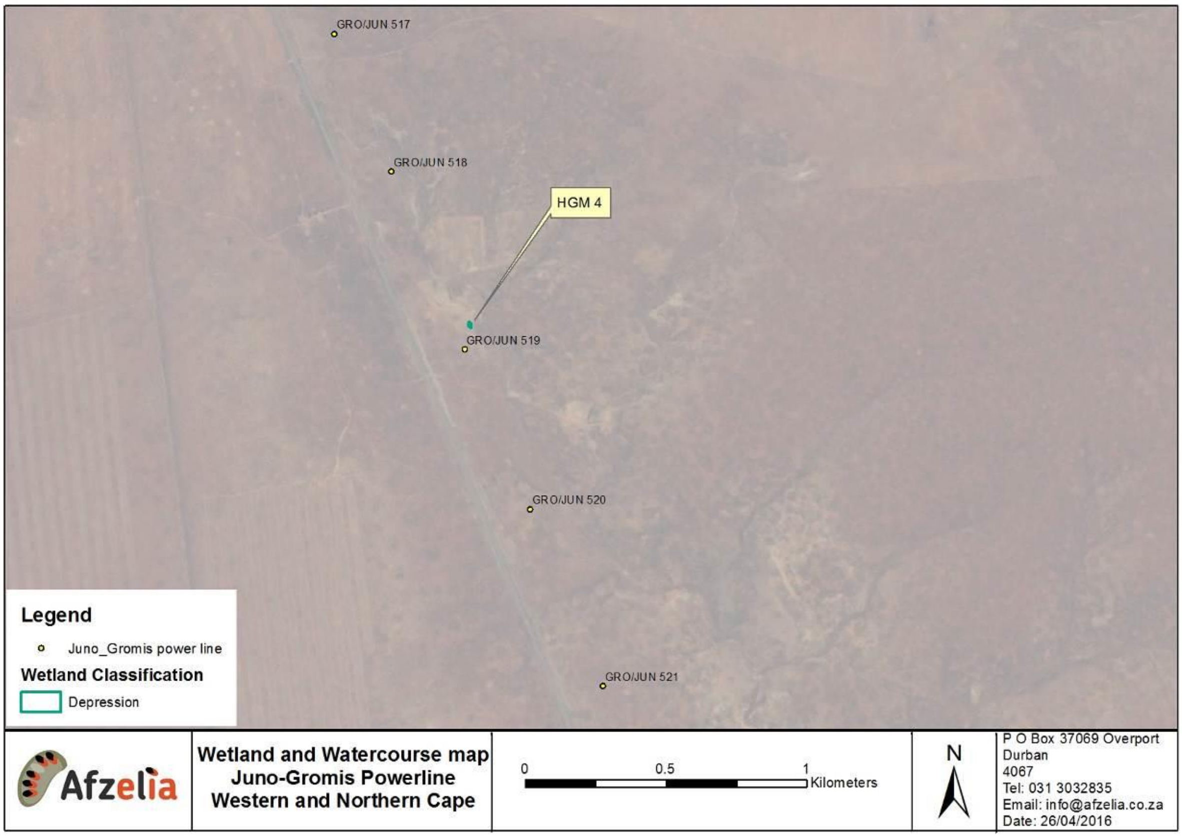

Figure 7: Depression system at tower 519 (HGM 4)

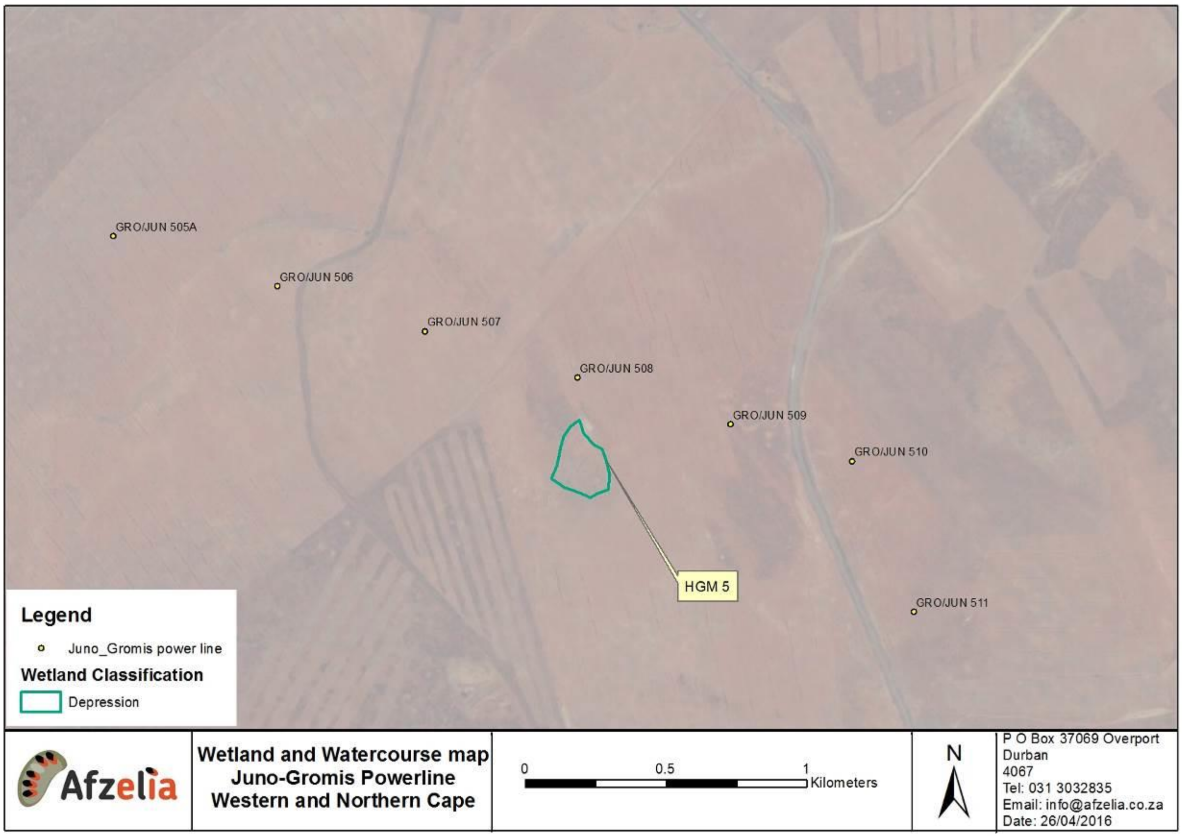

Figure 8: Depression system at tower 509 (HGM 5)

Table 5: Summary of PES score

HGM Unit and type	Hydrology	Geomorphology	Vegetation	Present Ecological Score (Category)
1	1.5	2.4	2.8	C (2.12)
2	1.5	2.5	2.8	C (2.15)
3	1.5	2.3	1.8	B (1.71)
4	1.5	2.8	3.0	C (2.30)
5	1.5	2.6	2.3	C (2.04)

The depression systems can be categorised as generally moderately modified (PES Category C), with one depression (HGM 3) being largely natural (PES Category B). Hydrology scores are all largely natural due to the isolated, inward draining nature of these pans, and the aridity of the surrounding landscape and therefore the limited potential for the hydrological flow to be modified extensively. The geomorphology scores and vegetation scores are classified as moderately modified due largely to agricultural activities. Grazing activities are causing the removal of basal cover within the wetland systems and adjacent areas, amplifying the deposition of sediment into the depressions.

5.3 Assessment of Ecological Importance and Sensitivity (EIS)

The Ecological Importance and Sensitivity (EIS) assessment was determined by utilising a rapid scoring system. This system has been developed to assess the 'Ecological Importance and Sensitivity' of the wetland within the larger landscape; the 'Hydrological Functional Importance' of the wetland; and the 'Direct Human Benefits' obtained from the wetland through either subsistence or cultural practices. The scoring assessments for these three aspects of wetland importance and sensitivity have been based on the requirements of the National Water Act, the original Ecological Importance and Sensitivity assessments developed for riverine assessments (DWAF, 1999), and the work conducted by Kotze *et al* (2008) on the assessment of wetland ecological goods and services from the WET-EcoServices tool. The scores obtained were placed into a category of very low; low; medium; high; and very high:

- Very low: 0 – 1.0
- Low: 1.1 – 2.0
- Medium: 2.1 – 3.0
- High: 3.1 – 4.0
- Very High 4.1 – 5.0

Table 6: Summary of the Ecological Importance and Sensitivity

		Score	Confidence	Category
HGM 1	Ecological Importance and Sensitivity	2.00	3.00	Medium
	Hydrological Functional Importance	1.50	3.00	Low
	Direct Human Benefits	0.87	3.50	Very Low
HGM 2	Ecological Importance and Sensitivity	2.00	3.00	Medium
	Hydrological Functional Importance	1.50	3.00	Low
	Direct Human Benefits	0.87	3.50	Very Low
HGM 3	Ecological Importance and Sensitivity	2.10	3.00	Medium
	Hydrological Functional Importance	1.50	3.00	Low
	Direct Human Benefits	0.87	3.50	Very Low
HGM 4	Ecological Importance and Sensitivity	2.17	3.00	Medium
	Hydrological Functional Importance	1.50	3.00	Low
	Direct Human Benefits	0.87	3.50	Very Low
HGM 5	Ecological Importance and Sensitivity	2.87	3.50	Medium-High
	Hydrological Functional Importance	1.50	3.00	Low
	Direct Human Benefits	0.87	3.50	Very Low

The overall Ecological Importance and Sensitivity[3] of the wetlands have been recorded as being medium (**Table 6**). These systems are utilised during the wetter season by a number of aquatic, avifaunal and faunal species for protection, feeding and breeding. The presence of water within these depressions particularly in the arid environment is considered paramount to the survival of the species that utilise these systems.

The overall Hydrological Functional Importance of the wetlands has been recorded as low-medium as a result of their isolated and inward-draining nature. The wetlands are not linked to the larger network of channels and therefore provide limited ecosystem services to the surrounding landscape. Human uses are limited; related to agriculture and the use of the areas for grazing.

[3] A medium score indicates features that are considered to be ecologically important and sensitive at a local scale. The functioning and/or biodiversity of these features is not usually sensitive to anthropogenic disturbances. They typically play a small role in providing ecological services at the local scale.

6. BUFFERS

The buffers for the HGM units were assessed using the Preliminary Guideline for the Determination of Buffer Zones for Rivers, Wetlands and Estuaries. Buffer zones associated with water resources have been shown to perform a wide range of functions, and on this basis, have been proposed as a standard measure to protect water resources and associated biodiversity (Macfarlane *et al*., 2014). These functions include:

- Maintaining basic aquatic processes;
- Reducing impacts on water resources from upstream activities and adjoining land uses;
- Providing habitat for aquatic and semi-aquatic species;
- Providing habitat for terrestrial species; and
- A range of ancillary societal benefits.

The buffer tool aims to provide a method for determining appropriate buffer widths for projects associated with wetlands, rivers or estuaries. It takes into account a number of different factors in determining the buffer width including the risk of the proposed activity on the water resource, climatic factors and the sensitivity of the water resource.

The results calculated show that a **21m buffer** is appropriate for the protection of the ecosystem services provided by these 5 endorheic depressions. This buffer is based on the current vegetation basal cover, the slope of the buffer area, the vulnerability to erosion as well as sedimentation, and the natural saturation of the depression systems.

The above buffer width must be enforced (i.e. not developed) during both the construction and operational phase of the proposed project particularly with regards to the positioning of the towers associated with the power line as well as the creation of any access roads.

7. IMPACT ASSESSMENT

Any development activity in a natural system will have an impact on the surrounding environment, usually in a negative way. The purpose of this phase of the assessment is to determine the significance of the potential impacts caused by the proposed development and to provide a description of the mitigation required so as to limit the identified impacts on the natural environment.

Identified negative impacts are associated with soil erosion and sedimentation, alteration to the hydrological flow entering the wetland areas, i.e. increased flood peaks, pollution of depressions and soil as a result of construction and operational activities and the spread of alien invasive species.

7.1 Significance of identified impacts

Significance scoring assesses and predicts the significance of environmental impacts through evaluation of the following factors; probability of the impact; duration of the impact; extent of the impact; and magnitude of the impact. The significance of environmental impacts is then assessed taking into account any proposed mitigations. The significance of the impact "without mitigation" is the prime determinant of the nature and degree of mitigation required[4]. Each of the above impact factors have been used to assess each potential impact using ranking scales (**Table 7**).

Unknown parameters are given the highest score (5) as significance scoring follows the Precautionary Principle. The Precautionary Principle is based on the following statement: *When the information available to an evaluator is uncertain as to whether or not the impact of a proposed development on the environment will be adverse, the evaluator must accept as a matter of precaution, that the impact will be detrimental. It is a test to determine the acceptability of a proposed development. It enables the evaluator to determine whether enough information is available to ensure that a reliable decision can be made.*

[4] Impact scores given "with mitigation" are based on the assumption that the mitigation measures recommended in this assessment are implemented correctly and rehabilitation of the site is undertaken. Failure to implement mitigation measures during and after construction will keep the impact at an unacceptably high level.

Table 7: Significance scoring used for each potential impact

Probability	***Duration***
1 - very improbable 2 - improbable 3 - probable 4 - highly probable 5 - definite	1 - very short duration (0-1years) 2- short duration (2-5 years) 3 - medium term (5-15 years) 4 - long term (>15 years) 5 - permanent/unknown
Extent	***Magnitude***
1 - limited to the site 2 - limited to the local area 3 - limited to the region 4 - national 5 - international	2 – minor 4 – low 6 – moderate 8 – high 10 – very high

Significance Points = (Magnitude + Duration + Extent) x Probability. The maximum value is 100 Significance Points.

Potential Environmental Impacts are rated as high, moderate or low significance as per the following:

<30 significance points = Low environmental significance

31-59 significance points = Moderate environmental significance

>60 significance points = High environmental significance

7.2 Loss of wetland habitat and ecological structure

<u>Description of impact</u>

Towers placed within wetland boundaries will lead to the direct loss of wetland soils and structure at this point having knock-on effects on the hydrological flow through the wetland leading to a loss of function. .

Further to this the placement of towers and access roads along the banks of watercourses will lead to erosion in the long term, particularly if the tower is placed on a slope. Wind erosion is of particular concern as this is a major distribution of soil in this region. Sedimentation by the deposited soil downslope of the corridor further poses a risk to the geomorphological/functional integrity of the non-perennial watercourse systems that will be crossed. It also impacts on the water quality downstream of the construction site reducing the ecological integrity of these systems outside of the construction servitude.

Impacts associated with the construction phase of the activities										
Future Impact	Probability		Duration		Extent		Magnitude		Significance scoring without mitigation	Significance scoring with mitigation
	Witho ut	With	Witho ut	With	Witho ut	With	With out	With		
Construction Phase										
Loss of wetland habitat and ecological structure	5	3	2	2	2	1	6	4	50 (moderate)	18 (low)
Operational Phase										

Loss of wetland habitat and ecological structure	5	5	5	5	1	1	4	2	50 (moderate)	40 (moderate)

Mitigation Options

- Enforcement of the buffer and the placement of towers outside of the depressions will significantly lower the impact of the proposed power line corridor on these systems.
- The creation of access roads must take all wetlands and watercourses into consideration and these systems must be avoided;
- The development footprint area is to be limited to what is absolutely essential so that environmental damage is minimised along the power line corridor.
- Demarcate all sensitive ecological areas outside of the construction servitude and ensure that these areas remain off-limits during construction.
- No vehicles must be allowed to drive through the depressions and within channels.
- No stockpiling of any materials may take place adjacent to any of the depressions or drainage channels. Erosion control measures must be implemented in areas sensitive to erosion, particularly in areas prone to wind erosion and where erosion has already occurred. These measures include but are not limited to - the use of sand bags, hessian sheets, silt fences, retention or replacement of vegetation and geotextiles such as soil cells which must be used in the protection of slopes.
- Do not allow surface water or storm water to be concentrated, or to flow down slopes without erosion protection measures being in place.
- The entire construction area must not be stripped of vegetation prior to commencing construction activities.
- Vegetation clearing must not be undertaken more than 10 days in advance of the work front. Vegetation clearing within 50m of any of the depression systems or watercourses must only be undertaken when construction activity is actually underway at these points and such areas must be rehabilitated within 2 weeks of initial clearing occurring.
- All disturbed areas must be rehabilitated as soon as construction in an area is complete or near complete and not left until the end of the project to be rehabilitated.
- Any channel banks that will be affected must be re-profiled as per the original soil horizon structure and re-vegetated with indigenous species.
- Tower 569 is proposed to be built in an alluvial floodplain. Particular emphasis on soil erosion preventative measures must be adhered to in this area.

7.3 Pollution of water resources and soil

Description of the impact

Sediment release from a construction site into an aquatic environment is one of the most common forms of waterborne pollution. Furthermore, mismanagement of waste and pollutants like hydrocarbons, construction waste and other hazardous chemicals will result in these substances entering and polluting sensitive natural environments either directly through surface runoff during rainfall events, or subsurface water movement.

Impacts associated with the construction phase of the activities										
Potential impact	Probability		Duration		Extent		Magnitude		Significance scoring without mitigation	Significance scoring with mitigation
	With out	With	Witho ut	With	With out	With	With out	With		
Construction Phase										
Pollution of water resources and soil	5	4	2	2	2	1	6	2	50 (moderate)	20 (low)
Operational Phase										
Pollution of water resources and soil	5	4	5	5	1	1	4	2	50 (moderate)	32 (moderate)

Mitigation Options

- All waste generated during construction is to be disposed of as per an Environmental Management Programme (EMPr) and no washing of containers, wheelbarrows, spades, picks or any other equipment adjacent to or in any of the drainage channels, non-perennial rivers or depression system along the power line corridor is permitted.
- Proper management and disposal of construction waste must occur throughout the lifespan of the project, especially during maintenance of the power line.
- No release of any substance i.e. cement, oil, that could be toxic to fauna or faunal habitats within the depressions.

8. CONCLUSION

Five wetland areas were identified within a 500m buffer surrounding the proposed power line corridor. The wetlands were classified into separate hydrogeomorphic (HGM) units, comprising of five separate depressions/pan systems. Numerous ‘A’ Section and ‘B’ Section channels were delineated along the power line corridor.

The tower positions in closest proximity to each depression/watercourse identified along the route was recorded to be used in finalising the position of each tower.

A health assessment was conducted for the depressions according to the WET-Health methods. The depression systems can be categorised as generally moderately modified (PES Category C), with one depression (HGM 3) being largely natural (PES Category B). Modifications to all depression systems stem from surrounding agricultural activities. Grazing activities are causing the removal of basal cover within the wetland systems and adjacent areas, amplifying the deposition of sediment into the depressions.

All depression systems have been classified as having a medium ecological sensitivity and importance. These systems are utilised during the wetter season by a number of aquatic, avifaunal and faunal species for protection, feeding and breeding. The presence of water within these depressions particularly in the arid environment is considered paramount to the survival of the species that utilise these systems.

Buffers were calculated to determine the minimum zone of protection that must be placed around the wetland systems. A number of different factors determine the buffer width including the risk of the proposed activity on the water resource, the threat assessment, climatic factors and the sensitivity of the water resource. A 21m buffer width is recommended to protect the identified depressions. This buffer must be enforced during the construction and operational phases of the proposed project.

A number of potential impacts that relate to soil erosion and sedimentation, alteration to the hydrological flow entering the depressions as well as the watercourses, pollution of the depressions/watercourses and soil as a result of construction and operational activities.

Mitigation measures are key to limiting the negative effects on the wetlands and watercourses and must be included in an Environmental Management Programme for the proposed project.

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10. GLOSSARY

Buffer zone: The strip of vegetation between the natural edge of a sensitive environmental system and the surrounding land use. ie wetland systems, forest systems

Catchment: The area where water from atmospheric precipitation becomes concentrated and drains downslope into a river, lake or wetland. The term includes all land surface, streams, rivers and lakes between the source and where the water enters the ocean.

Delineation: Refers to the technique of establishing the boundary of a resource such as a wetland or riparian area.

Invasive alien species: Invasive alien species means any non-indigenous plant or animal species whose establishment and spread outside of its natural range threatens natural ecosystems, habitats or other species or has the potential to threaten ecosystems, habitats or other species.

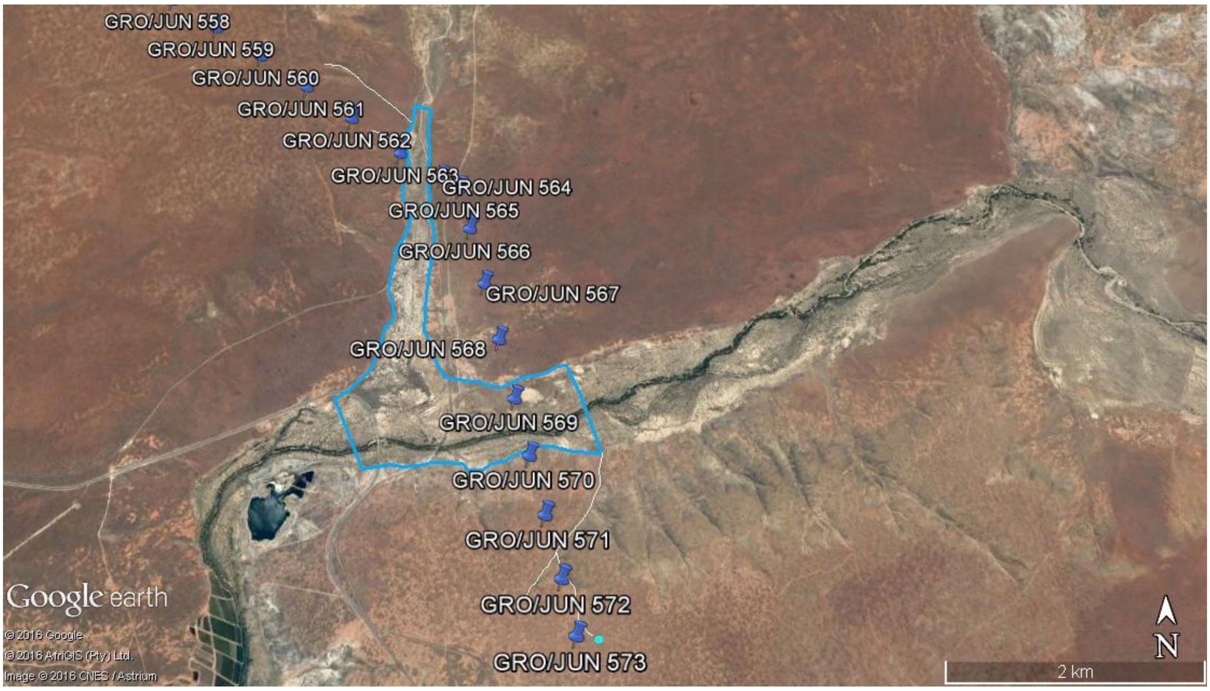
Mitigate/Mitigation: Mitigating impacts refers to reactive practical actions that minimise or reduce in situ wetland impacts. Examples of mitigation include “changes to the scale, design, location, siting, process, sequencing, phasing, and management and/or monitoring of the proposed activity, as well as restoration or rehabilitation of sites”. Mitigation actions can take place anywhere, as long as their effect is to reduce the effect on the site where change in ecological character is likely, or the values of the site are affected by those changes (Ramsar Convention, 2012).

Water course: Means a river or spring; a natural channel in which water flows regularly or intermittently: a wetland, lake or dam into which, or from which, water flows: and any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks (National Water Act, 1998).

Appendix A.

Aerial imagery of the wetlands and watercourses in relation to the tower positions

Key:
Light blue circular image – Depression system
Dark blue – 'B' Section Channels
White – 'A' Section Channels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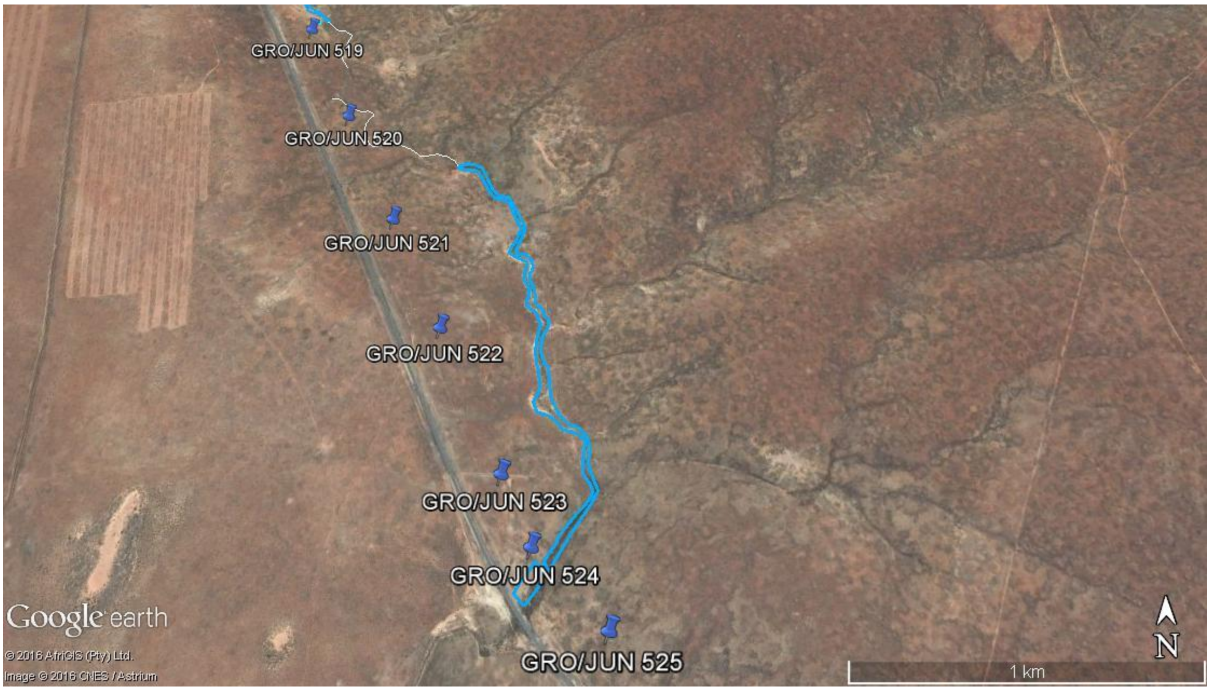
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Google earth
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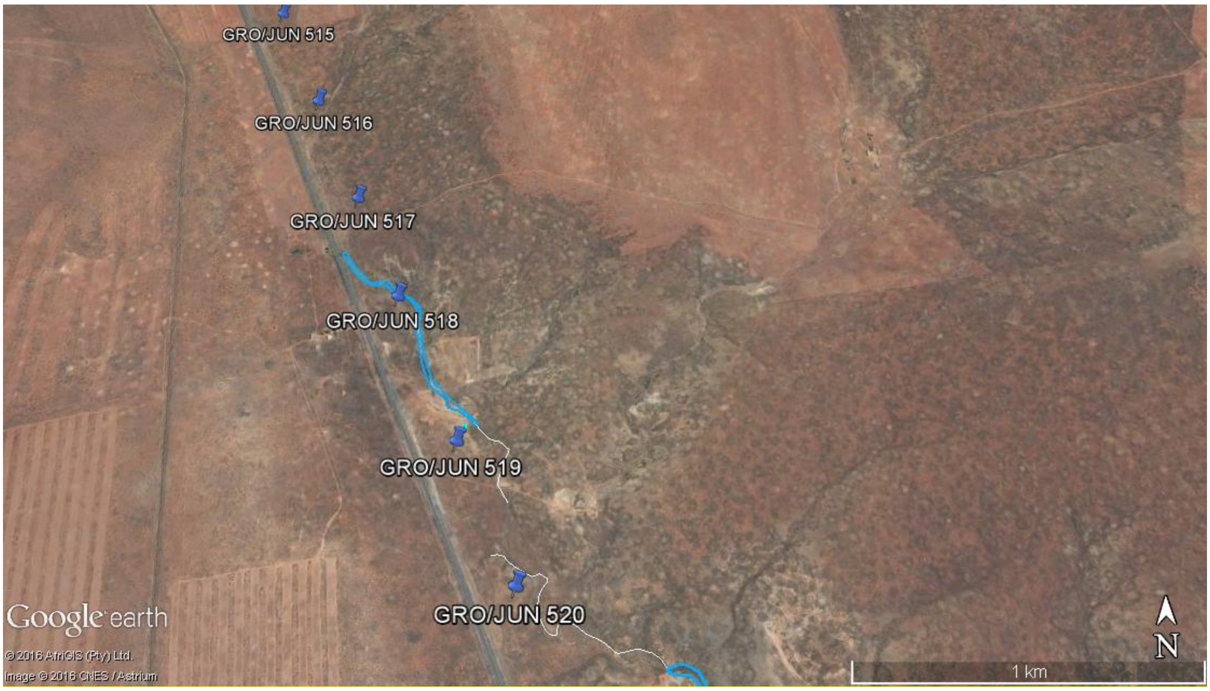
1 km
N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Google earth
1 km
N


/JUN 505
GRO/JUN 505A
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Google earth
1 km
N


GRO/JUN 465
GRO/JUN 466
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GRO/JUN 471
GRO/JUN 472
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GRO/JUN 475
GRO/JUN 476
GRO/JUN 477
Google earth
2 km
N


GRO/JUN 415
GRO/JUN 419
GRO/JUN 420
GRO/JUN 423
GRO/JUN 426
GRO/JUN 437
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GRO/JUN 463
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GRO/JUN 468
Google earth
7 km
N


GRO/JUN 372
GRO/JUN 373
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GRO/JUN 380
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Lepelsfontein
Google earth
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N
2 km


GRO/JUN 359
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Kotzesrus
GRO/JUN 364
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Google earth
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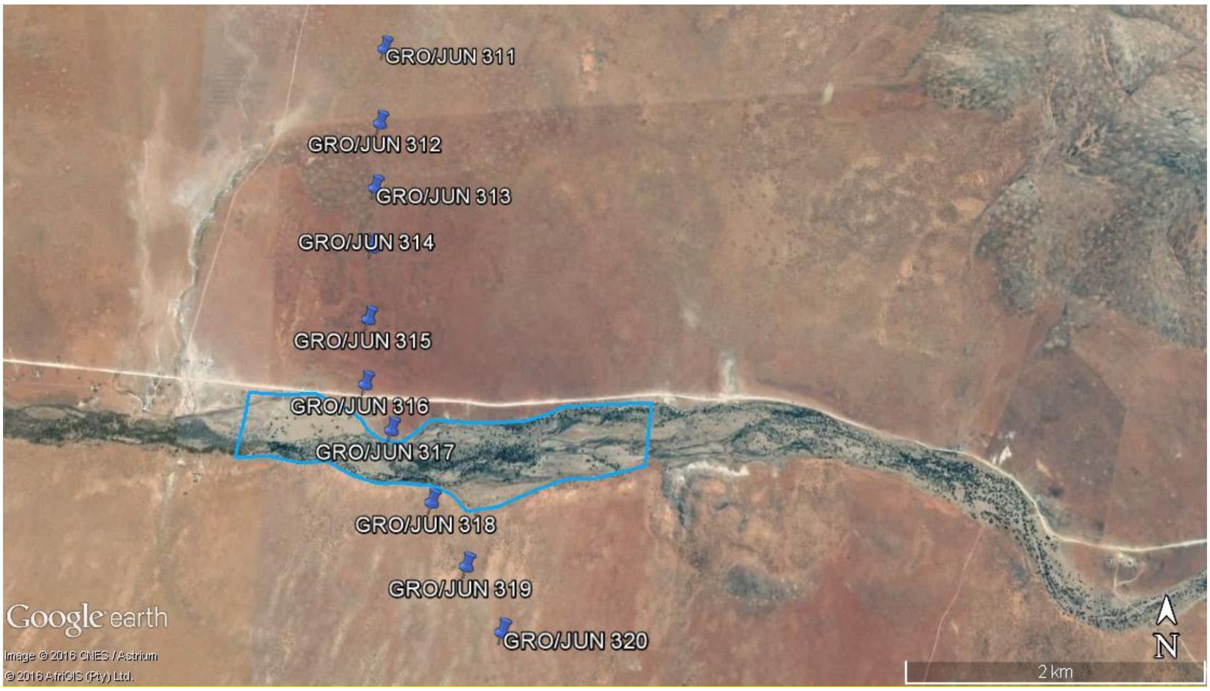
N
3 km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GRO/JUN 319
GRO/JUN 320
Google earth
N
2 km


GRO/JUN 300
GRO/JUN 301
GRO/JUN 302
GRO/JUN 303
GRO/JUN 304
GRO/JUN 305
GRO/JUN 306
Google earth
N
1 km

JN 285
RO/JUN 286
GRO/JUN 287
GRO/JUN 288
GRO/JUN 289
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GRO/JUN 291
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GRO/JUN 293
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Google earth
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N
1 km

GRO/JUN 259
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Langberg
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Google earth
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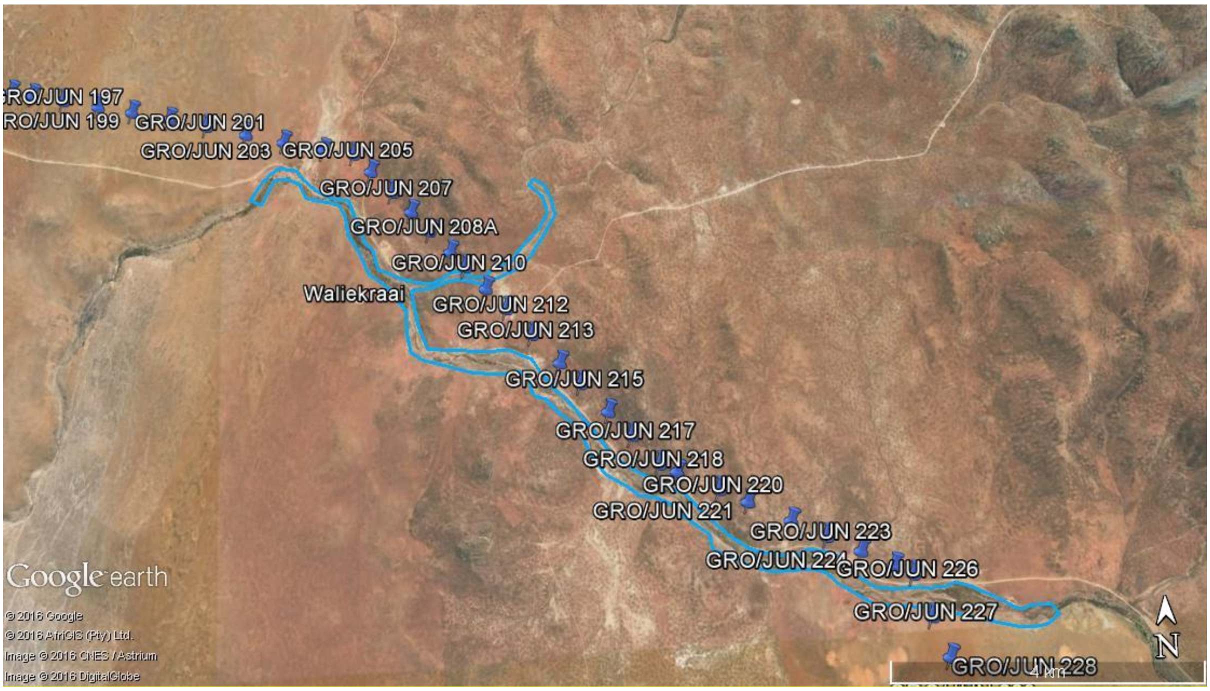
N
2 km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Waliekraal
GRO/JUN 212
GRO/JUN 213
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Koingnaas
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2 km


GRO/JUN 001
Gantry
GRO/JUN 002
GRO/JUN 002A
GRO/JUN 003
GRO/JUN 004
GRO/JUN 005
GRO/JUN 006
GRO/JUN 007
GRO/JUN 008
GRO/JUN 009
GRO/JUN 009A
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N
2 km