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Environmental Impact Assessment Report for the proposed construction of a substation and associated activities at Duynefontein (Koeberg Nuclear Power Plant site), in the Western Cape

Assessment of implications for freshwater ecosystems

3rd Draft

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Prepared by

Liz Day (PhD; Pr Nat Sci)

Freshwater Consulting cc

lizday@mweb.co.za

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1 INTRODUCTION

1.1. Background

Construction of a new substation and the associated infrastructure required to link with the existing Koeberg Nuclear Power Plant and the National Electricity Grid has been proposed by Eskom Holdings SOC (Limited) ("Eskom"), for its site at Duynefontein, located near Melkbosstrand, some 30km south of Cape Town. The proposed activities include several triggers requiring authorisation to be considered through an Environmental Impact Assessment (EIA) Process, in terms of the National Environmental Management Act (NEMA) (Act 107 of 1998). As a result, Eskom appointed Lidwala Consulting Engineers (Pty) Ltd ("Lidwala") to oversee the EIA process.

Since some of the alternative footprints of the proposed substation and its associated infrastructural requirements lie in close proximity to known wetlands, including natural watercourses, Freshwater Consulting cc (t/a The Freshwater Consulting Group / FCG) was in turn appointed by Lidwala to provide specialist input from a freshwater ecosystem perspective into the Environmental Impact Assessment.

This document comprises FCG's input into this process, and has been structured in terms of a specialist reporting template, provided by Lidwala to facilitate consistency between different specialist reports. The present (April 2015) report is the **second draft specialist report**, and supersedes the first draft, produced in October 2014.

1.2. Terms of reference and report objectives

This report is intended to inform decision-making as to the implications from a freshwater ecosystem perspective, of each of the proposed development and technology alternatives, including the option of undertaking no further development. Input into the report was thus informed by the following terms of reference, which required that the freshwater specialist:

- Check the footprint of the proposed activities against wetland maps that have been previously compiled by FCG for the site and adjacent areas;
- Conduct a site visit to ground-truth the wetland map against the proposed routes and allow for summary PES assessments for water courses / wetlands where these have not already been provided by past studies;
- Liaise with other specialists and the project team regarding the proposed project, its implications and the details of its design;
- Assess the potential impacts of the proposed activities for watercourses and other wetland ecosystems, using the assessment criteria included in Appendix A, provided by Lidwala;
- Recommend mitigation measures for all identified impacts to watercourses and other wetland types;
- Provide input into the Construction and Operational Phase EMPS for the project's implementation;
- Compile a report incorporating the above items.

1.3. Study area

Figure 1 shows the location of the present study area. The two portions of the study area, both on Eskom-owned land, are accessed directly off the R27 route from Cape Town.

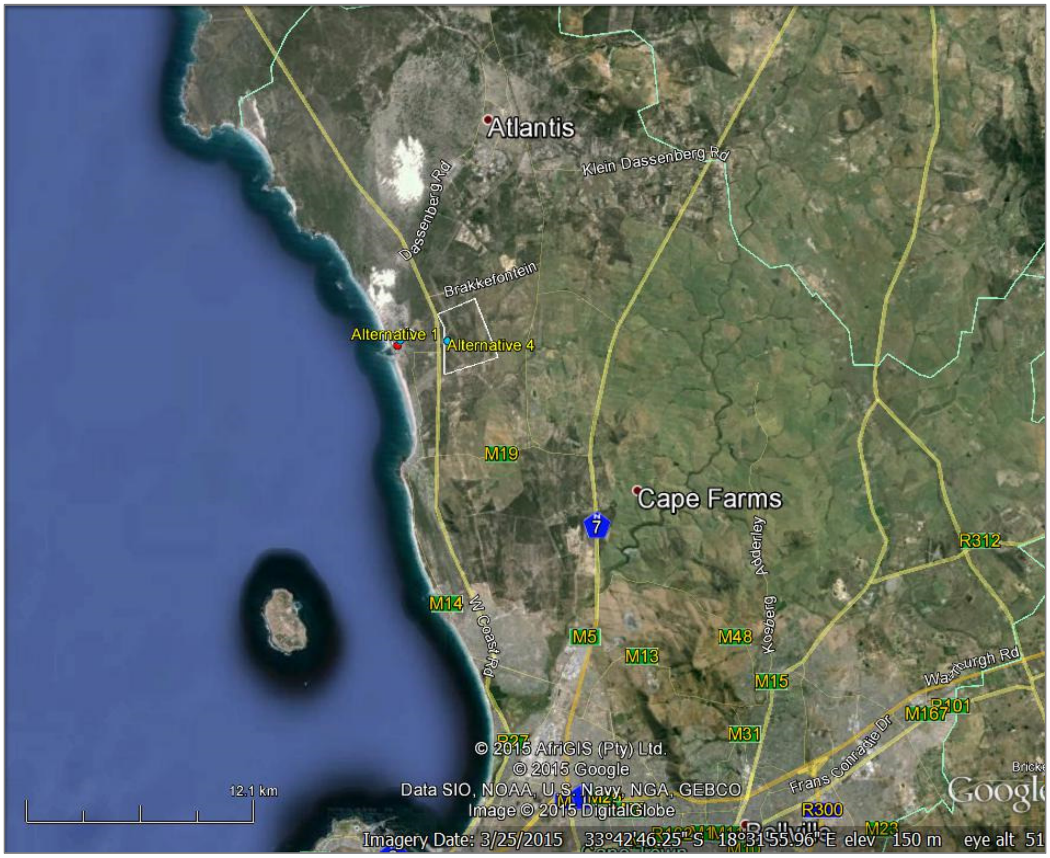

Figure 1

2015 GOOGLE image showing location of the present study area, including two portions of land, east and west of the R27 respectively.

1.4. Legislative Framework

While this section is not intended to comprise a full review of legislation affecting or affected by the proposed development and its application for authorisation, the legislation listed below is considered particularly relevant when considering issues relevant to freshwater ecosystems.

- The **National Water Act** (Act 36 of 1998) (NWA) – this act has relevance, *inter alia*, to any activities that are considered as "water uses" in terms of Section 21 of the Act, with specified water uses including:

  21(a) taking water from a water resource;
  21(b) storing water;
  21(c) impeding or diverting the flow of water in a watercourse;
  21(d) engaging in a stream flow reduction activity contemplated in section 36;

21(f) discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;

21(g) disposing of waste in a manner which may detrimentally impact on a water resource;

21(i) altering the bed, banks, course or characteristics of a watercourse.

- [1]The **National Environmental Management Act** (Act 107 of 1998) (NEMA) - Section 24 of this Act provides for certain listed activities that may not commence without an environmental authorisation and which require some form of environmental impact assessment to be undertaken. Of these activities, those most relevant in terms of the present report are listed in GNR 544 Listing Notice 1, activity 18, which focuses on "the infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 5 cubic metres from:

  (i) a watercourse;

  (ii) the sea;

  (iii) the seashore;

  (iv) the littoral active zone, an estuary or a distance of 100 metres inland of the high-water mark of the sea or an estuary, whichever distance is the greater- but excluding where such infilling, depositing, dredging, excavation, removal or moving is in accordance with an approved maintenance and management plan;

- The **National Environmental Management: Biodiversity Act** (Act 10 of 2004) (NEM:BA) prohibits the carrying out of a restricted activity involving a specimen of a "listed protected or threatened species" without a permit. "Listed threatened or protected species include species described as critically endangered, endangered, vulnerable and protected", and the term "Restricted activity" in relation to a specimen of a listed threatened or protected species, is defined as including:

  (ii) gathering, collecting or plucking any specimen of a listed threatened or protected species;

  (iii) picking parts of, or cutting, chopping off, uprooting, damaging or destroying, any specimen of a listed threatened or protected species;

  (vi) having in possession or exercising physical control over any specimen of a listed threatened or protected species;

  (viii) conveying, moving or otherwise translocating any specimen of a listed threatened or protected species..."

  Furthermore, Section 65(1) of the Act prohibits the carrying out of a restricted activity involving a specimen of an "alien species" without a permit.

[1] Note that the listed activities triggering a Basic Assessment in terms of NEMA were amended in December 2014. It is however assumed that the present application commenced prior to this date, and that the previous listed activities still therefore apply.

The term “Restricted activity” in relation to a specimen of an alien species or listed invasive species, is defined as including-

(ii) having in possession or exercising physical control over any specimen of an alien or listed invasive species;
(iii) growing, breeding or in any other way propagating any specimen of an alien or listed invasive species, or causing it to multiply;
(iv) conveying, moving or otherwise translocating any specimen of an alien or listed invasive species...”.

- The **Conservation of Agricultural Resources Act** (Act 43 of 1983) (CARA) – in terms of Section 6(1) of this Act, the Minister may, in order to achieve the objects of this Act, prescribe control measures that must be complied with by land users to whom they apply. Control measures that have been prescribed by the Minister in the Regulations promulgated under CARA, which relate to potential impacts on or from aquatic ecosystems include the following:

    a) Protection of cultivated land against erosion through the action of water;
    b) The prevention of waterlogging and salination of irrigated land;
    c) The utilization and protection of vleis, marshes, water sponges, water courses;
    d) The regulating of the flow pattern of run-off water;
    e) The utilization and protection of veld;
    f) Restoration or reclamation of eroded land;
    g) Restoration and reclamation disturbed or denuded land;
    h) Declaration of weeds and invader plants;
    i) Indicators of bush encroachment.

1.5. Terms and Definitions

All reference to wetlands and water courses in this document are based on the following definitions of wetlands and water courses, as stipulated in the National Water Act (NWA) (Act 36 of 1998):

“watercourse'' *means -*

(a) a river or spring;
(b) a natural channel in which water flows regularly or intermittently;
(c) a wetland, lake or dam into which, or from which, water flows; and
(d) any collection of water which the Minister may, by notice in the Gazette, declare to be watercourse, and a reference to a watercourse includes, where relevant, its bed and banks;

“wetland'' *means -*

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.

1.6. Study approach and methodology

1.6.1. Use of existing information

Considerable work has already been carried out on the freshwater ecosystems that occur on the western side of the R27 (see Figure 1) including:

- A detailed surface and groundwater monitoring programme, which addressed water quality, surface groundwater interactions, aquatic invertebrate assessment and monitoring and vegetation surveys, carried out as part of the monitoring programme associated with planning for the proposed Nuclear 1 development (e.g. Visser et al 2011, Visser et al 2012 and Visser et al 2013);
- The freshwater ecosystems EIA for the proposed Nuclear 1 development (Day 2011), which included wetland mapping and assessment of aquatic ecosystem condition, ecological importance and sensitivity and biodiversity;
- The freshwater ecosystems EIA for the (then) proposed Pebble Bed Modular Reactor (PBMR) at Duynefontein, which included wetland mapping and assessment, updated in the preceding citation;
- Assessment of aquatic macroinvertebrate diversity in seasonal wetlands at the Duynefontein site by Bird (2012).

The above reports were considered sufficiently detailed and up-to-date in their totality to inform the assessments made in this study of development-related impacts affecting areas on the western side of the R27. Background descriptions of freshwater ecosystems in this area have thus been extracted largely from these reports.

Less detailed work has been carried out from a freshwater ecosystems perspective on the site to the east of the R27, although the following work was used to inform assessments of proposed activities in this area:

- Wetlands as mapped in the City of Cape Town's (2012) Wetland Layer
- The City of Cape Town's (2009) wetland prioritization layer, based on the approach of Snaddon and Day (2009);
- Assessments of the condition of the Donkergat and Sout Rivers, provided by Day and Snaddon (2000) and updated in Pemberton (2006) and Day (2012);
- National Freshwater Ecosystem Priority Area data (Driver et al 2011).

The City of Cape Town's wetland layer was used as the basis on which ground-truthing of mapped wetlands on the portion of the study area to the east of the R27 was based. River condition provided in the above studies as well as in the City's river database was also assessed during ground-truthing, with a view to re-evaluation if condition appeared to have altered substantially in the interim.

1.6.2. Collection of new data

No new biophysical data was collected as part of this study, although aquatic ecosystem condition was ground-truthed, during two site visits, one in October 2013 and one in September 2014.

1.6.3. Wetland classification

Classification of wetlands outlined in the studies and datasets cited above were based on a now-outdated wetland classification system of SANBI (2009). Since then, a National Aquatic Ecosystem Classification protocol has been produced (see Ollis et al 2013), and wetlands referred to in the present report have been reclassified in terms of the updated approach, with the main difference between the two being, for the current purposes, that the latter does not include river channels as a wetland type.

1.7. Assumptions

1.7.1. Assumptions regarding existing data

This study has relied heavily on existing data, particularly in the case of the western portion of the study area, and it is assumed that these data are still valid. On the basis of the two site visits made during the course of this project, this assumption does seem to be a reasonable one, with the exception of one difference observed during the October 2014 site visit, namely that the area west of the R27 is, in places, substantially wetter than at any time since FCG first became involved in site monitoring, around 2006. Areas shown on the basis of vegetation type, surface/groundwater interaction models and water level data to be terrestrial, were at this time in several areas, saturated to inundated, with a clear increase (Barrie Low, COASTEC botanist, pers. comm. to Liz Day) in colonisation by plant species typically associated with temporary wetland conditions (e.g. *Senecio helimifolius*), suggesting wetter conditions this year. Such patterns were not evident in areas east of the R27, and it is suspected that the local groundwater table has risen above a threshold of where water daylights into low lying areas on the western side, but does not reach such thresholds on the generally higher lying east, where groundwater is deeper below the surface (SRK 2011). The above conditions (increased wettedness) applied to the area east of and north of the proposed GIS yard in this area.

1.7.2. Assumptions regarding the location of the proposed Nuclear1 site, in relation to the Weskusfleur site

Critical to the current assessment is my understanding that options for the layout and construction footprint of the proposed Nuclear-1 site at Duynefontein, currently still in its EIA phase, would not be impacted by the proposed construction of a GIS on Alternative 1 and that the proposed layout for the Nuclear-1 site, as included in **Appendix B** of this report, would form the basis for the EIA for that project. In particular, it is assumed that the setbacks from the dunes to the north of the Nuclear-1 site, as well as the proposed ecological corridors included in the Nuclear-1 layout (see Appendix B) <u>would not in any way be compromised by the location of a GIS in the area assessed in the present study</u>. In the event that this assumption does not hold true, the findings of this report would need to be wholly revisited.

1.8. Limitations

The findings of this study are also subject to the following limitations:

- The technology alternatives proposed as part of the development application have been assessed in this report from the perspective of their development footprints only. It is beyond the expertise of this specialist to comment on any other aspects of the proposed technologies involved.

- Alien invasion and high security fencing in parts of the site limited access to the Donkergat River, which was not accessed along its full route past the site. However, sufficient information was gained during the site visits for this limitation to be considered insignificant.
- This study did not include assessment of the effects of pylons on flying fauna (e.g. birds and bats) – such input, if required, would need to be informed by faunal specialist studies.
- The mapped extent of wetlands shown on the study area has not been subjected to the detailed wetland delineation described in DWAF (2005). This was not considered necessary for the present study, but would be necessary for the purposes of submitting an authorisation for a Water Use Licence through the Department of Water and Sanitation (DWS) in the event that infilling or encroachment into natural wetland areas was considered necessary (see Section 1.4).

2 DESCRIPTION OF THE PROJECT

The following description of the proposed project has been adapted from that outlined in Chapter 4 of the Draft Scoping Report for this project (Lidwala 2013).

The project as assessed in this report includes the following main elements that have been considered likely to have some bearing on freshwater ecosystems:

- The substation:
  - Although five location alternatives were originally provided for the substations (Lidwala 2013), three of these were eliminated during the Scoping Phase of the study, and only Alternatives 1 and 4 remain for consideration. They are located respectively on the west and eastern sides of the R27, as shown in Figures 1 and 2 and comprise:
    - **Alternative 1** – Located at the north-east corner of the KNPS for the 400kV yard and the southern part of the parking area south of the incoming 400kVlines for the 132kV yard; and
    - **Alternative 4** – Offsite option to the east of the R27 on the farm Brakke Fontein 32.
- Two technology alternatives have been proposed, comprising:
  - A Gas Insulated Substation (GIS);
  - An Air Insulated Substation (AIS).

  Of these, the GIS occupies considerably less space than the AIS (72 000 m^2 compared to 418 000 m^2), and is faster to construct / install (Lidwala 2013). However, the GIS has been ruled technically unfeasible at Alternative 4 (Lidwala 2013), and the AIS is considered not technically viable at Alternative 1 (Lidwala 2013), although it is assessed in this study.
- Transmission lines:
  - Each alternative site would be associated with a different alignment and design of transmission lines;
  - Alternative 4 would require more extensive transmission lines, given its location at a greater distance from the Koeberg power Plant itself, which would require additional lines to be constructed to accommodate construction outage requirements
  - Transmission towers – it is assumed that these would be cement or gabion stabilized / founded structures.

The respective footprints of the technology alternatives under consideration in this report are shown in **Figure 2**, at each of the two alternative development locations. The figure also shows the proposed temporary turn-in areas around Alternative 1, and the routing of the power line routes for both alternatives, to connect them with both Koeberg and the National Grid.

Note that it is assumed that:

- The proposed projects would not generate high volumes of stormwater runoff, and that stormwater generated would dissipate locally into the ground;
- It is also assumed that none of the proposed developments are likely to be associated with any chemical contaminant of high risk to surface or groundwater, other than those associated with normal construction activities.

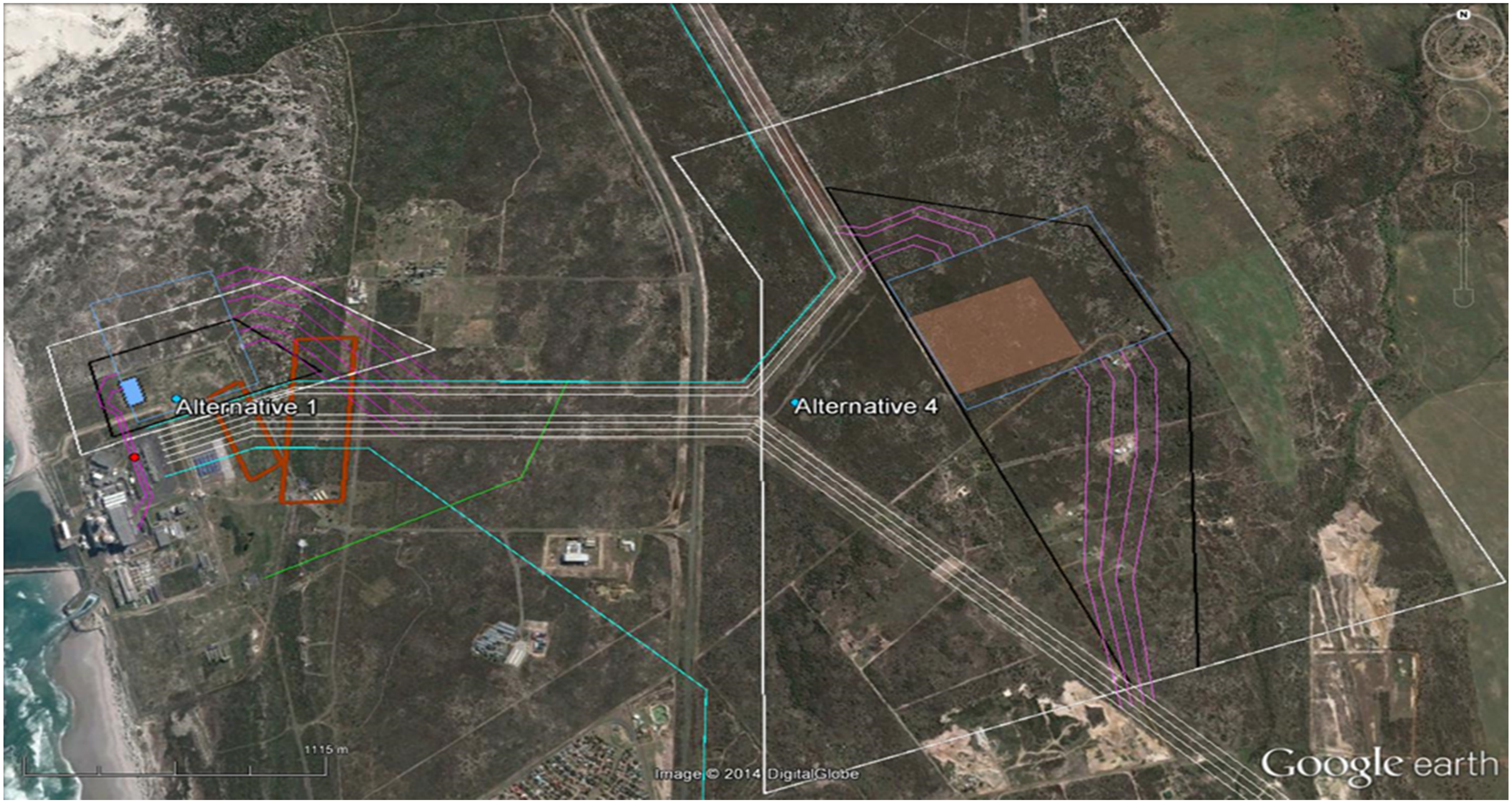

Figure 2

Proposed alignment of the two Weskusfleur substation alternatives, overlain on 2014 GOOGLE Earth imagery.

Figure courtesy Lidwala. The Figure shows the proposed location of the GIS (small, infilled blue block) at Site Alternative 1 and the AIS (brown infilled block) at Site Alternative 4. The blue open rectangular bock at Alternative 1 shows the conceptual location of an AIS at this site – note that this is not assessed further in this study. New links to the existing (white) transmission lines are shown in blue for Alternative 1 and pink for Alternative 4. The green line south east of Alternative 1 is an existing line.

3 DESCRIPTION OF THE AFFECTED ENVIRONMENT

3.1. Water Management Area and Catchment context

The study area lies within the Berg Water Management Area (WMA) within quaternary catchment G21B. The two proposed development alternatives in fact lie in two separate catchment areas, as distinguished in the City of Cape Town's database for Major Natural Catchments, with Alternative 1 on the western side of the R27 lying with the Atlantis catchment, while Alternative 4 on the eastern side of the R27 lies in the catchment of the Sout River, which passes into the Atlantic Ocean just south of the study area, in the residential area of Melkbosstrand (**Figure 3**). The Atlantis Catchment comprises a number of small, mainly seasonal watercourses that feed into the Atlantic Ocean at various points within the City's municipal boundary, as well as numerous isolated, mainly groundwater-fed wetlands. Note that NFEPA data (see Section 3.2) do not distinguish between these two catchment areas.

3.2. NFEPA context

The National Freshwater Ecosystem Priority Area (NFEPA) project was used to identify FEPAs (Freshwater Ecosystem Priority Areas) in South Africa. FEPAs are strategic priorities for conserving freshwater ecosystems and supporting the sustainable use of water resources (Driver et al 2011) and have been determined for different river and wetland types throughout South Africa, on the basis of a number of criteria that included ensuring that there is an adequate extent of conservation of different river and wetland ecosystem types, that they represent adequate habitats to support threatened fish species and their migration corridors; that free-flowing rivers (i.e. rivers without major dams) are prioritised as FEPAs, that water supply areas in high-water yielding sub-quaternary catchments are maintained and that ecological connectivity between systems is maintained as far as possible.

Figure 3 shows the present study area in the context of NFEPA data. The Sout River itself is a NFEPA River (i.e. shown in the 1:500 000 national rivers covers), and the river is classified throughout its reaches as far as the Melkbosstrand Waste Water Treatment Works (MWWTW) as an upper foothill river (NFEPA geozone D), and as a lower foothill river (geozone E) in its reaches from the MWWTW, immediately upstream of the R27, as far as its estuary (but see Section 3.5 for discussion).

NFEPA data accord the Sout River a Category D (Largely modified) Present Ecological State or condition rating throughout its reaches, and the river has not been accorded FEPA status in the NFEPA dataset.

The Donkergat River is not considered a NFEPA River, and no wetlands are shown in the NFEPA dataset as occurring in or adjacent to the present study area. Note however that this is not an accurate reflection of wetland extent in this area, as discussed in subsequent sections.

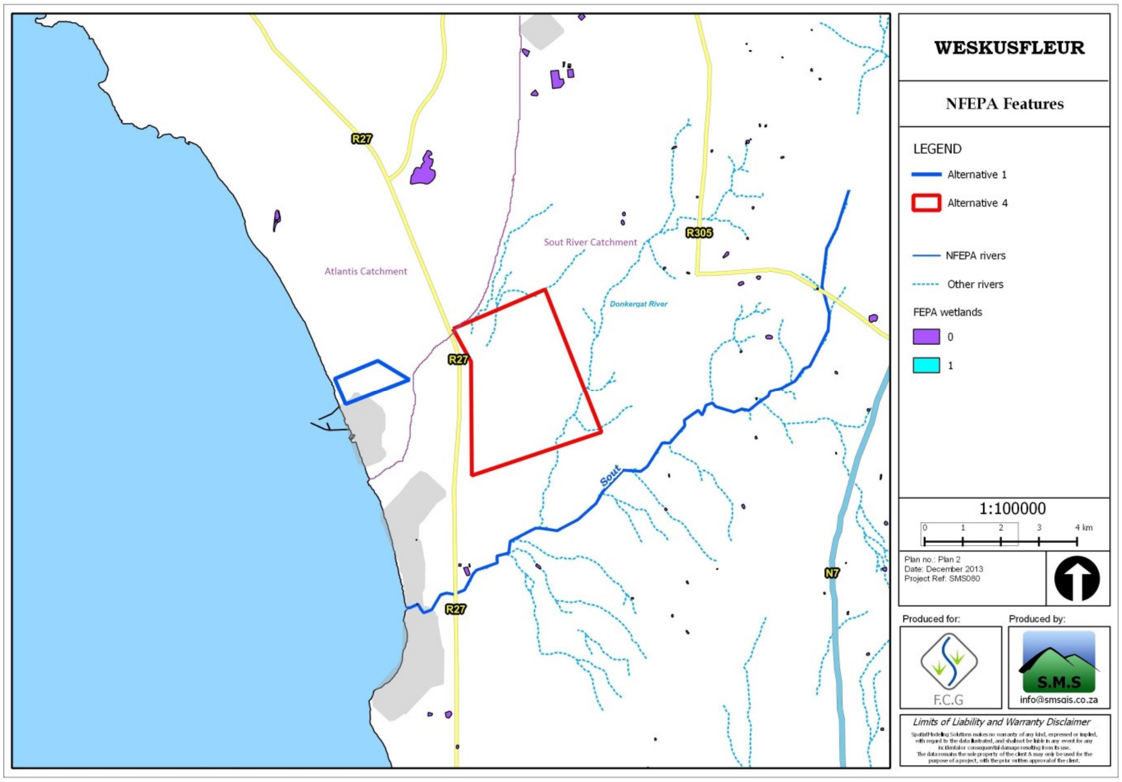

Figure 3
The sites of the proposed Weskusfleur substation in the context of NFEPA river and wetland data.

3.3. Context in terms of the City of Cape Town's Aquatic Ecosystem Biodiversity Layer

The City of Cape Town's (2013) biodiversity layer for aquatic ecosystems (**Figure 4**) shows a more accurate depiction of wetland extent than does the NFEPA dataset. Of the wetlands indicated in the two current study areas, those in the Alternative 1 area have all been accorded critical Biodiversity Area (CBA) Category 2 status, indicating high ranking "natural or semi-natural" wetlands within each type, in the second quarter (50-75%) of scores (Snaddon and Day 2009).

Included in the wetlands shown in **Figure 4** are however some wetlands identified in Day (2011) as artificial wetlands, and thus wetlands that are unlikely to deserve the high conservation importance implicit in the CBA2 rating. For this reason, the more accurate wetland and river descriptions and PES ratings outlined in Section 3.4 of this report should be used to inform the present study and assessment, and it is recommended that these findings should be updated into both the NFEPA dataset and the City's aquatic biodiversity layer.

Figure 4
The sites of the proposed Weskusfleur substation in the context of City of Cape Town wetland biodiversity data. Artificial wetlands (in terms of this database) shown as orange polygons; natural wetlands shown as green polygons – infilled polygons ground-truthed in Day (2011) – see text for details

3.4. [2]Overview of the Sout River catchment

The geology of the Sout River catchment comprises primarily shales of the Malmesbury Formation (SRK 2011). Water flowing through such formations is characteristically high in concentrations of dissolved salts, measured in this report as electrical conductivity (EC). As its name suggests, the water flowing in the Sout River is brackish and characterised by high EC levels.

The Sout River rises in the low-lying hills to the east of Melkbosstrand. It is a relatively short river, measuring some 18 km in length and draining a catchment of approximately 154 km^2 (Engelbrecht *et al* 1997). Natural summer flows in the river are low, and under natural conditions the water was probably ephemeral throughout its reaches during summer (Day 2000). At the end of the rainy season, flows throughout the system soon subside, and the river is reduced to a series of pools occurring at intervals along the river course, which become progressively more saline.

In its upper and middle reaches, the Sout River flows as a transitional stream through predominantly agricultural land. Note that this ground-truthed classification is in contrast to the NFEPA geozone classification as an upper foothill river. Although a number of small streams and other drainage lines enter the river along its whole length, the only tributary of significance is the Donkergat River, which joins it in the region of the Kleine Zoute Rivier

[2] This information has been adapted from Day (2011)

farm, just downstream of the present study area. The Donkergat River in fact flows through a portion of the Alternative 4 site (see **Figure 4**).

Downstream of its confluence with the Donkergat River, the Sout River passes along the southern border of the Melkbosstrand WWTW, from which it receives treated effluent. This effluent has resulted in large-scale changes to the river ecosystem, with the seasonal, slightly brackish conditions of the upstream reaches, dominated in their natural condition by low-growing sedges such as *Juncus kraussii,* giving way to perennially saturated, nutrient-enriched and much fresher conditions, dominated by *Typha capensis* reedbed. This change in vegetation is believed to be the direct result of the release of effluent.

Downstream of the Melkbosstrand WWTW, the river flows within a long reed bed, comprising mainly *Phragmites australis* but also *Typha capensis*. In these reaches, it passes first through the Ou Skip caravan park on the periphery of Melkbosstrand urban area, before entering its small estuary, which opens into the Atlantic Ocean on Melkbosstrand Beach. The river is channelised and then canalised in these reaches, with encroachment of the caravan park right up to the infilled, steepened and deepened river channel.

The estuary is permanently open to the sea (Engelbrecht *et al.* 1997), and the lower reaches of the river are subject to tidal influences, probably as far upstream as the lower bridge in the caravan park (Day 2011).

3.5. Detailed (ground-truthed) descriptions of freshwater systems in the broader study area

Figure 5 provides an overview of the freshwater ecosystems that occur on and in the vicinity of the proposed Weskusfleur substation alternative sites and their respective pylon alignments.

3.5.1. Overview

In the north east of the study area, the high porosity of the sandy substrate that characterises the area restricts the extent of surface drainage (Day 2011) and accounts for the ephemeral channel shown in **Figure 5** which crosses the north western corner of the Alternative 4 site and disappears into the sands of the Duynefontein site on the western side of the R27. This system has been classified as a **watercourse** in terms of the NWA definitions (see Section 1.5). Other than a stand of *Arundo donax* reed at a disturbed road crossing upstream of the site, the watercourse did not support wetland vegetation and opportunistic augering at two areas accessed along its route did not, in the accessed reaches, show signs of soil mottling or other hydromorphic indicators. Although under wetter conditions (e.g. in a wetter cycle and if alien vegetation was removed) the channel might become wetland in character, it is not presently treated as such (Photos A and B).

Photo A
Ephemeral drainage line just upstream of and north of Alternative 4

Photo B
Outlet of ephemeral drainage line just downstream of culvert under R27 – no defined channel visible

West of the R27, and towards the south western boundary of the Duynefontein site, lower-lying areas are however characterised by a shallow water table (SRK 2011 and Visser et al 2011 - 2013), particularly in the low lying south western area. Extensive areas of mainly groundwater-fed wetlands occur in a mosaic of lowlying vegetated dunes in this area, where groundwater is seasonally or perennially exposed (Photos C and D).

Photo C
Mosaic seasonal duneslack wetland depressions near Sw1 (see Figure 4)

Photo D
Degraded *Ficinia nodosa* wetland flats between Sw1 and the KNPP (see Figure 4)

In other areas (e.g. along the western boundary of the R27) the localised presence of impervious substrate has given rise to the formation of perched wetlands in areas where the overlying sands have been excavated. These wetlands are fed by a combination of groundwater through-flows and surface precipitation (Day 2011 and Visser et al 2011), and during the 2014 site visit, were noted to extend over far greater areas than previously noted (Photos E and F).

Photo E
Artificially excavated, perched wetland P1 (see Figure 4)

Photo F
Perched wetland P2a near the eastern boundary fence of Duynefontein

The northern part of the Duynefontein site comprises extensive sand dunes. The natural mobility of these dunes has been partially arrested by extensive alien vegetation cover. At least one shallow, seasonally inundated wetland in this area was described by Day (2011) as having developed over the past few years only, where the water table has been exposed as a result of dune movement. During wet cycles when the water table is higher, or when dune movements result in groundwater exposure, other wetlands are likely to be formed (Day 2011). Low (2011) described the mobile dune system as endemic, poorly represented on the Cape West Coast, and of high sensitivity and low vegetation resilience.

While the ephemeral drainage line described above simply dissipates into the sand on the western side of the R27, the Donkergat River is a larger system, and the Sout River's only major tributary. This river flows in a south-south westerly direction to the east of the Alternative 4 site, cutting through its south eastern corner. The river is a naturally saline ephemeral system (Day 2000) that flows within a broad, sandy corridor, heavily infested at the time of this study by alien vegetation (mainly *Acacia saligna*). The river does however receive inflows on an apparently ongoing basis from the Wesfleur WWTW (pers. obs), presumed to increase nutrient enrichment and fundamentally change river function.

Photo G
Wetland on artificially excavated quarry south of Alternative 4

Photo H
Artificial depressional wetland Sw8 just south of Alternative 4

Figure 5

Location of proposed Alternatives 1 and 4 and their associated infrastructure, in context of mapped wetlands and drainage lines. Aquatic ecosystems described in Section 3.5.2 and Table 1. Green polygons as ground-truthed for this study and in Visser et al (2013). Orange polygons indicate wetlands as mapped in the City of Cape Town's dataset. Outside of the study area, they have not been ground truthed in this study.

3.5.2. [3]Wetlands on and associated with the overall site

With the exception of wetlands associated with the Donkergat River, all of the wetlands identified in the broader study area have been classified as **wetland depressions**, which occur within a largely flat landscape, or **plain** setting (see Ollis et al. 2013). On the basis of their hydroperiod, these wetlands have been further divided into two categories, namely:

- **Seasonally saturated to inundated wetlands**, identified in **Figure 5** by the prefix "Sw" - Most of these wetlands are located in the south western portion of the site, where they are separated from the coast by a line of low dunes and collectively comprise an extensive mosaic of seasonally inundated shallow duneslack wetland, represented in **Figure 4** by wetlands **Sw1** and **Sw2**. Despite past and present disturbance in the form of a north-south access road through the wetlands immediately adjacent to the coast, as well as evidence of infilling and dumping in sections of the wetlands, presumably during the construction stage of the Koeberg Nuclear Power Plant (KNPP), these wetlands are considered likely to lie close to their reference condition in terms of water quality, hydroperiod and macrofauna. While most of the wetlands are underlain by sands, connecting to the shallow water table, localised perching occurs in places on naturally or artificially exposed, but patchy, rocky substrate.
  Other seasonally inundated to saturated wetlands occur across the site, comprising:
  - wetlands **Sw3, Sw4, Sw5** and **Sw6** – These comprise isolated, seasonally saturated or inundated depressional wetlands to the north and east of Sw1 and Sw2. Of these, **Sw4** and **Sw8** (Photo H) (the latter identified in the present study and not in Day 2011) are artificially created wetlands, formed as a result of internal road construction activities;
  - wetland **Sw7** – This is an isolated, seasonally saturated to inundated depressional wetland on the toe of the dune fields in the north of the Duynefontein site.
- **Perennially inundated, artificial wetlands** (**P1-P7**) **-** All of these are the product of past human activities on the site: They comprise permanently inundated to saturated wetlands which occur in the vicinity of the existing Koeberg NPP, in places along internal roads, along the boundary fence line and in the northern portion of the site, just north of the dune field, where they are fed *inter alia* with treated effluent from the Wesfleur WWTW;
- Infilled, **degraded wetland flats** (Photo D) just north of the duneslack wetland mosaic described above: this area was assumed by Day (2011) to have included, under natural conditions, portions of seasonally inundated wetland depression /dune mosaic habitat along the natural dune margins and within the mobile dune system. The area was however used as a lay down area during construction of the Koeberg NPP and today comprises a flattened, homogeneous, disturbed area, portions of which support *Ficinia nodosa* – a plant that typically occurs on the upslope side of seasonal to temporary wetlands in this area. The area is underlain by gravel and other fill, believed to be relics of past construction activities;
- Artificial wetlands assumed to be seasonally inundated only, formed in excavated areas of a sand quarry, just south of the Alternative 4 site (Photo G).

[3] This information has been adapted and expanded from that in Day (2011), considered still pertinent on the basis of observations made during the 2013 and 2014 site assessments

Table 1 summarises wetland condition as derived in Day (2011) and ground-truthed in this study.

Table 1
Summary of wetland condition and sensitivity, using information derived from Day (2011) and ground-truthed in this study

Wetland name	Natural or artificial	Comment	Present Ecological State (PES)	Ecological Importance and Sensitivity (EIS)
Sw1 / Sw2 representing the mosaic of seasonal duneslack wetlands in the south of the Duynefontein site	Natural	Support communities of aquatic macroinvertebrates considered at least regionally endemic and probably endangered as a result of extensive habitat loss (Visser et al 2013)	PES Category A/B	Class A – very high
Degraded *Ficinia nodosa* flats between the KNPP and Sw1	Natural – but highly degraded Natural		PES Category B	Class D – marginal importance
Sw3, Sw5 and Sw6 - seasonally inundated depression wetlands	Natural – but partially modified by excavation	Isolated within the broader Duynefontein site	Sw3 and Sw5: PES Category B Sw6: PES Category C	Class B – high conservation importance
Sw7 representing wetlands in mobile dunes	Natural	Seasonally inundated, but likely to disappear over time as the dunes move and infill wetland areas; more wetland areas likely in wetter periods, and as dune movement or blowouts expose groundwater	PES Category A/B	Class C/ B – moderate to high
Sw4	Artificial	Impacted by adjacent road	N/A	Low to Moderate Importance (assigned on basis of habitat quality as DWAF (1999) method not applicable)
Sw8	Artificial	Excavated and bermed; of low habitat quality	N/A	Negligible importance (assigned on basis of habitat quality as DWAF (1999) method not applicable)
P2a-d, P4, P5, P6 and P7	Artificial	Provide areas of standing water that supports wetland communities albeit not of high conservation significance	N/A	Low to Moderate importance (assigned on basis of habitat quality as DWAF (1999) method not applicable}
P3a-d	Artificial		N/A	Moderate (assigned on basis of habitat quality as DWAF (1999) method not applicable)
Excavated sand quarry wetlands	Artificial	Assumed to be seasonally inundated; provide habitat of low quality and diversity	N/A	Very Low (assigned on basis of habitat quality as DWAF (1999) method n/a)

3.5.3. Freshwater ecosystems in the vicinity of Alternative 1

This section provides a brief description of the actual proposed Alternative 1 site, its character from a freshwater ecosystems perspective and the wetlands if any that occur within the footprint of the site or its proposed transmission lines. **Figure 6** provides a more detailed view of this portion of the overall site than that provided by **Figure 5**.

Figure 6

Close view of Alternative 1 site on 2015 GOOGLE image, with colour coding as outlined in Figure 2 and wetlands as indicated in Figure 3 and described in Sections 3.5.1 and 3.5.2. Asterisk indicates anomalous flooded area in October 2014. See text Section 3.5.3.

The development area for this Alternative mainly comprises a degraded area, which has been disturbed in the past, presumably during the construction of the KNPP, result in flattening of most of the area between the gravel road to the north and the KNPP fence, and infilling of parts of this area with rubble / gravel fill material, contributing to its degraded condition.

The only wetlands that occur in the vicinity of any of the areas demarcated for Alternative 1 and its infrastructure comprise the following

- **Wetland P6** – an artificial excavation, dominated by reedbeds (*Phragmites australis*) which provide nesting habitat to passerine birds (e.g. Red Bishops). This wetland lies close to, but outside of, the area required for use as a temporary turn-in area, during construction under the existing lines (open brown rectangles);

- **Wetland P4** lies close to (but just outside of) the area required for use as a temporary turn-in / underpass area, during construction under the existing lines (open brown rectangles).

Photo I
Surface water accumulating in previously terrestrial area, in north east corner of Alternative 1 envelope

In addition to the above, at the time of the October 2014 site visit, an accumulation of surface water was evident in the area asterisked in **Figure 6**. This water was flowing out of a submerged pipeline (see Photo I, opposite). Ms Jurina Le Roux (Eskom) suggested that the water source was stormwater from the Conservation Office area- the distance of these buildings from the outlet does however cast some doubt on this. The source of water could also be local groundwater, the level of which has risen locally such that it finds its way into and then out of an existing defunct pipeline network, with groundwater levels seemingly much higher in this part of the site than at any other time assessed by FCG since 2007. If the pipeline continues to discharge water over an extended period of time in this area, it is likely that wetland conditions will develop over time, the existing terrestrial vegetation in the area (e.g. *Carpobrotus* sp.) having already partially die off as a result, it is assumed, of extended inundation.

While wetland habitat was not identified immediately north of the dirt road that edges the GIS alternative footprint (small black rectangle in **Figure 6**), it was noted that wetland extent had generally expanded in the area in the north of the KNPP and west of the R27 since Day (2011)'s wetland mapping. This is assumed to have resulted from exceptionally wetter conditions on the site, assumed to reflect natural cycles, but presently just above the threshold of depth-to-water table to promote wetland formation. Should this trend continue, it is possible that low-lying areas north of the gravel road may become wetland in the future. Such areas would however be highly unlikely to extend as far as the footprint of the proposed GIS site.

3.5.4. Freshwater ecosystems in the vicinity of Alternative 4

This section describes the proposed Alternative 4 site, its character from a freshwater ecosystems perspective and the wetlands if any that occur within the footprint of the site or its proposed transmission lines. **Figure 7** provides a more detailed view of this portion of the overall site than that provided by **Figure 5**.

No natural wetlands were identified in the overall development envelope (white polygon in **Figure 7**) for Alternative 4. Two natural watercourses were however identified, namely the ephemeral drainage line passing across the north western corner of the site and the Donkergat River, which passes across the south eastern corner of the site (**Figure 7**). Of these, the proposed pylons required for the Alternative 4 substation would cross the former. The south running pylons would pass in close proximity to the artificial wetlands that have developed in the excavated sand quarry, while the west-running pylons would pass near, but not directly over, the natural seasonal wetland Sw5 and the artificial perennial wetland P2b.

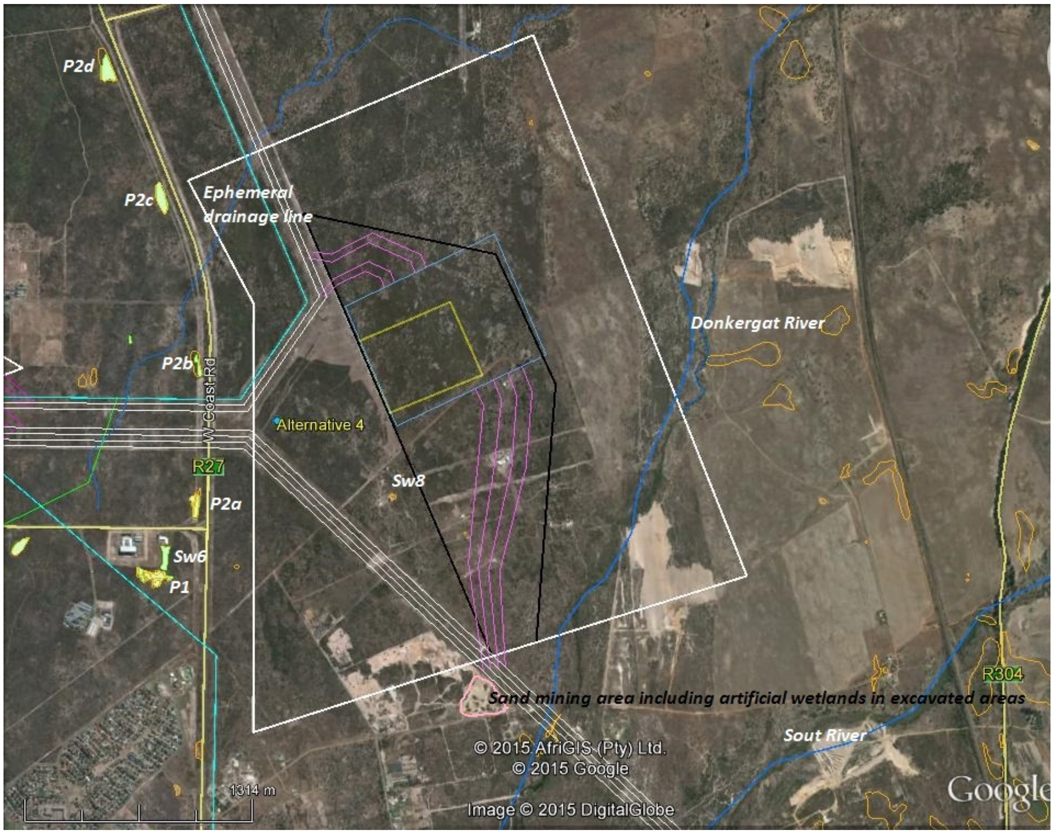

Figure 7
Close view of Alternative 4 site, with colour coding as outlined in Figure 2 and wetlands as indicated in Figure 5 and described in Section 3.5.1 and 3.5.2.

Although no other wetland areas were identified on the study area, it is noted that much of the study area was disturbed and subject to high levels of alien plant invasion (see Photo J). Clearing of woody alien plants could result in a locally raised water table, giving rise to future wetland formation during wetter periods, if the underlying water table came close enough to the soil surface for wetland conditions (i.e. temporary to permanent saturation within the top 50cm of the surface).

Photo J
Dense *Acacia saligna* vegetation dries out surface soils and prevents access across portions of Alternative 4

Photo K
Wetted surface conditions in places on Alternative 4, which may in time give rise to wetland formation

Areas in which such conditions might occur include under the existing pylons on the site, where although augering showed no signs of mottling and vegetation did not include wetland-associated plants, the site was muddy and wet in late winter (Photo K).

4 FINDINGS / IMPLICATIONS OF THE PROPOSED DEVELOPMENT ALTERNATIVES FOR AQUATIC ECOSYSTEMS

The impacts described in this section have specific reference to the descriptions of aquatic ecosystems lying within or in close proximity to the various development alternatives, as described in Section 3.5.

4.1. Substation

4.1.1. Alternative 1

4.1.1.1. Design and Layout

AIS alternative

Not technically viable for the site so not assessed (see Section 2).

GIS alternative

The layout of the proposed GIS alternative at site Alternative 1 would have no direct implications for aquatic ecosystems, as the footprint as shown would not extend onto or in proximity of extant wetland areas.

4.1.1.2. Construction phase

AIS alternative

Not technically viable for the site so not assessed (see Section 2).

GIS alternative

Assuming that standard best practice in construction was carried out, there should be no implications for aquatic ecosystems as a result of the construction phase of the GIS system.

The turn-in footprint shown in **Figure 7** for this alternative would however encroach close to wetlands P6, P4 and Sw4. All of these are artificial wetlands (see **Table 1**), of low-to-moderate conservation importance (EIS). They do however provide local wetland habitat and their degradation would be of low to medium negative significance. More specifically, the following impacts could arise:

- Disturbance to artificial wetlands P6, P4 and Sw4 as a result of their proximity to the temporary AIS turn-in area – it is assumed that these wetlands would be vulnerable to disturbance from vehicles, sediment and dust, resulting in their degradation. The wetlands have been assessed as of Low to moderate conservation importance (see **Table 1**);
- Increased disturbance to adjacent terrestrial areas as a result of dewatering and (assuming predictions of increased propensity for wetland formation are valid (see Section 3.5.3)) a resultant potential increase in (disturbed) wetland habitat in adjacent areas as a result of dewatering of areas with a high water table;

4.1.1.3. Operational phase

The only impact to freshwater systems potentially associated with Alternative 1 would be impacts from stormwater runoff from hardened surfaces, potentially giving rise to localized erosion and pooling of water in lowlying areas, potentially resulting in localized expansion of wetland areas, particularly in the north. Given the small size of the GIS site and the sandy nature of the terrain (GEOSS 2014), these are however likely to occur at very low magnitudes only, given the high infiltration rate of the adjacent sands, and assuming that passage into areas with a high water table did not take place.

4.1.1.4. De-commissioning phase

Although it is unlikely that decommissioning would result in restoration of the site to pre-impacted conditions, as evidenced by the impacted sites associated with construction of the KNPP. However, this would not affect surface aquatic ecosystems. Localised disturbance to nearby artificial wetlands P4, P6 and Sw4 might occur during decommissioning, as a result of their proximity to access roads and the site itself.

4.1.1.5. Cumulative impacts

Appendix B shows the location of the proposed GIS site within the proposed (but not approved) Nuclear 1 site layout. The figure indicates that the GIS would fall within the disturbance area already planned for Nuclear-1, and there would thus be no cumulative effects of its development on wetland ecosystems. Compared to present levels of development, while the GIS would result in development expansion on the site, these are not of significance to wetland ecosystems either.

4.1.2. Alternative 4

4.1.2.1. Design and Layout

GIS alternative

Not technically viable for the site so not assessed.

AIS alternative

The layout for an AIS substation on the Alternative 4 site would be unlikely to have implications for wetland ecosystems.

Removal of alien vegetation and higher rainfall might however result in an increased local water table in this area, which could have implications for the proposed sub-station and its 400 and 132 kV yards. These are not assessed here, but should be flagged by the developer.

4.1.2.2. Construction phase

Assuming that standard best practice in construction was carried out, there should be no implications for aquatic ecosystems as a result of the construction phase of the AIS system.

4.1.2.3. Operational phase

It is assumed that, if this alternative site is selected for development by Eskom, the same standards with regard to clearing of alien vegetation from the site as apply to the adjacent Duynefontein site would be applicable. This suggests that in the long-term, some improvement in aquatic ecosystem condition might accrue to alien-invaded systems on the site, in particular the ephemeral drainage line in the north west of the site and the Donkergat River to the south east of the site (see **Figure 7**). Such effects would be considered positive from an aquatic ecosystems perspective, but would apply only to a short reach of river or other watercourse in each case.

The only other impact to freshwater systems potentially associated with the Operational Phase of Alternative 4 would be impacts from stormwater runoff from hardened surfaces. Depending on the routing of this water, it could contribute to wetland expansion, or to localized erosion at outlet points. It is assumed that it would not be routed as far as the Donkergat River, but would be allowed to dissipate into the sands.

The above impacts are expected to occur at low magnitudes only, given the high infiltration rate of the adjacent sands, and assuming that passage into areas with a high water table did not take place.

4.1.2.4. De-commissioning phase

No decommissioning phase impacts to freshwater ecosystems are anticipated, and it is assumed that alien clearing would be long-term and on-going.

4.1.2.5. Cumulative impacts

Cumulative impacts to aquatic ecosystems are not anticipated as a result of implementation of the proposed Weskusfleur sub-station at Alternative 4.

4.1.3. No-go option

The no development option of Alternative 1 and its associated GIS would not have any direct negative effects on any aquatic ecosystems.

The no development option of Alternative 4 and its associated AIS would not have any direct negative effects on any aquatic ecosystems. In its absence, it is however unlikely that alien clearing along the ephemeral channel or the Donkergat River would occur – the length of the latter included on the site is however limited and the opportunity cost is thus not great.

4.2. Transmission line corridors

4.2.1. Transmission line corridors for Site Alternative 1

Note that the impacts associated with the turn-in area for this alternative have already been addressed in Section 4.1.1.2

4.2.1.1. Design and Layout

The alignment of transmission lines required for the GIS alternative would be unlikely to have any impact on existing aquatic ecosystems. The section of new lines that would pass just north east of the site (see **Figure 6**) would however pass over the area described in Section 3.5.3 as wetter than described in previous assessments, and in part impacted by outflows from a pipe. This issue is discussed in terms of operational phase impacts.

4.2.1.2. Construction phase

As a result of the relatively high water table in the area north east of the proposed substation (pink lines in **Figure 6**), construction phase impacts might include dewatering impacts, resulting in some degradation (silt and water) and potential cement contamination into the adjacent terrestrial areas; in the event that wetlands had developed further in this zone, this kind of activity would contribute to wetland as well as terrestrial degradation.

Disturbance (trampling/ vehicle movement and the movement of long cables and pylons through the area) would also have a localised impact on adjacent areas. Again, the present state of the affected area includes only potential wetland, likely to develop as a result of flows from the pipeline, and no actual wetland habitat.

4.2.1.3. Operational phase

The only operational phase impact identified for the transmission lines would be compaction and localised disturbance as a result of vehicle passage along these lines for maintenance purposes.

4.2.1.4. De-commissioning phase

Decommissioning of the transmission lines required for the GIS at Site 1 would be associated with the same low levels of impact to aquatic ecosystems described for the construction phase.

4.2.1.5. Cumulative impacts

No cumulative impacts are associated with this relatively benign activity (from a freshwater ecosystems perspective).

4.2.2. Transmission line corridor for site Alternative 4

The length of transmission lines required for the proposed Alternative 4 site would be more extensive than those required in the case of Alternative 1, as they would need to link back to the main KNPP and tie into the grid to the north and south, as shown by the pink and blue lines shown in **Figure 7**.

This means that they would:

- Cross the ephemeral drainage line passing across the north western corner of the site;
- Pass in close proximity to the artificial wetlands that have developed in the excavated sand quarry to the south of the site – these wetlands are on the opposite side of the access road and it is assumed that they would not be impacted by activities associated with the current project;
- Pass near, but not directly over, the natural seasonal wetland Sw5 and the artificial perennial wetland P2b;
- Pass in the vicinity of the Donkergat River in the south eastern corner of the site.

4.2.2.1. Design and Layout

No impacts specifically associated with design and layout of the transmission lines have been identified, with most associated implications being more easily assigned to Construction or Operation phase impacts.

4.2.2.2. Construction phase

Installation of pylons and stringing of electrical cabling during the construction phase of the project is likely to be associated with the following forms of disturbance to some of the aquatic ecosystems listed above, namely:

- Disturbance to the ephemeral watercourse, possibly involving vehicle damage to its (already disturbed and alien infested) banks and beds; [4]clearing of alien vegetation to gain access across the site – impacts such as damage to beds and banks could affect the rehabilitation potential for the watercourse and increase impacts such as erosion;
- Unlikely, but possible disturbance as a result of vehicle damage, stockpiling construction materials (cabling, pylon structures etc.) nearby; access for pylon stringing of natural seasonal wetland Sw5 and the artificial perennial wetland P2b, affecting the integrity of these wetland habitats, described in more detail in **Table 1**.

4.2.2.3. Operational phase

Operational phase impacts to freshwater ecosystems associated with the installation of the pylons would be likely to centre on:

- Periodic low levels of disturbance associated with maintenance activities, potentially resulting in disturbance to the ephemeral watercourse as a result of occasional passage of vehicles through it;
- Possible localized disturbance to purported emerging seeps on the site, under the existing pylons, as a result of ongoing wet-season passage of heavy vehicles along this route, resulting in compaction.

More positively, ongoing alien clearing would, it is assumed, be necessary along the full pylon route and this, if carried out using standard best practice approaches, could result in improved establishment of indigenous plants and wetter conditions along cleared sections of the ephemeral watercourse. If however operational phase clearing of alien vegetation was extended to the entire site, including the reaches of the Donkergat River, then there could be a significant (but highly localised) improvement in ecological function.

4.2.2.4. De-commissioning phase

Similar levels of disturbance would probably be associated with decommissioning the transmission lines as with the construction phase. The only additional risk would be that associated with incomplete off-site removal of material, which would result in permanent defunct infrastructure on the site.

4.2.2.5. Cumulative impacts

Despite their widening of the existing footprint of the transmission lines corridors, the additional lines would have a very low cumulative effect from an aquatic ecosystem perspective, largely because they do not cross through extensive wetlands.

Their role in terms of affecting bird flight paths (and thus potentially wetland waders or water fowl) has not been assessed in this report.

4.2.3. "No-go" alternative

The no development alternative would mean that the risk of low level disturbance to the various aquatic ecosystems described in Section 4.2 would not take place. However, as with the no development option for the site as a whole, it is also considered unlikely that alien clearing along the ephemeral channel or the Donkergat River would occur.

[4] It is assumed that alien clearing would be simply for access purposes and that cleared areas would resprout rapidly

5 FORMAL ASSESSMENT OF IMPACTS

The formal assessment results provided in this section have been developed through the use of a spread sheet, based on an automated assessment methodology required of specialists by Lidwala, and repeated in this report in **Appendix A**. **Tables 2 to 6** show the actual results of the automated rating system, for different development phases.

Assignment of different rating criteria to the different impacts has been carried out on the basis of the descriptions of both the impact and the affected wetland / watercourse.

The assessments provided in the tables in this section include assessment ratings for impacts with and without mitigation. It is assumed for these purposes that the full mitigation measures outlined in Section 6 are included in each case.

5.1. Substation Site Alternatives

5.1.1. Alternative 1

5.1.1.1. Design and layout

No impacts to aquatic ecosystems identified (**Table 2**).

5.1.1.2. Construction phase

Construction phase impacts to wetlands would be associated with disturbance to wetlands P6, P4 and Sw4 as a result of the turn-in areas, as well as from dewatering. The impacts have been assessed in **Table 3** as localized, relatively short-lived, and readily mitigated against. The significance of impact would be Very Low and Low for impacts with and without mitigation.

5.1.1.3. Operational phase

Operational phase impacts would be limited to potential impacts associated with stormwater runoff (see **Table 4**). Confidence in design was low, as stormwater management is not specified in the project design details. However, given that no wetlands of importance would be affected by runoff, impact significance would be low, and mitigation measures, which are essentially simply standard best practice measures, would bring the significance down still further, although the automated rating in Table 4 shows no change, a non-automated rating would be to Very Low levels.

5.1.1.4. De-commissioning phase

These impacts are considered of low significance (**Table 5**) and readily mitigable.

5.1.1.5. Cumulative impacts

Cumulative impacts (**Table 6**) were not identified for this site.

5.1.2. Alternative 4

5.1.2.1. Design and layout

No design and layout impacts were identified.

5.1.2.2. Construction phase

No construction phase impacts were identified, given the fact that the site does not include extant wetland areas.

5.1.2.3. Operational phase

Positive impacts, of low significance only, were accorded this Alternative, as a result of assumed alien clearing activities on the site.

Low significance negative impacts were accorded to stormwater impacts off the site – but these impacts would be readily mitigable to (Very) Low levels (**Table 4**).

5.1.2.4. De-commissioning phase

No decommissioning impacts were identified.

5.1.2.5. Cumulative impacts

No cumulative impacts were identified.

5.1.3. No-go option

No go alternatives have not been formally rated in this assessment, but their implications have been described in Sections 4 and 6.

5.2. Transmission lines

5.2.1. Transmission line corridor for Site Alternative 1

5.2.1.1. Construction phase

Construction phase impacts were rated as of low significance only, and readily mitigable (**Table 3**).

5.2.1.2. Operational phase

Operational phase impacts to freshwater ecosystems were rated as of low significance only (**Table 4**).

5.2.1.3. De-commissioning phase

Only low significance impacts were associated with the decommissioning phase, and these would be readily mitigable (**Table 5**).

5.2.1.4. Cumulative impacts

No cumulative impacts would be associated with the transmission lines (**Table 6**).

5.2.2. Transmission line corridor for Site Alternative 4

5.2.2.1. Construction phase

Construction phase impacts were linked mainly to disturbance of the watercourse, and rated as of low significance only, and readily mitigable (**Table 3**).

5.2.2.2. Operational phase

Operational phase impacts were also rated as of low significance only, and readily mitigable through basic rehabilitation and best practice management measures (**Table 4**).

5.2.2.3. De-commissioning phase

Only low significance impacts were associated with the decommissioning phase, and these would be readily mitigable to (Very) Low levels (**Table 5**).

5.2.2.4. Cumulative impacts

No cumulative impacts are likely to be associated with the transmission lines.

5.2.3. No-go alternative

No go alternatives have not been formally rated in this assessment, but their implications have been described in Sections 4 and 6.

Table 2
Impacts associated with design and layout:
Formal impact assessment rating, using automated spreadsheet provided to specialists by Lidwala (see Appendix A).
Note Design and Layout rating only applicable to substation alternatives.

Potential Impact	Mitigation	Extent (E)	Duration (D)	Magnitude (M)	Probability (P)	Significance (S=(E+D+M)*P)		Status (+ve or -ve)	Confidence
Design and Layout Phase									
GIS Substation - Site 1									
No direct impacts associated with design and layout	**Nature of impact:**	No design and layout impacts identified							
	with mitigation							-	
	without mitigation								
	degree to which impact can be reversed:								
	degree of impact on irreplaceable resources:								
AIS Substation - Site 4									
No impacts to freshwater ecosystems associated with design and layout - effects of increased water table on structures flagged	**Nature of impact:**	No design and layout impacts identified							
	with mitigation								
	without mitigation								
	degree to which impact can be reversed:								
	degree of impact on irreplaceable resources:								

Table 3
Impacts associated with Construction phase
Formal impact assessment rating, using automated spreadsheet provided to specialists by Lidwala (see Appendix A).

Potential Impact	Mitigation	Extent (E)	Duration (D)	Magnitude (M)	Probability (P)	Significance (S=(E+D+M)*P)		Status (+ve or -ve)	Confidence
Construction Phase									
GIS Substation - Site 1									
Disturbance to artificial wetlands P4, P6, Sw4 and potential new wetlands	**Nature of impact:**	Vehicle disturbance, dust, sediment and dewatering							
	with mitigation	1	1	0	2	4	Low	-	Medium
	without mitigation	1	2	2	3	15	Low	-	Medium
	degree to which impact can be reversed:	Reversible with rehabilitation measures							
	degree of impact on irreplaceable resources:	Low - can be re-created elsewhere							
AIS Substation - Site 4									
No construction phase impacts identified assuming standard best practice measures followed in construction	**Nature of impact:**	None							
	with mitigation								
	without mitigation								
	degree to which impact can be reversed:								
	degree of impact on irreplaceable resources:								
Transmission Line - Site Alternative 1									
Degradation of edges of development area with high potential for wetland development	**Nature of impact:**	Dewatering, physical disturbance as a result of pulling cables through, vehicle traffic							
	with mitigation	1	1	0	2	4	Low	-	Low - wetlands may not in fact develop
	without mitigation	1	1	2	3	12	Low	-	
	degree to which impact can be reversed:	Reversible with rehabilitation measures							High
	degree of impact on irreplaceable resources:	Low							High
Transmission Line - Site Alternative 4									
Disturbance to ephemeral watercourse, wetlands Sw5 and P2b	**Nature of impact:**	Vehicle disturbance, dust, sediment, alien clearing disturbanceand compaction of potential seep areas							
	with mitigation	1	1	0	2	4	Low		Medium
	without mitigation	1	2	2	3	15	Low		Medium
	degree to which impact can be reversed:	Reversible with rehabilitation measures							Medium
	degree of impact on irreplaceable resources:	Low							Medium

Table 4
Impacts associated with Operational Phase:
Formal impact assessment rating, using automated spreadsheet provided to specialists by Lidwala (see Appendix A).

Potential Impact	Mitigation	Extent (E)	Duration (D)	Magnitude (M)	Probability (P)	Significance (S=(E+D+M)*P)		Status (+ve or -ve)	Confidence
Operational Phase									
GIS - Site 1									
Stormwater impacts into groundwater-fed wetlands	Nature of impact:	Increased volume of water and potential water quality changes resulting in wetland expansion in adjacent areas, and with possible erosion							
	with mitigation	1	4	0	2	10	Low	-	Low
	without mitigation	1	4	0	2	10	Low	-	low
	degree to which impact can be reversed:	Moderate							Medium
	degree of impact on irreplaceable resources:	Low							Medium
AIS - Site 4									
Improvement in aquatic habtat diversity and condition as a result of assumed ongoing alien clearing	Nature of impact:	Assuming alien clearing takes place at the site level, indigenous riparian and wetland plants would potentially establish in cleared areas along the ephemeral drainage line and the river, improving river function and overall habitat quality							
	with mitigation	1	2	4	3	21	Low	+	Medium
	without mitigation	1	2	2	1	5	Low	+	Low
	degree to which impact can be reversed:	Reversible if not sustained							
	degree of impact on irreplaceable resources:	Low							
Stormwater impacts into groundwater-fed wetlands	Nature of impact:	Increased volume of water and potential water quality changes resulting in wetland expansion in adjacent areas, and with possible erosion							
	with mitigation	1	4	0	2	10	Low	-	Low
	without mitigation	1	4	2	2	14	Low	-	low
	degree to which impact can be reversed:	Moderate							Medium
	degree of impact on irreplaceable resources:	Low							Medium
Transmission Line - Site Alternative 1									
No operational phase impacts above a negligible rating identified	Nature of impact:	None							
	with mitigation								
	without mitigation								
	degree to which impact can be reversed:								
	degree of impact on irreplaceable resources:								
Transmission Line - Site Alternative 4									
Low level disturbance of ephemeral drainage line during rtoutine maintenance	Nature of impact:	Periodic bank destabilisation,							
	with mitigation	1	4	0	1	5	Low		Medium
	without mitigation	1	4	2	2	14	Low		Medium
	degree to which impact can be reversed:	Reversible with rehabilitation measures							Medium
	degree of impact on irreplaceable resources:	Low							Medium

Table 5

Impacts associated with Decommissioning / rehabilitation Phase:

Formal impact assessment rating, using automated spreadsheet provided to specialists by Lidwala (see Appendix A).

Potential Impact	Mitigation	Extent (E)	Duration (D)	Magnitude (M)	Probability (P)	Significance (S=(E+D+M)*P)		Status (+ve or -ve)	Confidence
Decommissioning / Rehabilitation Phase									
GIS - Site 1									
Disturbance to artificial wetlands P4, Sw4 and potential new wetlands	**Nature of impact:**	Vehicle disturbance, dust, sediment and dewatering, compaction and accumulation of rubble and waste							
	with mitigation	1	1	0	2	4	Low	-	Medium
	without mitigation	1	2	2	3	15	Low	-	Medium
	degree to which impact can be reversed:	Reversible with rehabilitation measures							
	degree of impact on irreplaceable resources:	Low - can be re-created elsewhere							
AIS -Site 4									
No impacts assuming standard best practice measures implemented	**Nature of impact:**	None							
	with mitigation								
	without mitigation								
	degree to which impact can be reversed:								
	degree of impact on irreplaceable resources:								
Transmission Line - Site Alternative 1									
Degradation of edges of development area with high potential for wetland development	**Nature of impact:**	Dewatering, physical disturbance as a result of pulling cables through, vehicle traffic, compaction							
	with mitigation	1	1	0	2	4	Low	-	Low - wetlands may not in fact develop
	without mitigation	1	1	2	3	12	Low	-	
	degree to which impact can be reversed:	Reversible with rehabilitation measures							High
	degree of impact on irreplaceable resources:	Low							High
Transmission Line - Site Alternative 4									
Disturbance to ephemeral watercourse, wetlands Sw5 and P2b	**Nature of impact:**	Vehicle disturbance, dust, sediment, alien clearing disturbance and compaction of potential seep areas; accumulation of disused waste and infrastructure							
	with mitigation	1	1	0	2	4	Low		Medium
	without mitigation	1	2	2	3	15	Low		Medium
	degree to which impact can be reversed:	Reversible with rehabilitation measures							Medium
	degree of impact on irreplaceable resources:	Low							Medium

Table 6
Cumulative Impacts associated with the project
Formal impact assessment rating, using automated spreadsheet provided to specialists by Lidwala (see Appendix A).

Cumulative Impacts									
GIS - Site 1									
Potential Impact	**Mitigation**	**Extent (E)**	**Duration (D)**	**Magnitude (M)**	**Probability (P)**	**Significance (S=(E+D+M)*P)**		**Status (+ve or -ve)**	**Confidence**
No cumulative impacts	**Nature of impact:**	No impacts identified							
	with mitigation							-	
	without mitigation								
	degree to which impact can be reversed:								
	degree of impact on irreplaceable resources:								
AIS Substation - Site 4									
No cumulative impacts	**Nature of impact:**	No impacts identified							
	with mitigation								
	without mitigation								
	degree to which impact can be reversed:								
	degree of impact on irreplaceable resources:								

6 MITIGATION AND MANAGEMENT MEASURES

The measures outlined in this section are intended to mitigate against the impacts to freshwater ecosystems associated with the various proposed activities and layout alternatives assessed in Sections 4 and 5.

6.1. Substation Alternatives

6.1.1. Alternative 1 (GIS)

6.1.1.1. Design and Layout

No mitigation required.

6.1.1.2. Construction phase impact mitigation

Construction phase mitigation against impacts to wetlands P4, P6 and Sw4 for this alternative would need to include:

i. Treatment of the two wetlands P4 and Sw4 as no-go areas during construction, including:

   a) Erection of temporary fencing (not danger-tape) to prevent accidental access by machines or personnel into the wetlands;

   b) Location of stockpiles including sediment or other material likely to blow, seep or wash into the wetlands at a distance of at least 20m from the wetland edge;

   c) Management of water and sediment stockpiles on site such that they do not blow or wash into these wetland areas;

   d) Management of dewatering activities so that sediment collection is into controlled, disturbed areas only; infiltration areas are not used for any dewatered liquid that has been contaminated with materials other than natural sediments from the site; and such that runoff is controlled and does not give rise to local erosion;

   e) Removal of all excess construction-associated material or waste at the end of the construction phase;

ii. Compilation and implementation of a Construction Phase Environmental Management Programme (CEMP), overseen by an adequately experience professional, that includes measures to address the above concerns.

6.1.1.3. Operational phase mitigation

Management of stormwater must ensure that stormwater runoff is treated appropriately such that any sediment or water quality contaminants are adequately filtered before the stormwater passes out of the yard, and that outflows into the surrounding area are managed so as to dissipate stormwater runoff without causing erosion. If detention ponds are required, these should be designed so as to maximize aquatic habitat diversity, with flat sloping sides (1:5 or less) and be located out of any areas deemed of ecological sensitivity or importance.

6.1.1.4. De-commissioning phase mitigation

Similar measures to those recommended for the Construction Phase would need to be implemented, with the additional stipulation that no waste construction material (concrete, rubble etc.) should be left within 30m of the edge of any wetland, and moreover should ideally be removed entirely from the Duynefontein site as a whole. It is however assumed that the decommissioning phase would be to make way for an alternative development, and that restoration of natural or pre-development conditions would not be the goal of this activity.

6.1.1.5. Cumulative impacts

No mitigation measures are proposed, given that Cumulative Impacts have not been identified.

6.1.2. Alternative 4 (AIS)

6.1.2.1. Design and Layout

No mitigation measures considered applicable.

6.1.2.2. Construction phase mitigation

Alien clearing activities required for the construction phase should be carried out to ensure long-term alien control, rather than short-term site access. Hence:

i. Approved alien plant clearing methods should be followed;
ii. Painting of cut stumps with appropriate herbicides should be carried out to prevent re-sprouting;
iii. Cleared / cut woody material should be removed from the vicinity of any wetlands or watercourses, and should ideally be removed altogether from the site.

6.1.2.3. Operational phase mitigation

i. Management of stormwater must ensure that stormwater runoff is treated appropriately such that any sediment or water quality contaminants are adequately filtered before the stormwater passes out of the yard, and that outflows into the surrounding area are managed so as to dissipate stormwater runoff without causing erosion. If detention ponds are required, these should be designed so as to maximize aquatic habitat diversity, with flat sloping sides (1:5 or less) and be located out of any areas deemed of ecological sensitivity or importance.
ii. The following measures would increase the certainty that the assumed positive impacts associated with proposed alien clearing would accrue at the level of the site. It is recommended that:
    i. An alien removal plan should be formulated and implemented, that looks at practical approaches to address alien invasion across the site and bring it under control within a five year time frame from development authorisation;
    ii. Approved alien plant clearing methods should be followed for all alien control activities, including allowance for painting of cut stumps with appropriate herbicides should be carried out to prevent re-sprouting;

iii. Cleared / cut woody material should be removed from the vicinity of any wetlands or watercourses, and should ideally be removed altogether from the site;

iv. Where the Donkergat River and/or other watercourses and wetlands are destabilised as a result of alien clearing, allowance must be made for their reshaping and, where necessary, planting with appropriate locally indigenous vegetation.

6.1.2.4. De-commissioning phase mitigation

No mitigation measures are considered necessary from a wetland/ river perspective during the Decommissioning Phase, although it is assumed that standard best practice measures would be applied to issues such as waste removal and site (terrestrial) rehabilitation. Again, it is however assumed that the decommissioning phase would make way for an alternative development, and that restoration of natural or pre-development conditions would not be the goal of this activity.

6.1.2.5. Mitigation against Cumulative impacts

No mitigation measures are considered necessary from a wetland/ river perspective, given the fact that no cumulative impacts to these resources were identified in this study.

6.1.3. No-go option mitigation

Implementation of ongoing, effective alien plant clearing by the landowner would be effective mitigation against the only significant impact assumed to result from the no-development alternative at this site – namely, a lost opportunity for alien clearing activities. Clearing of listed Category 1 and 2 invasive alien plants by a landowner is in any cases mandatory in terms of the Conservation of Agricultural Resources Act (Act 43 of 1983) (CARA). The confidence of this author in this measure being enforced or implemented in a no development scenario is however very low.

6.2. Transmission line corridor for site Alternative 1

6.2.1.1. Mitigation against impacts of Design and Layout

No mitigation measures are considered necessary.

6.2.1.2. Construction phase mitigation

Construction activities should take place in the dry season, when the water table is lowest, dewatering activities are likely to be least onerous, and damage to adjacent areas as a result of waterlogging of roads and other areas would be minimised.

A Construction Phase EMP should moreover be compiled to ensure that:

- Cement and other construction materials are kept well away from wetlands or other sensitive areas, which should be clearly delineated on site as such;
- Dewatering water does not pass directly into any wetland area – it should be allowed to dissipate and lose sediment in disturbed areas, identified on site and managed for such purposes.

6.2.1.3. Operational phase mitigation

No mitigation measures are considered necessary.

6.2.1.4. De-commissioning phase impact mitigation

The same mitigation measures recommended for addressing construction phase impacts at this site area are recommended (Section 6.2.1.2), along with a requirement for any wetlands that have developed under the transmission lines in the interim to be rehabilitated by reshaping and/or ripping as necessary to address impacts such as compaction.

6.2.1.5. Cumulative impact mitigation

No mitigation measures are considered necessary from a wetland/ river perspective, given the fact that no cumulative impacts to these resources were identified in this study.

6.2.2. Transmission line corridors for Alternative 4

6.2.2.1. Mitigation against impacts of Design and Layout

No mitigation measures are considered necessary.

6.2.2.2. Construction phase mitigation

i. Alien clearing activities:

   a. Approved alien plant clearing methods should be followed for all alien control activities, including allowance for painting of cut stumps with appropriate herbicides should be carried out to prevent re-sprouting;

   b. Construction phase alien clearing at the ephemeral watercourse should ensure that aliens are removed from the full width of the existing and proposed pylon extent, with an additional width of 20m cleared outside of the pylon corridor;

   c. Cleared / cut woody material should be removed from the vicinity of any wetlands or watercourses, and should ideally be removed altogether from the site;

   d. Where watercourses and wetlands are destabilised as a result of alien clearing, allowance must be made for their reshaping and, where necessary, planting with appropriate locally indigenous vegetation.

ii. Wetland protection activities:

   a. Wetlands Sw5 and P2b should be protected from vehicle and / or pedestrian access as well as the passage of construction associated sediments throughout the construction phase of the east-west pylons from Alternative 4, by:

      i. Erection of temporary fencing (not danger-tape) to prevent accidental access by machines or personnel into the wetlands;

      ii. Location of stockpiles including sediment or other material likely to blow, seep or wash into the wetlands at a distance of at least 20m from the wetland edge;

      iii. Management of water and sediment stockpiles on site such that they do not blow or wash into these wetland areas;

iv. Management of dewatering activities so that sediment collection is into controlled, disturbed areas only; infiltration areas are not used for any dewatered liquid that has been contaminated with materials other than natural sediments from the site; and such that runoff is controlled and does not give rise to local erosion;

v. Removal of all excess construction-associated material or waste at the end of the construction phase;

vi. Compilation and implementation of a Construction Phase Environmental Management Programme (CEMP), overseen by an adequately experience professional, that includes measures to address the above concerns.

iii. Wetland / watercourse rehabilitation activities to address disturbed banks or beds of the ephemeral watercourse or any other affected aquatic ecosystem should be allowed for, and should include:

a. Bank reshaping to achieve a more natural grade and shape;
b. Establishment of locally indigenous appropriate vegetation to improve bank stabilisation;
c. Maintenance of alien clearing activities.

6.2.2.3. Operational phase mitigation measures

i. The rehabilitated ephemeral watercourse should not be driven through by vehicles, and maintenance access should, if required, be from either side;

ii. Alien clearing activities should be carried out <u>at least</u> along the full pylon route on the site, and to a distance of 20m width beyond this, using the alien clearing specifications outlined in Section 6.1.2.2.

6.2.2.4. De-commissioning phase

The same mitigation measures recommended for addressing construction phase impacts at this site area are recommended (Section 6.2.1.2), along with a requirement for any wetlands that develop under the transmission lines in the interim to be rehabilitated by reshaping and/or ripping as necessary to address impacts such as compaction.

6.2.2.5. Mitigation against Cumulative impacts

No mitigation measures are considered necessary.

6.2.3. "No-go" alternative

As in the case of mitigation against the no development option being pursued for the site as a whole, implementation of ongoing, effective alien plant clearing beneath the existing pylon corridor by Eskom would be effective mitigation against the only significant impact assumed to result from the no-development alternative at this site – namely, a lost opportunity for alien clearing activities. Clearing of listed Category 1 and 2 invasive alien plants by a landowner is in any cases mandatory in terms of the Conservation of Agricultural Resources Act (Act 43 of 1983) (CARA). The confidence of this author in this measure being enforced or implemented in a no development scenario is however low.

7 SITE PREFERENCE RATING

7.1. Background

Specialists engaged in the present EIA were required by Lidwala to adopt a Site Preference Rating System to facilitate final selection of a preferred site alternative that consistently takes into account the various concerns of different disciplines.

Sites were rated into the following categories:

1 Not suitable for development / No-Go;
2 Not preferred;
3 Acceptable;
4 Preferred.

While each specialist study is required to have the Site Preference as an outcome, how they evaluate each site varies between disciplines. **Table 7** provides a description of the considerations used to inform ratings of site preference in this report, where "sites" are considered to comprise:

- Alternative 1 with GIS
- Alternative 4 with AIS

It is assumed that the required pylons and other infrastructure would form part of each of the above overall "site" selections.

Table 7

Criteria used for Site Preference Ratings in the aquatic ecosystem specialist study

Note that only one criterion is required to assign a category to a site, and that the lowest rating is the one selected per site.

Site preference Rating	Criteria
Preferred (4)	Not associated with any impacts above low (negative) significance Ideally some potential for positive outcomes, not outweighed by negative outcomes Not likely to result in cumulative impacts above low significance Ideally meeting the above criteria before mitigation
Acceptable (3)	Not associated with any impacts above low (negative) significance Not likely to result in cumulative impacts above low significance Able to meet the above criteria after basic mitigation
Not Preferred (2)	Associated with impacts of medium (negative) significance or higher, before mitigation Likely to result in cumulative impacts above low significance Mitigation measures likely to address impacts are complex/ expensive or require ongoing policing
No-Go (1)	Associated with impacts of medium (negative) significance or higher, after mitigation; or are not mitigable except by avoidance Likely to result in cumulative impacts above low significance Mitigation measures likely to address impacts are complex/ expensive or require ongoing policing

7.2. Results of site preference rating

Using the above approach, the following site preference ratings were obtained:

- Alternative 1 with GIS: Would be **acceptable**;
- Alternative 4 with AIS: Would be marginally **preferred**.

From a freshwater ecosystem perspective, Alternative 4 would be associated with a small measure of positive impact, as a result of the alien clearing that would potentially be associated with it, and would not encroach on any natural wetland systems, other than at transmission line crossings of watercourses, the impacts of which would be readily mitigable.

This said, the positive weighting of Alternative 4 is not considered of sufficient magnitude to provide a clear argument for the siting of the substation on this site, and either site would be acceptable, provided that full mitigation measures were implemented. In other words, freshwater ecosystems should not be the deciding factor for the siting of the (proposed) infrastructure, and there is a good argument that impacts should generally be consolidated, rather than spread out over a wider area.

8 CONCLUSIONS

This assessment has addressed the implications for aquatic ecosystems (rivers, other watercourses and wetlands) of the proposed Weskusfleur substation and its ancillary infrastructure.

Two site alternatives were assessed, each with a different technology alternative, the AIS and GIS technologies respectively having been deemed not technically feasible for implementation at site Alternative 1 and Alternative 4. In fact, the actual footprints of the proposed substations at both sites largely avoided wetland habitat, although some uncertainty was raised by the fact that the area in the north of the proposed Alternative 1 site was clearly going through a wetter phase than in the recent past, and on the basis of changing plant communities (e.g. the recent dominance of lowlying but hitherto terrestrial areas by *Senecio helimifolius*) may be on a trajectory that will see the emergence of wetlands in these relatively dynamic areas.

The only wetlands that would be potentially affected by the proposed substation alternatives comprised (on Alternative 1) the artificial wetlands P4, P6 and Sw4, where the likely disturbance impacts would be readily mitigable through avoidance or rehabilitation.

The transmission lines for Alternative 1, would also be associated with low levels of impacts to wetlands, all of which would however be readily mitigable. In the case of Alternative 4, the Donkergat River and an ephemeral drainage line would both potentially be disturbed by transmission line crossings. Again, such disturbance could be readily mitigated against and indeed, positive impacts associated with necessary ongoing alien clearing along the watercourses might also accrue.

From a freshwater ecosystem perspective, it was concluded that both alternatives considered in this report would be acceptable, assuming full implementation of the mitigation measures outlined here. Alternative 4 would be nominally preferred over Alternative 1, given the possibility of positive impact associated with alien clearing on this site. This is not considered a strong enough argument to use to sway decisions regarding site selection, particularly as alien clearing in any case is required of all land-owners, by law.

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APPENDIX A IMPACT ASSESSMENT METHODOLOGY

The following information has been extracted directly from Chapter 10 of the Draft Scoping Report for this project (Lidwala 2013): Plan of Study for Environmental Impact Assessment

The objective of the assessment of impacts is to identify and assess all the significant impacts that may arise as a result of the proposed Weskusfleur substation and associated infrastructure. The process of assessing the impacts of the project encompasses the following four activities:

- Identification and assessment of potential impacts;
- Prediction of the nature, magnitude, extent and duration of potentially significant impacts;
- Identification of mitigation measures that could be implemented to reduce the severity or significance of the impacts of the activity; and
- Evaluation of the significance of the impact after the mitigation measures have been implemented i.e. the significance of the residual impact.

The possible impacts associated with the project were primarily identified in the Scoping Phase through on-site and desktop study and public consultation. In the Impact Assessment Phase, additional impacts will be identified through the more in-depth specialist investigations to be undertaken and through the ongoing consultation process with interested and affected parties.

In accordance with Government Notice R.543, promulgated in terms of section 24 of the National Environmental Management Act, 1998 (Act 107 of 1998), specialists will be required to assess the significance of potential impacts in terms of the following criteria:

- Cumulative impacts;
- Nature of the impact;
- Extent of the impact;
- Intensity of the impact;
- Duration of the impact;
- Probability of the impact occurring;
- Impact non-reversibility;
- Impact on irreplaceable resources; and
- Confidence level.

Issues will be assessed in terms of the following criteria:

- The **nature**, a description of what causes the effect, what will be affected and how it will be affected;
- The physical **extent**, wherein it is indicated whether:
  - 1 - the impact will be limited to the site;
  - 2 - the impact will be limited to the local area;
  - 3 - the impact will be limited to the region;
  - 4 - the impact will be national; or
  - 5 - the impact will be international;
- The **duration**, wherein it is indicated whether the lifetime of the impact will be:
  - 1 - of a very short duration (0–1 years);
  - 2 - of a short duration (2-5 years);
  - 3 - medium-term (5–15 years);
  - 4 - long term (> 15 years); or
  - 5 - permanent;
- The **magnitude of impact on ecological processes**, quantified on a scale from 0-10, where a score is assigned:
  - 0 - small and will have no effect on the environment;
  - 2 - minor and will not result in an impact on processes;
  - 4 - low and will cause a slight impact on processes;
  - 6 - moderate and will result in processes continuing but in a modified way;
  - 8 - high (processes are altered to the extent that they temporarily cease); or
  - 10 - very high and results in complete destruction of patterns and permanent cessation of processes;
- The **probability of occurrence**, which describes the likelihood of the impact actually occurring. Probability is estimated on a scale where:
  - 1 - very improbable (probably will not happen;
  - 2 - improbable (some possibility, but low likelihood);
  - 3 - probable (distinct possibility);
  - 4 - highly probable (most likely); or
  - 5 - definite (impact will occur regardless of any prevention measures);
- the **significance**, which is determined through a synthesis of the characteristics described above (refer formula below) and can be assessed as low, medium or high;
- the **status**, which is described as either positive, negative or neutral;
- the degree to which the impact can be reversed;
- the degree to which the impact may cause irreplaceable loss of resources; and
- the degree to which the impact can be mitigated.

The **significance** is determined by combining the criteria in the following formula:

S = (E+D+M)*P; where
S = Significance weighting
E = Extent
D = Duration
M = Magnitude
P = Probability

The **significance weightings** for each potential impact are as follows:

- **< 30 points:** Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),
- **30 - 60 points:** Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated),
- **> 60 points:** High (i.e. where the impact must have an influence on the decision process to develop in the area).

This EIA Report will assess the significance of impacts for all phases of the project i.e. construction, operation and decommissioning. The results of the above will be summarised in a tabular format. An example is provided below.

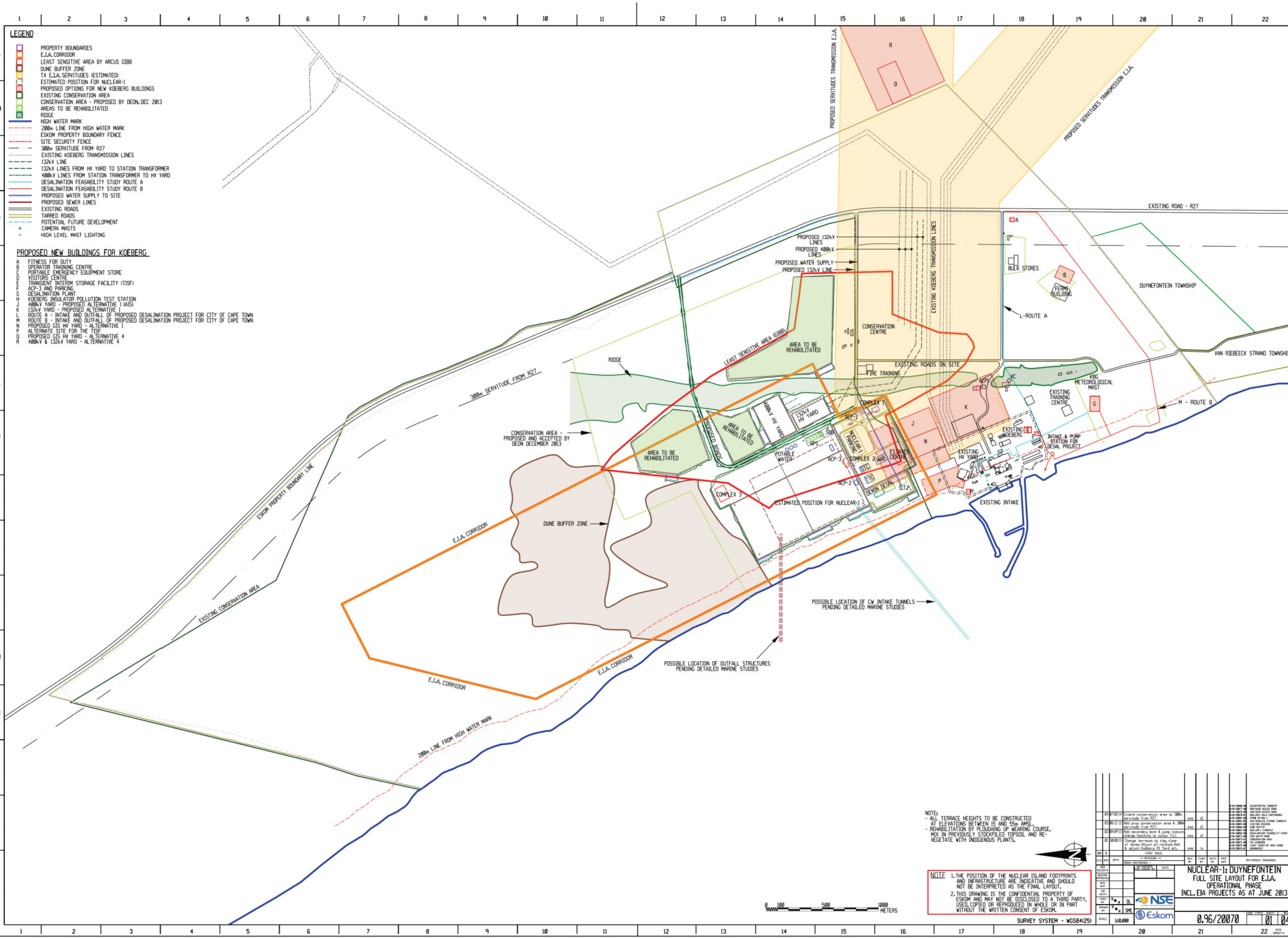
Potential Impact	**Mitigation**	**Extent (E)**	**Duration (D)**	**Magnitude (M)**	**Probability (P)**	**Significance (S=(E+D+M)*P)**		**Status (+ve or -ve)**	**Confidence**
CONSTRUCTION PHASE									
BIODIVERSITY									
Impact 1: Loss or degradation of natural/ pristine habitat Koeberg Nature Reserve.	**nature of impact:**	Adverse Impact due to loss or degradation of natural habitat							
	with mitigation	1	4	2	3	**21**	**Low**	-	high
	without mitigation	2	5	2	4	**36**	**Medium**	-	high
	degree to which impact can be reversed:	None							high
	degree of impact on irreplaceable resources:	Low							high

APPENDIX B

PROPOSED LAYOUT FOR NUCLEAR-1 DEVELOPMENT AT DUYNEFONTEIN.

**"FIGURE 96_20070 01_REV04_
NUCLEAR-1_DUYNEFONTEIN SITE_
FULL SITE LAYOUT FOR EIA"**

SEE SECTION 1.7.2 FOR IMPORTANT ASSUMPTIONS IN THIS REGARD.



LEGEND
PROPERTY BOUNDARIES
E.I.A. CORRIDOR
LEAST SENSITIVE AREA BY ARCUS GIBB
DUNE BUFFER ZONE
TX E.I.A. SERVITUDES (ESTIMATED)
ESTIMATED POSITION FOR NUCLEAR-1
PROPOSED OPTIONS FOR NEW KOEBERG BUILDINGS
EXISTING CONSERVATION AREA
CONSERVATION AREA - PROPOSED BY DEON, DEC 2013
AREAS TO BE REHABILITATED
RIDGE
HIGH WATER MARK
200m LINE FROM HIGH WATER MARK
ESKOM PROPERTY BOUNDARY FENCE
SITE SECURITY FENCE
300m SERVITUDE FROM R27
EXISTING KOEBERG TRANSMISSION LINES
132kV LINE
132kV LINES FROM HV YARD TO STATION TRANSFORMER
400kV LINES FROM STATION TRANSFORMER TO HV YARD
DESALINATION FEASABILITY STUDY ROUTE A
DESALINATION FEASABILITY STUDY ROUTE B
PROPOSED WATER SUPPLY TO SITE
PROPOSED SEWER LINES
EXISTING ROADS
TARRED ROADS
POTENTIAL FUTURE DEVELOPMENT
CAMERA MASTS
HIGH LEVEL MAST LIGHTING
PROPOSED NEW BUILDINGS FOR KOEBERG
A FITNESS FOR DUTY
B OPERATOR TRAINING CENTRE
C PORTABLE EMERGENCY EQUIPMENT STORE
D VISITORS CENTRE
E TRANSIENT INTERIM STORAGE FACILITY (TISF)
F ACP-3 AND PARKING
G DESALINATION PLANT
H KOEBERG INSULATOR POLLUTION TEST STATION
J 400kV YARD - PROPOSED ALTERNATIVE 1 (AIS)
K 132kV YARD - PROPOSED ALTERNATIVE 1
L ROUTE A - INTAKE AND OUTFALL OF PROPOSED DESALINATION PROJECT FOR CITY OF CAPE TOWN
M ROUTE B - INTAKE AND OUTFALL OF PROPOSED DESALINATION PROJECT FOR CITY OF CAPE TOWN
N PROPOSED GIS HV YARD - ALTERNATIVE 1
P ALTERNATE SITE FOR THE TISF
Q PROPOSED GIS HV YARD - ALTERNATIVE 4
R 400kV & 132kV YARD - ALTERNATIVE 4
PROPOSED SERVITUDES TRANSMISSION E.I.A.
EXISTING ROAD - R27
PROPOSED 132kV LINES
PROPOSED 400kV LINES
PROPOSED WATER SUPPLY
PROPOSED 132kV LINE
EXISTING KOEBERG TRANSMISSION LINES
BULK STORES
FERMS BUILDING
DUYNEFONTEIN TOWNSHIP
L-ROUTE A
CONSERVATION CENTRE
AREA TO BE REHABILITATED
LEAST SENSITIVE AREA (GIBB)
EXISTING ROADS ON SITE
FIRE TRAINING
VAN RIEBEECK STRAND TOWNSHIP
KBG METEOROLOGICAL MAST
EXISTING TRAINING CENTRE
M - ROUTE B
RIDGE
300m SERVITUDE FROM R27
CONSERVATION AREA - PROPOSED AND ACCEPTED BY DEON DECEMBER 2013
AREA TO BE REHABILITATED
400kV HV YARD
132kV HV YARD
PROPOSED ROADS
COMPLEX 1
ACP-1
EXISTING KOEBERG
INTAKE & PUMP STATION FOR DESAL PROJECT
EXISTING HV YARD
POTABLE WATER
ACP-3
ACP-2
COMPLEX 2
ESTATES CENTRE
DEMIN DESAL
S.T.P.
COMPLEX 3
ESTIMATED POSITION FOR NUCLEAR-1
EXISTING INTAKE
ESKOM PROPERTY BOUNDARY LINE
DUNE BUFFER ZONE
E.I.A. CORRIDOR
EXISTING CONSERVATION AREA
POSSIBLE LOCATION OF CW INTAKE TUNNELS PENDING DETAILED MARINE STUDIES
POSSIBLE LOCATION OF OUTFALL STRUCTURES PENDING DETAILED MARINE STUDIES
200m LINE FROM HIGH WATER MARK
0 100 500 1000 METERS
NOTE:
- ALL TERRACE HEIGHTS TO BE CONSTRUCTED AT ELEVATIONS BETWEEN 15 AND 55m AMSL.
- REHABILITATION BY PLOUGHING UP WEARING COURSE, MIX IN PREVIOUSLY STOCKPILED TOPSOIL AND RE-VEGETATE WITH INDIGENOUS PLANTS.
NOTE 1. THE POSITION OF THE NUCLEAR ISLAND FOOTPRINTS AND INFRASTRUCTURE ARE INDICATIVE AND SHOULD NOT BE INTERPRETED AS THE FINAL LAYOUT.
2. THIS DRAWING IS THE CONFIDENTIAL PROPERTY OF ESKOM AND MAY NOT BE DISCLOSED TO A THIRD PARTY, USED, COPIED OR REPRODUCED IN WHOLE OR IN PART WITHOUT THE WRITTEN CONSENT OF ESKOM.
04 070214 Extend conservation area to 300m servitude from R27. sme dl
03 061213 Add prop conservation area & 300m servitude from R27. sme dl
02 040913 Add secondary dune & pump station, change hatching to colour fill. sme dl
01 300813 Change terraces to stay clear of dunes. Adjust all related. Add & adjust Koeberg HV Yard alt. sme tv
00 0 FIRST ISSUE
REFERENCE DRAWINGS
NSE
Eskom
NUCLEAR-1: DUYNEFONTEIN
FULL SITE LAYOUT FOR E.I.A.
OPERATIONAL PHASE
INCL. EIA PROJECTS AS AT JUNE 2013
SCALE 1:10,000
SURVEY SYSTEM - WGS84(25)
0.96/20070
01 04
A0L