MELKHOUT BATTERY ENERGY STORAGE SYSTEM, HUMANSDORP, EASTERN CAPE PROVINCE

AQUATIC IMPACT ASSESSMENT

Report Number 535611/3

Report Prepared by

srk consulting

November 2018

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AQUATIC IMPACT ASSESSMENT

SRK Consulting (South Africa) (Pty) Ltd.

Ground Floor Bay Suites
1a Humewood Rd.
Humerail
Port Elizabeth 6001
South Africa

e-mail: portelizabeth@srk.co.za
website: www.srk.co.za

Tel: +27 (0) 41 509 4800
Fax:+27 (0) 41 509 4850

SRK Project Number 531512

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Compiled by:

Luc Strydom
Environmental Consultant

Karissa Nel
Senior Environmental Scientist

Email: knel@srk.co.za

Peer Reviewed by:

Rob Gardiner
Principal Environmental Scientist

Authors:

Luc Strydom & Karissa Nel

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List of Abbreviations

amsl	above mean sea level
BESS	Battery Energy Storage System
BLMC	Biodiversity Land Management Classes
CBA	Critical Biodiversity Area
C.A.P.E.	Cape Action for People and the Environment
CESA	Critical Ecological Support Areas
CoCT	City of Cape Town
DAEA	Department of Agriculture and Environmental Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EAPSA	Environmental Assessment Practitioners of South Africa
EC	Electrical Conductivity
ECBCP	Eastern Cape Biodiversity Conservation Plan
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMPr	Environmental Management Programme
FEPA	Freshwater Ecosystem Priority Area
GDACE	Gauteng Department of Agriculture, Conservation and Environment
GIS	Geographical Information Systems
GPS	Global Positioning System
HDPE	High Density Polyethylene
HGM	Hydrogeomorphic
MAP	Mean Annual Precipitation
NMBM	Nelson Mandela Bay Municipality
NFEPA	National Freshwater Ecosystem Priority Area
OESA	Other Ecological Support Areas
PE	Potential Evaporation
PES	Present Ecological State
pH	Potential Hydrogen
PPT	Parts Per Thousand
RD	Rural Division
REC	Recommended Ecological Category
SANBI	South African National Biodiversity Institute
WMA	Water Management Area

Definitions

Artificial Wetland	Produced by human beings, not naturally occurring.
Brackish Water	Water which has a salinity level of between 0.5 – 30 parts per thousand (PPT).
Catchment	The land area from which water runs off into a specified wetland or aquatic ecosystem; a drainage basin.
Coliform	Rod-shaped Gram-negative non-spore forming and motile or non-motile bacteria
Concentrated Flow	A flow of water contained within a distinct channel. Rivers are characterised by concentrated flow, either permanently or periodically.
Delineation (of a wetland)	The determination of the boundary of a wetland based on soil, vegetation, and/or hydrological factors.
Depression	An inland aquatic ecosystem with closed (or near closed) elevation contours, which increases in depth from the perimeter to a central area of greatest depth, and within which water typically accumulates.
Diffuse Flow	When water flow is not concentrated within a distinct channel, but is rather spread as sheet-flow on the ground surface, or as seepage below the ground surface.
Ecoregions	Geographic regions delineated on the basis of physical/abiotic factors.
Endorheic	As relates to a <u>depression</u>, inward-draining with no transport of water into downstream systems via subsurface or surface flow. Water leaves via <u>evapotranspiration</u> and <u>infiltration</u> only.
Evapotranspiration	The movement of water from the Earth's surface into the atmosphere through the combined process of evaporation and transpiration.
Exorheic	As relates to a <u>depression</u>, outward-draining with water transported to downstream systems via concentrated or diffuse surface flow, or as subsurface flow.
Facultative (FAC)	As relates to <u>wetland indicator status</u>, equally likely to occur in wetlands (estimated probability 34% - 66%) or non-wetlands.
Facultative Upland (FACU)	As relates to <u>wetland indicator status</u>, usually occur in non-wetlands (estimated probability 67% - 99%) but occasionally found in wetlands (estimated probability 1% - 33%).
Facultative Wetland (FACW)	As relates to <u>wetland indicator status</u>, usually occurs in wetlands (estimated probability 67% - 99%) but occasionally found in non-wetlands.
Forb	A herbaceous flowering plant that is not a graminoid (see Graminoid and Herbaceous Plant).
Graminoid	A herbaceous plant with a grass-like morphology, i.e. elongated culms with long, blade-like leaves (see Herbaceous Plant).
Groundwater	Subsurface water in the saturated zone below the water table.
Herbaceous Plant	Plants that have no persistent woody stem above ground (includes forbs and graminoids).

Infiltration	Downward permeation of water below the ground surface, either into the soil or into the groundwater.
Inundated	Covered by water (water is observably present at the surface).
Mottles	As relates to wetland soils, spots of colour in the soil that contrast with the background (matrix) soil colour. Mottles occur where minerals in the soil that have been reduced under anaerobic conditions are re-oxidised.
Natural Wetland	Existing in, or produced by, nature; not manmade or caused by humankind.
Non-perennial	a) Does not flow continuously throughout the year, although pools may persist.
Obligate (OBL)	As relates to wetland indicator status, almost always occurs in wetlands (estimated probability > 99%) under natural conditions.
Perennial	Flows continuously throughout the year, in most years.
DWS Regulated Area	b) The outer edge of the 1:100 year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; c) In the absence of a determined 1:100 year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench (subject to compliance to section 144 of the Act); or A 500 m radius from the delineated boundary (extent) of any wetland or pan.
Seepage	Percolation of water through a soil layer, as subsurface flow.
Terrestrial	Of or on dry land; outside the boundaries of a wetland or other aquatic ecosystem.
Water Table	The upper surface of groundwater or that level below which the soil is completely saturated with water.
Wetland	As defined in the National Water Act (Act No. 36 0f 1998), “a wetland is land that 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.
Wetland Indicator Status	Denotes the probability of individual species of vascular plants occurring in freshwater, brackish and saltwater wetlands.

1 Project Introduction

1.1 Introduction

The Applicant, Eskom Holdings SOC Ltd., proposes to build a Battery Energy Storage System (BESS) system at the Melkhout substation, located near Humansdorp in the Eastern Cape, to optimise excess Independent Power Producer (IPP) in-feeds into the distribution network.

In compliance with the 2014 EIA Regulations promulgated in terms of the National Environmental Management Act (Act 36 of 107), an Environmental Basic Assessment process has commenced by SRK Consulting (SRK) on behalf of Eskom Holdings SOC Ltd. in order to assess the potential environmental and social impacts of the proposed BESS.

The potential occurrence of watercourses and/or wetlands have been identified within 500 m of the proposed site and therefore an Aquatic Impact Assessment is required to assess the aquatic features and any potential impacts to these systems. This Aquatic Assessment Report will provide input into the relevant environmental assessment reports and will form part of the Water Use Application to be submitted in terms of Section 21(c) and (i) of the National Water Act (Act 36 of 1998).

1.1.1 Applicant Details

Eskom Holdings SOC Limited	Contact person: Ms Angelina Shalang
2nd Floor SKG Building Crossing, Beacon Bay, East London	Tel: 012 421 3353 / 083 743 6713
Eastern Cape	Fax: 086 662 0183
5205	Email: shalanar@eskom.co.za

1.1.2 Assessor Details

SRK Consulting	Contact person: Ms Karissa Nel
PO Box 21842	Tel: (041) 405 4800
Port Elizabeth	Fax: (041) 405 4850
6000	Email: knel@srk.co.za

1.2 SRK Profile and Expertise of Project Team

Karissa Nel, from the SRK Port Elizabeth office, was appointed as the specialist to undertake the Aquatic Impact Assessment in terms of applicable legislation and guidelines.

Aquatic Impact assessor, Project assistant: Luc Strydom, BA (Environmental Management)
Luc Strydom is an Environmental Consultant in the Port Elizabeth office. Luc has been involved in environmental management for the past 4 years. His expertise includes Environmental Impact Assessments (EIA), Environmental Management Programmes (EMPr), Water Use License Applications (WULA), Environmental Auditing, Aquatic Impact Assessments (AIA) and Geographic Information Systems (GIS).
Aquatic Impact assessor, Project coordinator: Karissa Nel, MEM (Environmental Management), CEAPSA
Karissa Nel is an Environmental Scientist, with 12 years' experience in Environmental Impact Assessments (EIA), Aquatic Impact Assessments (AIA), Environmental Management Programmes (EMPr) and Environmental Auditing, Environmental Licensing, as well as Geographic Information Systems (GIS). Her training is in aquatic research, zoology, microbiology and environmental management.
Internal Reviewer: Rob Gardiner, MSc, MBA, Pr Sci Nat
Rob Gardiner is the Principal Environmental Scientist and head of SRK's Environmental Department in Port Elizabeth. He has more than 25 years' environmental consulting experience covering a broad range of projects, including Environmental Impact Assessments (EIA), Environmental Management Systems (EMS),

Environmental Management Programmes (EMPr), and environmental auditing. His experience in the development, manufacturing, mining and public sectors has been gained in projects within South Africa, Lesotho, Botswana, Angola, Zimbabwe, Suriname and Argentina.

1.3 Statement of SRK Independence

Neither SRK nor any of the authors of this Report have any material present or contingent interest in the outcome of this Report, nor do they have any pecuniary or other interest that could be reasonably regarded as being capable of affecting their independence or that of SRK.

SRK's fee for completing this Report is based on its normal professional daily rates plus reimbursement of incidental expenses. The payment of that professional fee is not contingent upon the outcome of the Report.

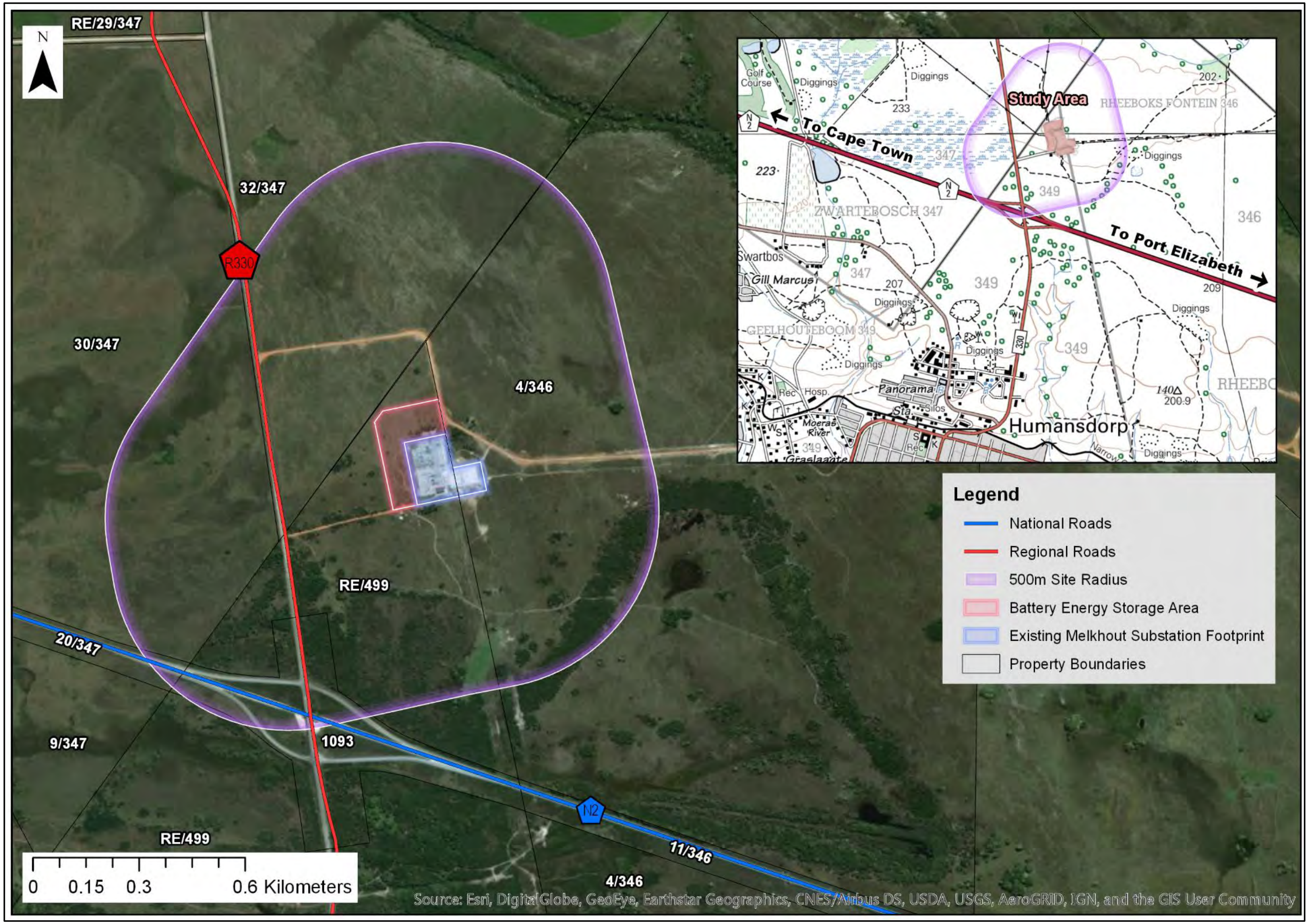

Figure 1-1: Locality Plan of the development

2 Study Scope and Methodology

2.1 Terms of Reference

The scope of works to conduct this aquatic impact assessment included the following activities:

- Conduct a desktop research study regarding the wetlands within 500 m of the construction activities as well as other watercourses within 100 m of the site or that could potentially be affected or that have been affected by the unlawful commencement of construction activities on the site;
- Site visit to ground truth the information obtained in the desktop study. This will include delineation of wetlands and riparian areas of aquatic systems that could be/ have been impacted by the development;
- Classify the delineated wetlands;
- Compile the relevant maps indicating wetlands, watercourses and buffers (if required);
- Determine the Present Ecological State (PES) and the Ecological Importance and Sensitivity (EIS) and comment on the conservation status and ecosystem function and services of wetlands and watercourses;
- Compile a report that will include a description and condition of identified wetlands and watercourses. The report will also include the identification of impacts on the aquatic environment that are likely to have occurred as a result of the unlawful activities on the site, and suggest rehabilitation measures (if necessary) as well as mitigation measures to prevent further such impacts. Actions to enhance the functioning of identified aquatic features will also be considered and recommended, if any; and
- Complete the prescribed DWS Risk Assessment Matrix for Section 21(c) & (i) water uses.

2.2 Methodology

Desktop analysis and ground-truthing

The aquatic assessment commenced in September 2018 with a desktop study during which data was collected and studied using existing literature, maps and aerial photography of the study area and Geographical Information Systems (GIS). In a desktop exercise, all potentially affected watercourses, associated riparian zones and wetlands were identified and delineated at a scale of 1:1,250 before field verification.

Site visits were conducted on 4October 2018 and 24 October 2018 to verify the desktop data and collect the required field data for watercourse delineation and classification. Special attention was given to observations with regard to characteristics of the environment, existing land uses and impacts in and around the site, potential sources of pollution, as well as potential wetland uses/ functions.

Wetland delineation, classification, PES and EIS determination

The study wetlands were delineated considering the methods and indicators described in DWS's practical field procedure for identification and delineation of wetlands and riparian areas (DWAF, 2005). The key indicators considered for delineation include the terrain or position in the landscape, soil wetness, and vegetation (typical wetland species adapted to wet conditions). Plant species were mainly categorised as terrestrial, facultative, or obligate wetland/ riparian species. The height and density of vegetation in the wetlands was also noted as this influences roughness.

Due to the nature of the wetlands observed, the accepted wetlands classification system called a 'Classification System for Wetlands and other Aquatic Ecosystems in South Africa' (Ollis, *et al*., 2013) and published by the South African National Biodiversity Institute (SANBI), was used. This system uses hydrological and geomorphological characteristics to distinguish between primary wetland units. A six-tiered structure is given which progresses from Systems (Marine vs. Estuarine vs. Inland) (Level

I), through Regional Setting (Level 2) and Landscape Units (Level 3), to Hydrogeomorphic (HGM) Units at the finest spatial scale (Level 4). At Level 5, the hydrological regime is used as distinguishing factor and at Level 6, six descriptors have been included to differentiate between aquatic systems based on structural, chemical and/ or biological characteristics (Ollis, *et al*., 2013).

The assessment of ecosystem services and functions delivered by wetlands, that is the benefits provided to people by the relevant ecosystems, was conducted by applying the relevant tool (WET-EcoServices) as described in Kotze, et al (2008). The tool provided a mechanism to flag important ecosystem services that need to be considered during future planning processes in the wetland catchment and downstream, and when managing the wetland. Desktop data, as well as data collected during the site investigation was used in this assessment.

Similarly, the health or integrity of the wetland was assessed using the tool described by Macfarlane, et al. (2009) known as Wet-Health. This assessment uses indicators based on geomorphology, hydrology and vegetation, and generates a score for the Present Ecological State (PES) of the wetland according to the DWS categories.

The Ecological Importance and Sensitivity (EIS) of each wetland was assessed according to the method as adapted from DWAF (1999) which describes a technique to determine EIS and Ecological Management Class (EMC) for floodplains. The method takes into consideration PES scores and scores for ecosystem service provision as well as a range of other determinants to enable the assessor to determine an EIS Category for the wetland feature or group that will reflect its importance to the maintenance of ecological diversity and functioning. The determinants for EIS are assessed on a scale of 0 to 4, where 0 indicates no importance and 4 indicates very high importance. The median of the determinants is used to assign the EIS category. A confidence score is also given on a scale of 0 to 4, where 0 indicates low confidence and 4 very high confidence.

Riparian zone delineation, PES and EIS determination

The proposed development boundary does not fall within the DWS Regulated Area of any of the surrounding rivers and/or drainage lines (100 m), and therefore no assessments of riparian areas were conducted.

Impact assessment

Finally, considering the outcome of the above-mentioned assessments, the potential impacts that the proposed development could have during the construction and operational phases of the activity were investigated. Where possible, mitigation and/ or management measures were proposed to limit the impact of the proposed development on wetland and other aquatic ecosystems. Rehabilitation or enhancements measures were also recommended where necessary.

As per the terms of reference, no impact rating is done for the identified impacts. However, comment is made on the different aspects of the impacts that could affect a rating. These are the following:

- Extent– the area over which the impact will be experienced;
- Intensity– the magnitude of the impact in relation to the sensitivity of the receiving environment;
- Duration– the time frame for which the impact will be experienced;
- Probability– the likelihood of the impact occurring;
- Status – positive or negative impact; and
- Reversibility - ability of the impacted environment to return to its pre-impacted state

The different levels under each of the above aspects that were used in the impacts description is given in Appendix A.

In the case of the "No-Go" alternative, no additional construction or clearing of vegetation would occur and the site would remain in its current condition until/ unless any other development is approved.

In most cases, the "No-Go" alternative approximates the baseline situation. In the sections assessing specific impacts below, the "No-Go" alternative is only assessed where the baseline descriptions do not fully capture current impacts.

2.3 Study Limitations

Please note that the following assumptions and limitations have been considered in the preparation of the assessment:

- The assessment is based on information collected during two site visits undertaken in October 2018. This can influence the quality and accuracy of the data collected. However, every attempt was made to collect the types of information necessary to assist in the assessment of the status and potential impacts of the wetlands and watercourses on site;
- Some inaccuracy (margin of error) in the hand-held Global Positioning System (GPS) is expected. The GPS used is accurate to within approximately 5 m; and
- The scope of this study is limited to site-specific impacts, i.e. impacts that may occur as a result of the no-go option, on other projects or areas outside of the project study area, are not addressed in this study.

Notwithstanding these limitations, it is our view that this report provides a good description of aquatic systems in the vicinity of the proposed site as well as the potential impacts associated with the activity.

2.4 Relevant Legislation

2.4.1 National Legislation

National Water Act (Act 36 of 1998)

The National Water Act (NWA) recognises that the protection of water resources, including not only the water itself but the entire aquatic ecosystem, is necessary to achieve sustainable use of water for the benefit of all water users. In section 1 of the NWA a *water resource* is defined as being all water found in the various phases of the hydrological cycle, including that portion of water that is found underground. This definition ensures that the entire water resource is treated in an integrated fashion and as a resource that is common to all. The DWS has regulated that no activity may take place within a watercourse without authorisation from DWS. Therefore no development activities may occur within any wetland or riparian zone unless authorisation is granted by DWS in terms of section 21 of the NWA.

A General Authorisation (GA) in terms of Section 39 of the NWA, which is an authorisation for water uses as defined in Section 21(c) and section 21(i) without a license provided that the water use is within certain limits and complies with conditions as set out in the GA, was issued by DWS for prescribed water uses as contained in General Notice 509 of 2016 as published in the Government Gazette No. 40229 of 26 August 2016. However, according to section 3 of the Notice, it must be noted that the GA does not apply:

- to the use of water in terms of section 21(c) or (i) of the Act for the rehabilitation of a wetland as contemplated in General Authorisation 1198 published in Government Gazette 32805 dated 18 December 2009;
- to the use of water in terms of section 21(c) or (i) of the Act within the regulated area of a watercourse where the Risk Class is Medium or High as determined by the Risk Matrix;
- in instances where an application must be made for a water use license for the authorisation of any other water use as defined in section 21 of the Act that may be associated with a new activity;

- where storage of water results from the impeding or diverting of flow or altering the bed, banks, course or characteristics of a watercourse; and
- to any water use in terms of section 21(c) or (i) of the Act associated with construction, installation or maintenance of any sewerage pipelines, pipelines carrying hazardous materials and to raw water and wastewater treatment works.

National Environmental Management Act (Act 107 of 1998)

The National Environmental Management Act (NEMA) (Act 107 of 1998) and the associated Regulations (No R. 324, No R. 325 and No R. 326) as amended (April 2017), states that prior to any development taking place within a wetland or riparian area, an environmental authorisation process needs to be followed. This could follow either the Basic Assessment Report (BAR) process or the Environmental Impact Assessment (EIA) process depending on the type and location of the proposed activity.

2.4.2 Provincial Legislation and Policy Regarding Buffers

A buffer zone is defined as a strip of land surrounding a wetland or riparian area in which activities are controlled or restricted in order to reduce the impact of adjacent land uses on the wetland or riparian area (DWAF, 2005). Buffer zones have been shown to have a variety of functions and have been proposed as a standard mitigation measure to protect or limit potential impacts on wetlands and other watercourses. Some generic functions of buffer zones are the following:

- Sediment trapping;
- Erosion control;
- Nutrient retention;
- Maintaining basic hydrological processes;
- Reducing impacts on water resources from upstream activities and adjoining land uses; and
- Providing habitat for various aspects of biodiversity.

Available local government policies require that wetland buffer zones be determined from the outer edge of the temporary zone of a wetland and river buffer zones be calculated from the outer edge of the riparian zone (DAEA, 2002; CoCT, 2009; GDACE, 2008). However, no formal guidelines for riverine and wetland buffer zones have been established applicable to this study area in the Eastern Cape Province. Recommendations in the available policies and guidelines are listed in Table 2-1.

Table 2-1: Recommended buffer zones for wetlands and other aquatic systems in available local government policies and guidelines

Policy/ Guideline	Recommended Buffer
Kwa-Zulu Natal Department of Agriculture and Environmental Affairs (DAEA) Interim Guidelines for Development Activities That May Affect Wetlands (2002)	*15 m* – hardened surfaces should be located at least 15 m outside of the outer boundary of the seasonal/ permanent wetland zone; and *20 m* – a predominantly vegetated buffer area at least 20 m wide should be included between the stormwater outflow and the outer boundary of the wetland, with mechanisms for dissipating water energy and spreading and slowing water flow and preventing erosion.
Gauteng Department of Agriculture, Conservation and Environment (GDACE) Requirements for Biodiversity Assessments: Version 2 (2008)	*30 m* – from the outer edge of the wetland temporary zone, for wetlands occurring inside the urban edge; *50 m* – from the outer edge of the wetland temporary zone, for wetlands occurring outside the urban edge; Larger buffer zones may be required for wetlands supporting sensitive species (Red list of plant species – *200 m* buffer and Giant Bullfrog – *60 m* buffer)
	32 m – from the edge of the riparian zone, for rivers and streams within the urban edge; and *100 m* – from the edge of the riparian zone for rivers and streams outside the urban edge.

Policy/ Guideline	Recommended Buffer
City of Cape Town (CoCT) Prioritisation of City Wetlands Report (2009).	Minimum of *32 m* buffer for wetlands ranging up to *75 m*; *32 m* – artificial wetlands given the status of Critical Ecological Support Area (CESA) should be protected by a buffer of at least 32 m, but which can be wider, if deemed necessary by a wetland ecologist; and *10 m* – artificial wetlands given the status of an Other Ecological Support Area (OESA) should be protected by a buffer of at least 10 m, but these wetlands must still be assessed and ground-truthed by a wetland ecologist.
Eastern Cape Biodiversity Conservation Plan (ECBCP) (Berliner, *et al*., 2007)	*50 m* – for all wetlands until a provincial priority ranking system for wetlands is developed.
	50 m – mountain streams and upper foothills of all 1:500,000 rivers; *100 m* – lower foothills and lowland rivers of all 1:500,000 rivers; and *32 m* – all remaining 1:500,000 rivers.
Department of Water Affairs and Forestry (DWAF) Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas (2008).	*20 m* – watercourses in afforested areas Specific (defensible) objectives should be identified for buffers
Water Research Commission Preliminary Guideline for the Determination of Buffer Zones for Rivers, Wetlands and Estuaries (Macfarlane, *et al.,* 2014)	A buffer zone tool for determination of aquatic impact buffers was developed in 2014 for use a guideline tool to determine appropriate buffer zones for aquatic resources on a case by case basis. Each resource is assessed (using the buffer tool and the associated guideline document) in order to determine appropriate aquatic resource specific buffers, taking the following into consideration: • Site-based delineation and classification of aquatic resource; • Management objectives as per the determined PES and EIS; • Threats posed by the proposed land use / activity; • Sensitivity of aquatic resource to threats posed by lateral land-use impacts; • Sensitivity of important biodiversity elements to threats posed by lateral land-use impacts; • Site based investigations (topographical, ecological and geological characteristics); and • Identification of additional mitigation measures which could refine the impact buffer width.

The recommended buffer zone guideline (as listed above) will be selected for use according to the sensitivity of the aquatic resources (and its surrounding habitat) as well as the nature of the proposed land-use/ activity.

3 Proposed and Completed Activities

3.1 Background Information & Activity Description

The Applicant, Eskom Holdings SOC Ltd., proposes to build a Battery Energy Storage System (BESS) system at the existing Melkhout substation, located near Humansdorp in the Eastern Cape, to optimise excess Independent Power Producer (IPP) in-feeds into the distribution network.

The proposed Melkhout BESS forms part of a broader Eskom project to deploy 1,440 MWh of storage capability into the South African electricity system at various locations around the country. The project is being rolled out in two phases, with Phase 1 targeting the completion of 800 MWh (about 200 MW) before 31 December 2019 and Phase 2 targeting 640 MWh (about 160 MW) shortly thereafter. Melkhout BESS is one of Eskom's pilot projects with a planned capacity of 3 MW/30 MWh.

3.2 Project location

The project site is located across two properties, namely Portion 4 of the Farm Rheeboksfontein No. 346 Humansdorp RD and Erf 499, Humansdorp, within the Eastern Cape (see Figure 1 1). The study area is located directly adjacent to the R330 Regional Road, just off the N2 National Road. The BESS site is located directly adjacent to the existing Melkhout Substation. The nearest town, Humansdorp, lies approximately 1.3 km to the south, of the site.

4 Desktop Assessment: Description of the Study Area

4.1 Climate

The climate of the Humansdorp area (closest town to the site) receives on average 474 mm of rain per year. Humansdorp receives its highest rainfall during August (48 mm) and its lowest rainfall during January (27 mm). The average midday temperatures range between 18.6°C in Winter (July) to 25°C in February (Summer). The coldest time is during July when night time temperatures drop to 7.4°C on average (SA Explorer, 2000-2018). Figure 4-1 portrays the local climate conditions of the area within which the residential development is proposed.

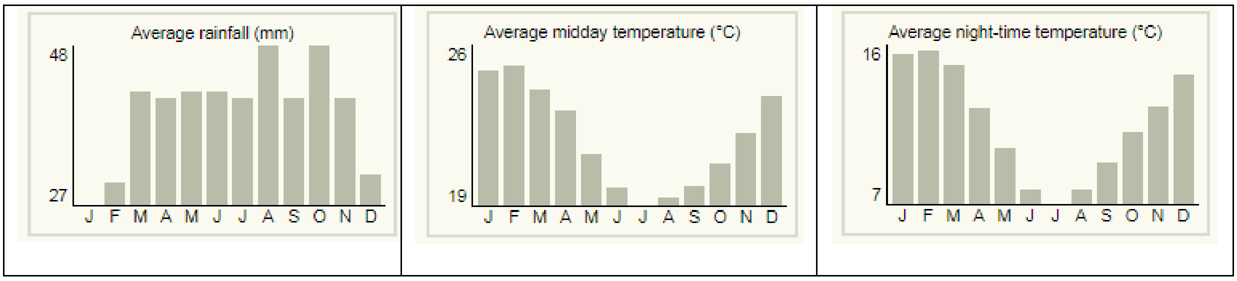

Figure 4-1: Climate conditions of the surrounding area (SA Explorer, 2000-2018)

4.2 Geology

According to Johnson, *et al*. (2006), the site is underlain by the Goudini Formation (Table Mountain Group, Cape Supergroup), which consists of medium-grained quartzrose sandstone. Bedding is thinner and topography is less pronounced, compared with the underlying Peninsula and overlying Skurweberg sandstones. Numerous shallow caves are typically present in cliffs in this formation. Although cross-bedding is common, it is generally unconspicuous. Shale layers are normally less than one metre thick (Le Roux, 2000).

According to the National Soil Classes database (BGIS[1]), the site is underlain by imperfectly drained soils, often shallow and often with a plinthic horizon. These soils may be seasonally wet. Soils have a marked clay accumulation, are strongly structured and a non-reddish colour. They may occur associated with one or more vertic, melanic and plinthic soils.

[1] http://bgis.sanbi.org/MapViewer

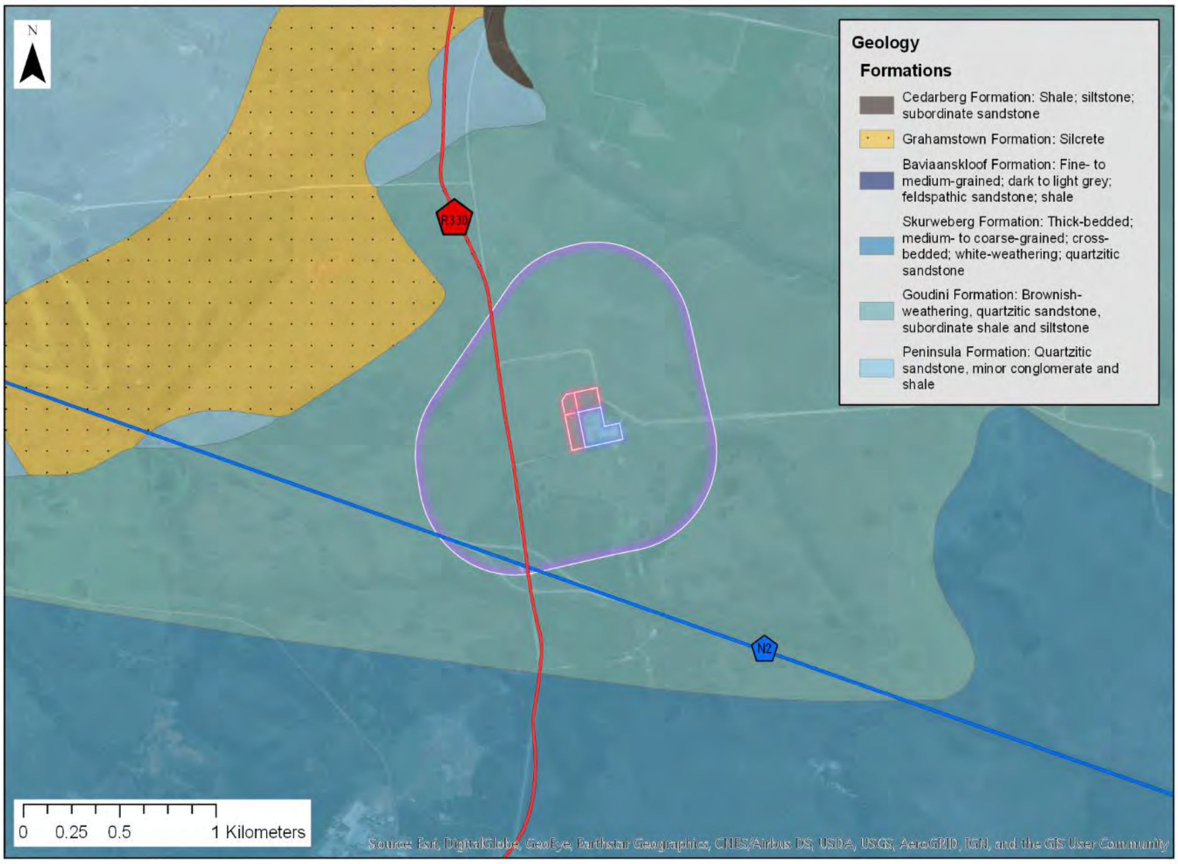

Figure 4-2: Geological map of the development site (Johnson, *et al*., 2006)

4.3 Land Cover and Land Use

Vegetation

The National South African Vegetation Map (Mucina & Rutherford, 2006) categorises the historical vegetation habitats that extended across the proposed development area as *Kouga Grassy Sandstone Fynbos* (refer to Figure 4-3).

Kouga Grassy Sandstone Fynbos is characterised as low shrubland with sparse, emergent tall shrubs and dominated by grasses in the undergrowth, or grassland with scattered ericoid shrubs. The lower dry slopes, where leaching is less severe and nutrient levels are higher, support a higher grassy cover. It is listed as *Least Concern* (with a conservation target of 23%) according to *Mucina & Rutherford* (2006).

According to the National Land-Cover (2009) data, the land-cover within the study area includes Grassland, Shrubland Fynbos, Woodland/ Open Bush, Thicket/Dense Bush and Bare/ Non-Vegetated.

Land Uses

The surrounding area does not fall within a conservation area or semi-urban settlements and has been mostly transformed for agriculture purposes, wind farms or pasture lands. Isolated farm structures are present within the immediate surrounding area. The N2 national road is situated directly south of the site and the R330 regional road is situated directly west of the site. The vegetation on the site itself remains moderately intact apart from the existing substation and related access roads and fencing. There are no formally protected areas within 20 km from the site.

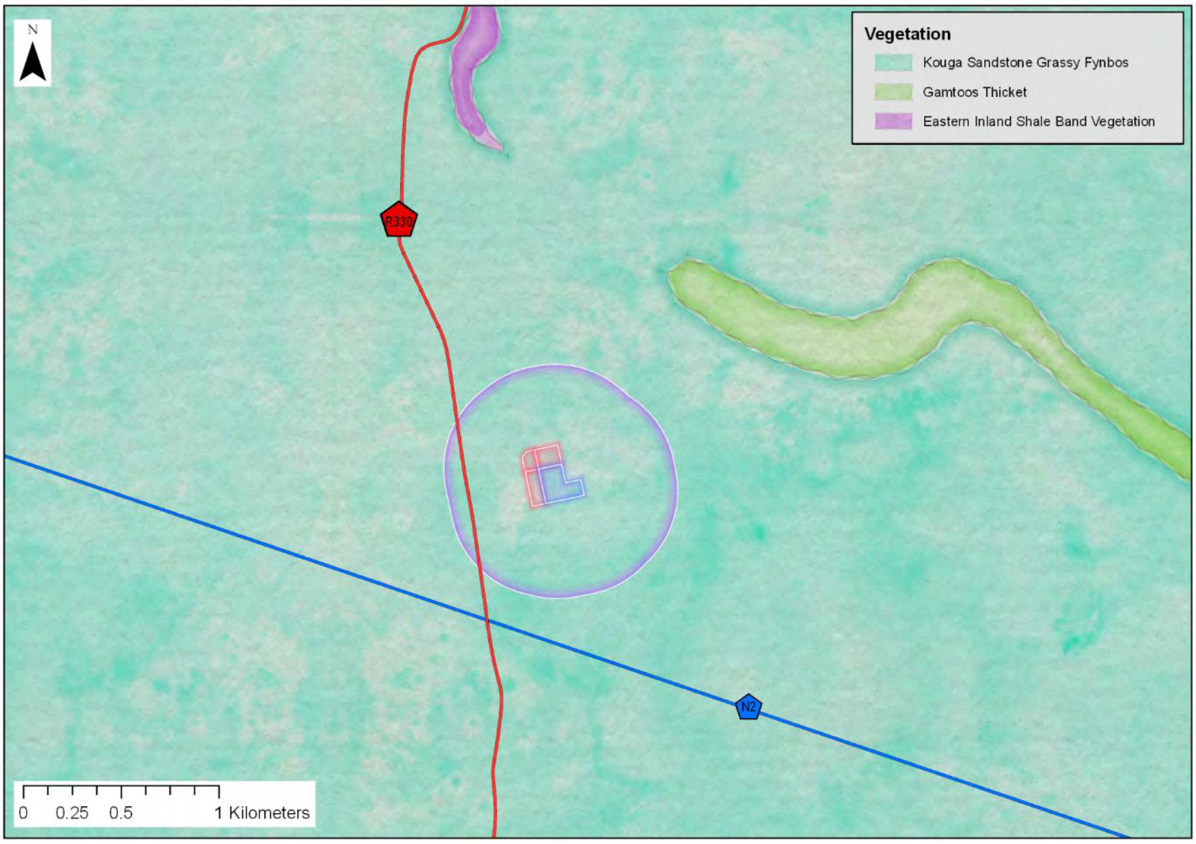

Figure 4-3: Historical vegetation map of the development site (Mucina & Rutherford, 2012)

4.4 Hydrology

The site falls within the Fish to Tsitsikamma Water Management Area (WMA), specifically within the Tsitsikamma Sub-Water Management Area. The quaternary catchment applicable to the development is K90F (see Figure 4-4).

The latest 1:50,000 topographical data shows no drainage lines occur within 500 m of the development site. A few farm dams have been built in the area (mostly along drainage lines), to provide domestic and stock water. The Swart River, located approximately 740 m to the north, and the Seekoei River, approximately 6.2 km to the south, are the predominant perennial rivers within the quaternary catchment. The site gradually slopes to the south (towards the N2).

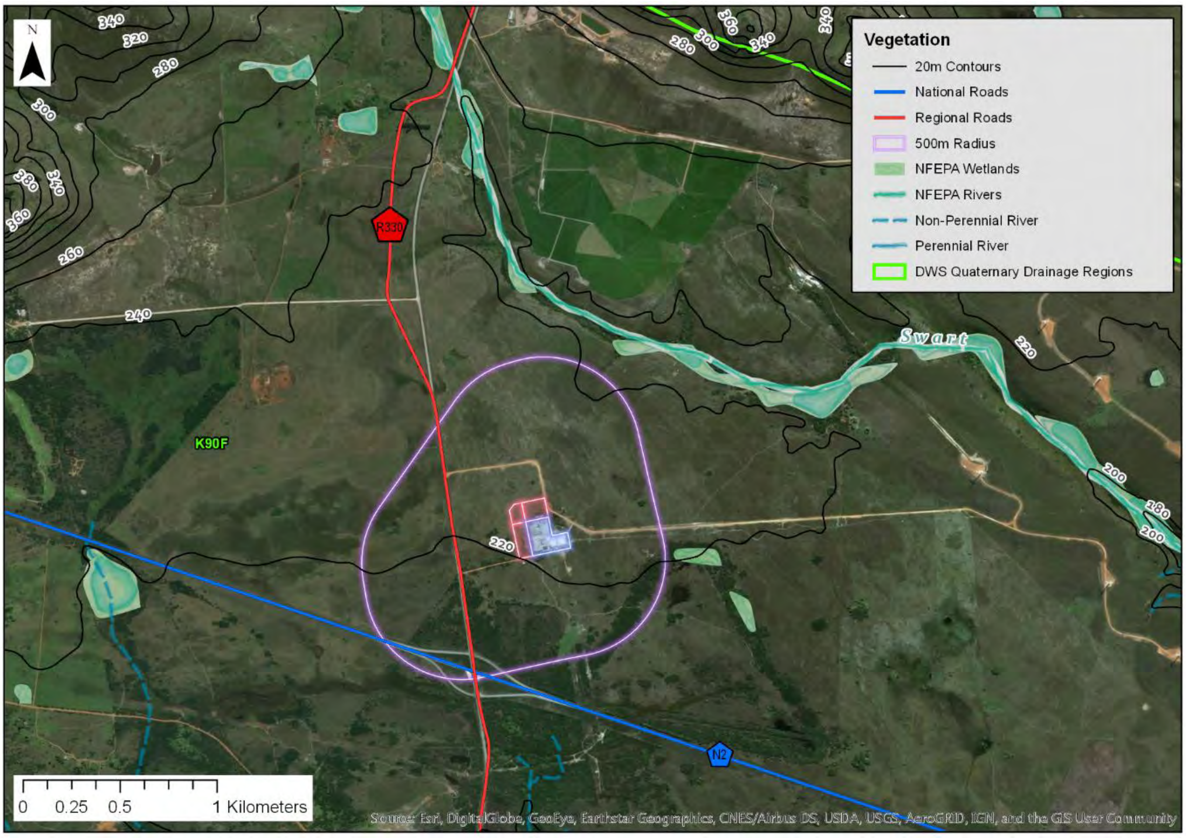

Figure 4-4: Hydrology map of the development site.

5 Desktop Assessment: General Importance of the Study Area with regards to Aquatic Ecosystems

5.1 Ecoregions

Ecoregional classification or typing allows for the grouping of rivers according to similarities based on a top-down nested hierarchical approach. It is based on physical/ abiotic attributes such as physiography, climate, rainfall, geology and potential natural vegetation (Kleynhans, *et al*., 2005). The ecoregional classification approach is specifically useful for the purposes of the determination of the Ecological Reserve, but also for managing inland aquatic ecosystems more generally. In Kleynhans, *et al*., 2005, 31 Level I Ecoregions were identified throughout South Africa, Lesotho and Swaziland.

The study area falls within the *South Eastern Coastal Belt ecoregion (ID – 20)*. This information is useful for the purposes of the wetland classification system as the Level I Ecoregions for South Africa, Lesotho and Swaziland are applied at Level 2 of the classification system.

5.2 Freshwater Ecosystem Priority Areas

The National Freshwater Ecosystem Priority Areas (NFEPA) project aimed to identify a national network of freshwater conservation areas and to explore institutional mechanisms for their implementation. The goal is to conserve a sample of the full diversity of species and the inland water ecosystems in which they occur, as well as the processes which generate and maintain diversity (SANBI, 2011b). The NFEPA database was used to obtain information with regards to areas of ecological importance on or in close proximity to the study area.

The study area falls within the *Fish to Tsitsikamma Water Management Area (WMA ID – 16)* and the *Tsitsikamma Sub-water Management Area (sub-WMA ID – 22)*. Of the total area of these management/ catchment areas, 20% of the WMA and 20% of the sub-WMA has been identified as a Freshwater Ecosystem Priority Area (FEPA). This includes the area of sub-quaternary catchment identified as river FEPAs, wetland FEPAs and wetland clusters. The planning unit identifiers for the sub-quaternary catchments relevant to the study area are 9132 & 9116.

Fish sanctuaries are sub-quaternary catchments that are essential for protecting threatened and near-threatened freshwater fish populations that are indigenous to South Africa. The combined GIS layer for fish sanctuary maps was used with river condition to divide fish sanctuaries, and fish rehabilitation and translocation areas into FEPAs and Fish Support Areas, where fish sanctuaries in a good condition (A or B ecological category) were selected as FEPAs, and the remaining ones became Fish Support Areas.

According to SANBI's BGIS web-based information, the relevant sub-quaternary catchment in which the proposed development site exists (ID 9132) was identified as a Phase2FEPA (see Figure 5-1). According to the NFEPA data, Phase2FEPA's should not be degraded further, as they may in future be considered for rehabilitation. The dataset indicates that one fish species of special concern is present within the sub-quaternary catchment, namely *Sandelia capensis (*status = *data deficient)*. The catchment has been identified as being important for rehabilitation for threatened fish species, however it has not been identified as important in terms of relocation, translocation or migration corridors of threatened fish.

Additionally, the sub-quaternary catchment north of the development site, included within a 500 m radius from the site (ID 9116), is identified as a FEPA (see Figure 5-1). According to the NFEPA data, FEPAs should remain in a good condition in order to contribute to national biodiversity goals and support sustainable use of water resources. The dataset indicates that one fish species of special concern is present within the sub-quaternary catchment, namely *Sandelia capensis (*status = *data deficient))*. The catchment has also been identified as being important for rehabilitation for threatened fish species, however it has not been identified as important in terms of relocation, translocation or migration corridors of threatened fish.

5.3 Wetland Ecosystem Type

The approach to identify wetland ecosystem types uses wetlands that are classified on the basis of a hydrogeomorphic approach to Level 4a of the 2010 version of the National Wetland Classification System (SANBI, 2009) and using a GIS protocol for automation. These were then combined with groupings (called wetland vegetation groups) of the vegetation map of South Africa (Mucina and Rutherford, 2006) to derive wetland ecosystem types that were used to depict the diversity of wetland ecosystems across the country (792 wetland ecosystem types). Wetlands in the same wetland ecosystem types are expected to share similar broad functionality and ecological characteristics. A goal of NFEPA is to ensure that at least 20% of each wetland ecosystem type is managed in a natural or near-natural state. This serves to conserve many common species and communities, and the habitats in which they evolve (Nel, *et al*., 2011).

The dominant Wetland Ecosystem Types relevant to the study area is the *Eastern Fynbos-Renosterveld Sandstone Fynbos*. This information was used to derive the FEPAs mentioned above.

5.4 National Wetland Map 4

The most recent national wetlands locality map augments the waterbodies and wetlands from the National Land Cover 2000 with inland water features from the Department of Land Affairs' Chief Directorate: Surveys and Mapping (DLA-CDSM). All of these have been classified as either 'natural' or 'artificial' wetlands to derive the National Wetland Map 3. Finally, wetland data layers from sub-national wetland locality maps (e.g. KwaZulu-Natal province and the Cape Action for People and the Environment (C.A.P.E.) fine-scale biodiversity planning domains) have also been added to derive the final NFEPA Wetland Map/ National Wetland Map 4.

Wetlands within one kilometre of each other were placed into initial clusters. Clusters allow for important ecological processes such as migration of frogs and insects between wetlands. NFEPA wetland clusters were identified where a cluster contained at least three wetlands of which at least 50% of the wetlands are natural, and where the majority of the wetland cluster area is under natural land cover. A goal of NFEPA is to ensure that at least 20% of the wetland cluster area identified for each wetland vegetation group is managed in a way that supports dispersal between wetlands within the cluster, ideally a natural or near-natural condition (CSIR, 2011).

According to the NFEPA database, there are no wetland features occurring within 500 m from the proposed construction activities as indicated on Figure 5-1. Some wetlands were however identified during the site investigation. More information regarding the individual features is provided in section 6.1 below.

5.5 Rivers

Rivers data on the SANBI database is derived from the 2007 1:500,000 rivers data layer available from the DWS website, which were updated and amended at various instances. Additional information includes river condition, river ecosystem types and free-flowing river information that were used in deriving FEPAs for river ecosystems. River condition on this database was determined by using DWAF's 1999 Present Ecological State (Kleynhans, 2000) data for quaternary catchment mainstem rivers and modelled data for tributaries. Only river ecosystems in good condition (A or B ecological category) were chosen as FEPAs because these rivers provide the best representative examples of South Africa's freshwater ecosystems and associated biodiversity.

The most recent study by Birkhead, *et al*. (2013) reported the Present Ecological State (PES), Ecological Importance and Sensitivity (EIS) for Water Management Areas (WMAs) 12 and 15 in a study for the DWS.

The study area drains towards the sea at Paradise Beach. There are no perennial or non-perennial drainage lines within 500 m of the study area. The Swart River is the closest perennial river (approximately 740 m) to the north of the study area, located in sub-quaternary catchment ID 9116. The Seekoei River is the main perennial river (mainstem) within the sub-quaternary catchment ID 9132 in which the majority of the development site falls.

The Swart River is a perennial first order river. The PES for the Swart River according to the1999 study by the Department of Water Affairs (DWA is indicated as Class D which is described as *largely modified*.

Results from the EIS/PES update for WMA 12 & 15 study (Birkhead, *et al.,* 2013) indicate however that the PES on a sub-quaternary catchment level for the Swart River system is Class C (moderately modified). The Environmental Importance (EI) is rated as *Moderate* and the Environmental Sensitivity (ES) is rated as *High* (refer to Figure 5-2).

The Seekoei River is also a perennial first order river. The PES for the Seekoei River according to the1999 study by the Department of Water Affairs (DWA) and the EIS/PES update for WMA 12 & 15 study (Birkhead, *et al.,* 2013) is indicated as Class D which is described as *largely modified*. The Environmental Importance (EI) is rated as *Moderate* and the Environmental Sensitivity (ES) is rated as *High* (refer to Figure 5-2).

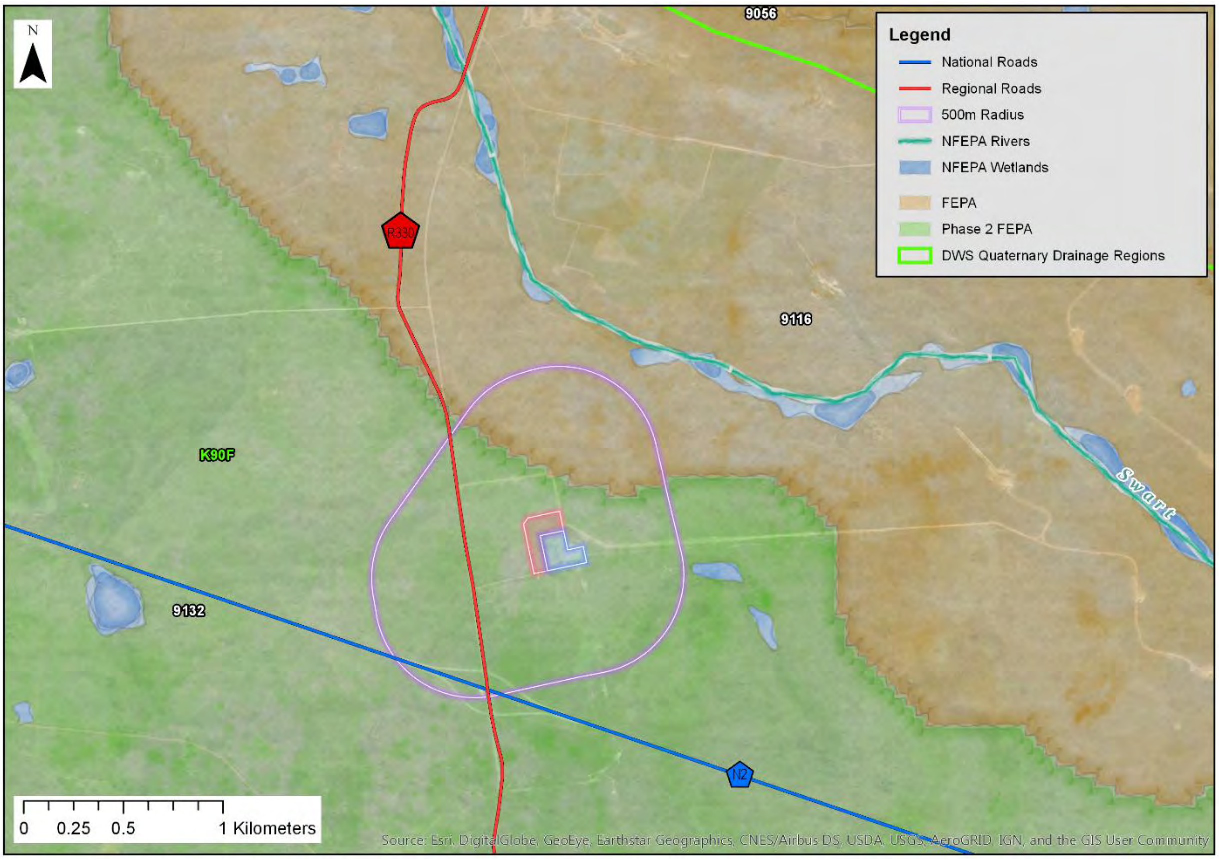

Figure 5-1: NFEPA data in relation to the study site location

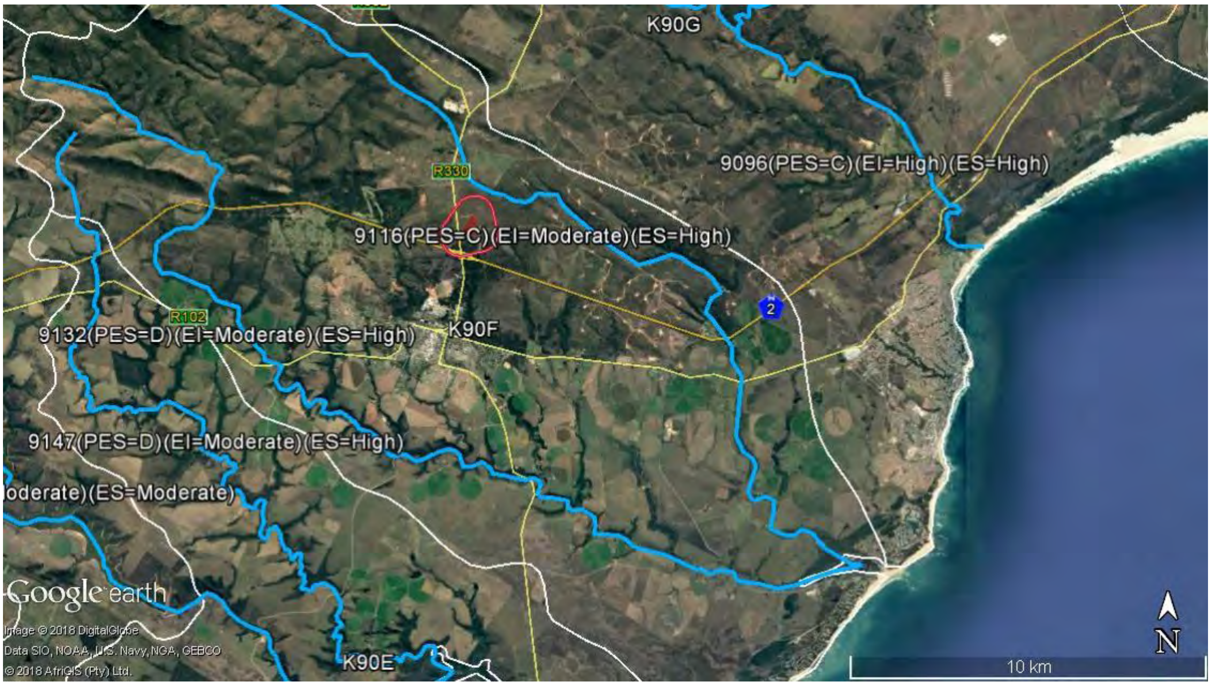

Figure 5-2: Present Ecological State (PES) map for rivers of the primary catchment K90 (project location indicated in red) (Birkhead, et al., 2013).

5.6 Eastern Cape Biodiversity Conservation Plan

The Eastern Cape Biodiversity Conservation Plan (ECBCP) is a broad-scale biodiversity plan. It integrates other existing broad-scale biodiversity plans in the Province, and fills in the gaps using mainly national data. It has been designed to serve as the basic biodiversity layer in Strategic Environmental Assessments, State of Environment Reports, SDFs, EMFs and Bioregional Plans and contains maps of terrestrial and aquatic CBAs, as well as suggested land use guidelines.

A land management objectives-based approach has been adopted in the ECBCP. This approach rests on the concept of Biodiversity Land Management Classes (BLMCs). Each BLMC sets out the desired ecological state that an area should be kept in to ensure biodiversity persistence. Table 5-1 depicts the desired ecological state for the relevant aquatic CBA's.

The study area does not fall within an Aquatic CBA area.

Table 5-1: Biodiversity Land Management Classes for Aquatic CBA's (Berliner, *et al*., 2007)

CBA Map Category	Code	BLMC		Description of CBAs	ABLMC Transformation Threshold
Aquatic CBA 1	A1	ABLMC 1	Natural state	Critically important river sub-catchments; Priority primary catchments for E1 estuaries	Less than 10% of total area of sub-quaternary catchment
	E1				
	A3a / E3a				
Aquatic CBA 2	A2a	ABLMC 2a	Near natural state	Important sub-catchments, Primary catchment management areas for E2 estuaries	Less than 15 % of total area of sub-quaternary catchment
	E2				
Aquatic CBA 3	A3b				
Aquatic CBA 3	A2b	ABLMC 2b	Near natural state	Catchments of free flowing rivers important for fish migration	Less than 20 % of total area of sub-quaternary catchment

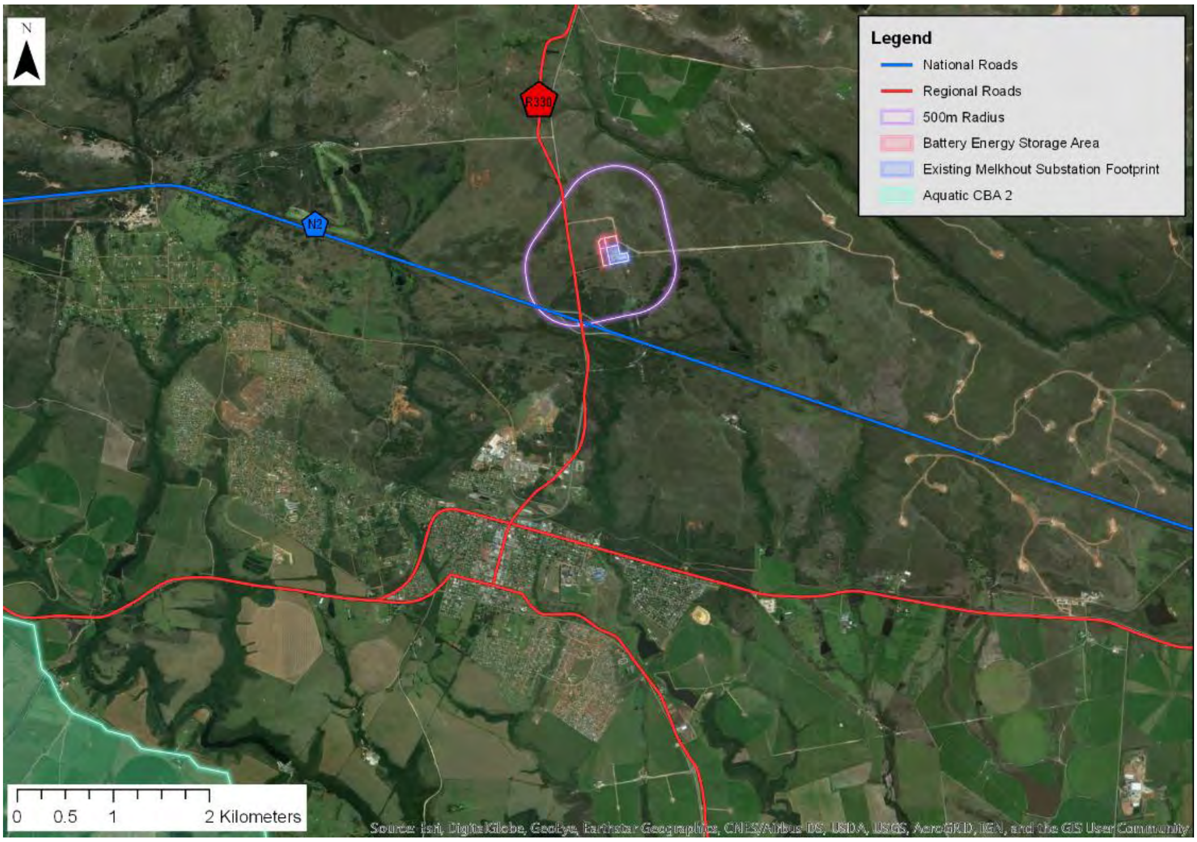

Figure 5-3: ECBCP Aquatic CBA spatial data in relation to the site locality (Berliner, *et al*, 2007)

5.7 Strategic Water Source Areas (SWSA)

Strategic water source areas are those areas that supply a disproportionate amount of mean annual runoff to a geographical region of interest. Any area estimated to have ≥135 mm/year in its 1 x 1 minute grid cell was considered to be a SWSA at the national level. These areas span South Africa, Lesotho and Swaziland and occupy 8% of the land surface area in the region. Together, these areas supply 50% of the region's mean annual runoff.

Strategic water source areas are important because they have the potential to contribute significantly to overall water quality and supply. Deterioration of water quality and quantity in these areas can have a disproportionately large negative effect on the functioning of downstream ecosystems and the overall sustainability of growth and development in the regions they support. Appropriate management of these areas can greatly support downstream sustainability of water quality and quantity. Maintaining healthy functioning riparian zones and wetlands are some of the key management measures for these areas (Nel, *et al*. 2013).

The mean annual runoff (MAR)[2] for the proposed site is given as 44 mm/year. The area within 500 m of the development site is therefore not considered a SWSA.

5.8 Groundwater Recharge

Groundwater is essential for sustaining river flows during dry seasons. Groundwater recharge is a process whereby rainwater seeps into groundwater systems and is calculated as an average over

[2] Mean annual runoff for South Africa (mm/year for each 1 x 1 minute grid cell), based on disaggregating the Water Resources Assessment 2005 data (Middleton and Bailey, 2009), which represents the most commonly-used national mean annual runoff data used by the Department of Water and Sanitation for water resources planning and management.

many years. Rainfall and geological permeability are the two main factors on which recharge is dependent and will vary among areas. An area where recharge is high is considered to be a recharge hotspot and it is essential that vegetation in these areas is kept intact to maintain the healthy functioning of groundwater dependent ecosystems, which are in the immediate vicinity or several kilometres removed from the recharge area (Nel, *et al*. 2011).

The percentage recharge for each sub-quaternary catchment is expressed as the percentage recharge of the relevant primary catchment to identify areas where groundwater recharge is at least three times more than that of the primary catchment.

The groundwater recharge for the relevant sub-quaternary catchment is given as 50% (SANBI, 2011a), which is not regarded as significant. The area is therefore not considered important or sensitive from a groundwater recharge perspective.

6 Study Results

6.1 Watercourse Description and Delineation

As mentioned above, there are no perennial or non-perennial rivers identified within 100 m of the site according to the 1:50,000 topographical data. Additionally, there are no wetland or river features identified within a 500 m radius from the site according to the available databases (refer to Figure 5-1) (and therefore not within the DWS regulated area).

During the site visit, low-lying or potential wet areas within the 500 m radius from the proposed construction activities were visited in order to verify and delineate wetlands, watercourses and their associated riparian areas. Six potential wetlands identified during the desktop study were found to be natural or artificial (naturalised) wetlands. These are included in the assessment as they occur within 500 m of the proposed site and could potentially be affected by construction related activities.

The hydrology of the area appears to include subsurface sheet-flow on a shallow impermeable rock layer for most of the site and surrounding areas. Soil samples taken in the surrounding areas indicate regular water flow. It appears that water received within the surrounding catchment flows along the shallow rock layer (under the soil surface) in a south-south-western direction collecting in depressions where the wetland features are located (as mentioned below). Disturbances, such as the Melkhout Substation and the adjacent windfarm access road, have altered/ blocked the sheet-flow in areas, causing changes in the hydrology of the area.

Wetlands

Wetlands 1, 2, 3 & 4 (W1, W2, W3 & W4) are seep wetlands located on Portion 30 of Farm 347, Humansdorp RD, directly east of the proposed site. The R330 separates the wetlands from the proposed site. Water input appears to be supplied by groundwater sheet flow from the upstream catchment, which flows along a shallow impermeable rock layer that appears to be present throughout the area. It is possible that the construction of the N2 to the south (downstream side) of these wetlands has contributed to the wetness in this area (causing a barrier for sheet flow). Additionally, adjacent to Wetland 4 (slightly up-gradient), there is an old borehole (artesian well) which was observed flowing during the site visit (refer to Photo 22). Water from this borehole flows into Wetland 4. Several inundated pools are scattered within Wetland 1 which are the permanent zone(s) of the wetland. W2, W3 and W4 has no permanent wetland zones. Water samples taken during the site visit from one of the inundated pools indicate that the water within the wetland is slightly alkaline (approximately 8.6 pH) and fairly fresh (approximately 0.55 mS/m). Soil samples indicated waterlogged sandy soils with mottles in the shallow (0-10 cm) and deeper (30-40 cm) samples typical of a seasonal and temporary wetland zones. The wetlands are separated from each other by outcrops containing a mix of terrestrial Fynbos and Thicket vegetation species. The wetlands are occupied by a diverse community of obligate and facultative hydrophytic vegetation, most notably *Elegia fistulosa, Isolepis levynsiana,Isolepis marginata, Thamnochortus glaber, Miscanthus ecklonii, Tristachya leucothrix, Cymbopogon marginatus* and *Cliffortia ferruginea.* The small pools of water are dominated mainly by obligate species such as *Aponogeton junceus, Cotula coronopifolia, Eleocharis dregeana, Juncus oxycarpus* and *Spirodela punctata.* Several other hydrophytic species were noted scattered around the wetlands and are listed in Table 6-1. Additionally, aquatic birds *Anas undulata* (Yellow-Billed Duck), *Ardea melanocephala* (Black-Headed Heron) and *Euplectes capensis* (Yellow Bishops) were observed within the wetland during the site visit. Minimal invasive alien vegetation was noted within these wetlands, although the area directly south-east of the wetlands in the corner of the property adjacent to the R330 and N2 is heavily infested with *Acacia mearnsii* (Black Wattle). *Polypogon monspeliensis* is also prominent around the inundated pools to the west of the Wetland 1. A map indicating the delineated wetland boundaries is included in Figure 6-2 to Figure 6-5.

Wetland 5 (W5) is a wetland that consist of two Hydrogeomorphic (HGM) units, i.e. a seep and a depression (refer to the classification in section 6.2). The wetland is situated directly south (down-gradient) from the proposed site. As with the wetlands mentioned above, it appears that water input for the wetland is supplied by subsurface sheet-flow, which flows along a shallow impermeable rock layer that appears to be present throughout the area. Several inundated pools exist throughout the wetland. It is unclear to what degree the construction of the N2 national road contributed to the formation of the wetland, but it is likely that it contributed to the wetness in this area that is directly up-gradient from the road. An old farm dam (excavated tank) exists at the outer edge of the eastern toe of the wetland that appears from historically imagery to be permanently inundated. This feature is classified as a depression (refer to Figure 6-6). The remainder of the wetland is either seasonal and temporary zone. Water samples taken during the site visit indicate that the water within the wetland is slightly alkaline (approximately 8.82 pH) and fairly fresh (approximately 0.6 mS/m). From the sheen on the water surface, it appears that coliform bacteria could be present in the water, most likely the faecal matter from grazing animals, or potentially a combination this and other coliforms. The wetland is dominated by Cliffortia linearifolia and low sedges and herbaceous shrubs and grasses throughout including *Centella asiatica, Andropogon eucomus, Isolepis marginata, Isolepis fluitans, Isolepis levynsiana, Schoenoplectus decipiens, Drosera cistiflora* and *Cliffortia linearifolia*. The permanently inundated areas are occupied by *Aponogeton junceus, Cyperus denudatus, Eleocharis dregeana, Eleocharis limosa* and *Paurida aquatica*. Several other hydrophytic species were noted scattered around the wetland and are listed in Table 6-1. The wetland is heavily infested with Acacia mearnsii and Acacia saligna. The Acacia mearnsii infestations along the outer edges of the wetland are particularly dense. Several bird species known to inhabit aquatic areas were observed within the wetland, including *Anas capensis* (Cape Teal), *Anas undulata* (Yellow-Billed Duck) and *Bostrychia hagedash* (Hadeda Ibis) mainly occurring at the farm dam. Frogs are also abundant within the wetland habitat. A map indicating the delineated wetland boundary is included in Figure 6-6.

Wetland 6 (W6) is a depression wetland situated to the east (down-gradient) of the proposed site. Much like the wetlands mentioned above, it is likely that the water input comes from subsurface sheet flow, however the construction of access road to the north appears to be affecting the flow. The northern section of the wetland displays soils with lots of mottling and the colour is compatible with wetland soils, however it was completely dry and the hydrophytic vegetation within the wetland appears to have been replaced by more terrestrial species. This is most likely due to hydrological changes as a result of the construction of the access road. There is potential that this section of the wetland may disappear in the future. Additionally it appears that a smaller wetland was present to the north of Wetland 6, however it has disappeared, most likely as a result of loss of water input due to the access road blocking subsurface flow. Areas to the north of the newly built road appears to be getting wetter as a result of this scenario. The south-eastern portion of the wetland is mostly surrounded by dense stands of alien vegetation, *Acacia mearnsii*, on its boundary. No water was present within the wetland during the site visit. Soil samples revealed hard dry clay soils with mottling. Hydrophytic vegetation within the wetland is sparse, and mostly consists of *Eragrostis curvula, Centella asiatica, Helichrysum cymosum subsp. calvum, Restio capensis* and *Restio tetragonus*. A list of vegetation observed during the site visit is included in in Table 6-1. A map indicating the delineated wetland boundary is included in Figure 6-7.

Maps of the delineated wetlands and drainage lines are included in Figure 6-1 to Figure 6-7 below.

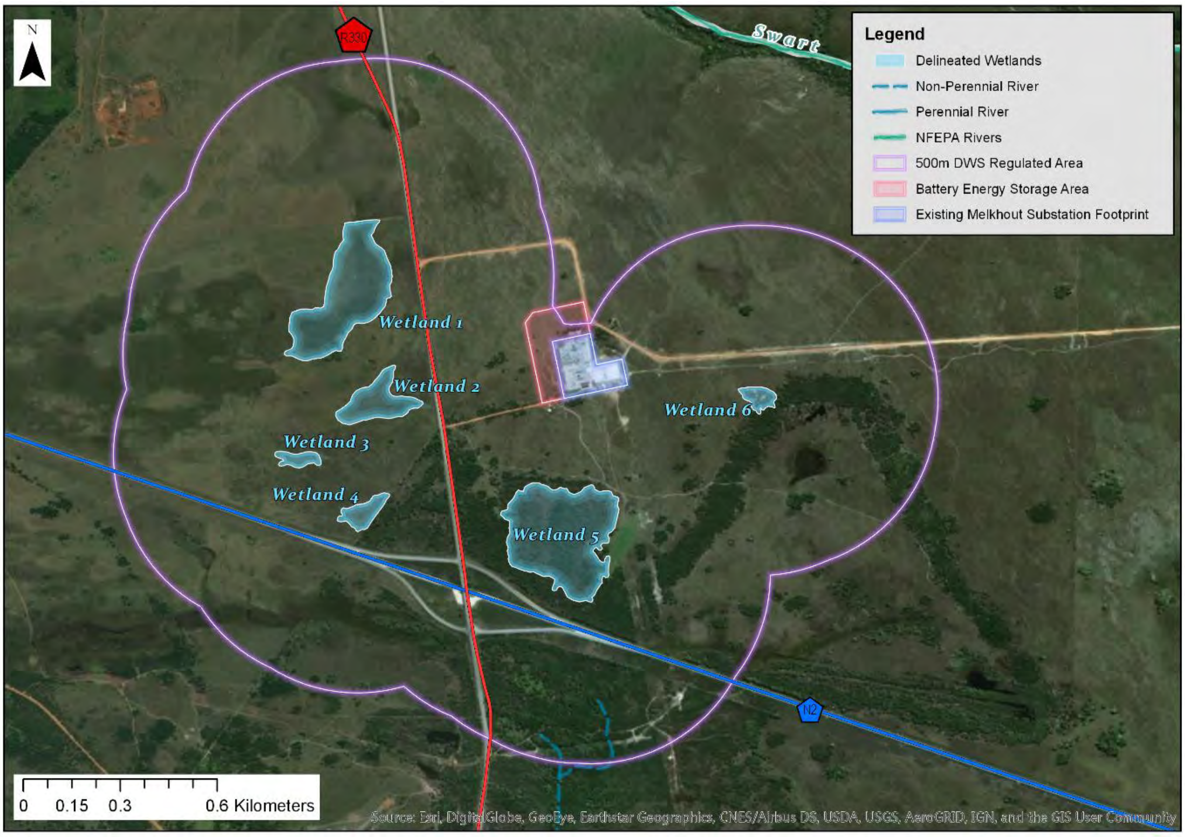

Figure 6-1: Overview of identified wetlands within 500 m of the proposed development

Figure 6-2: Delineation of Wetland 1

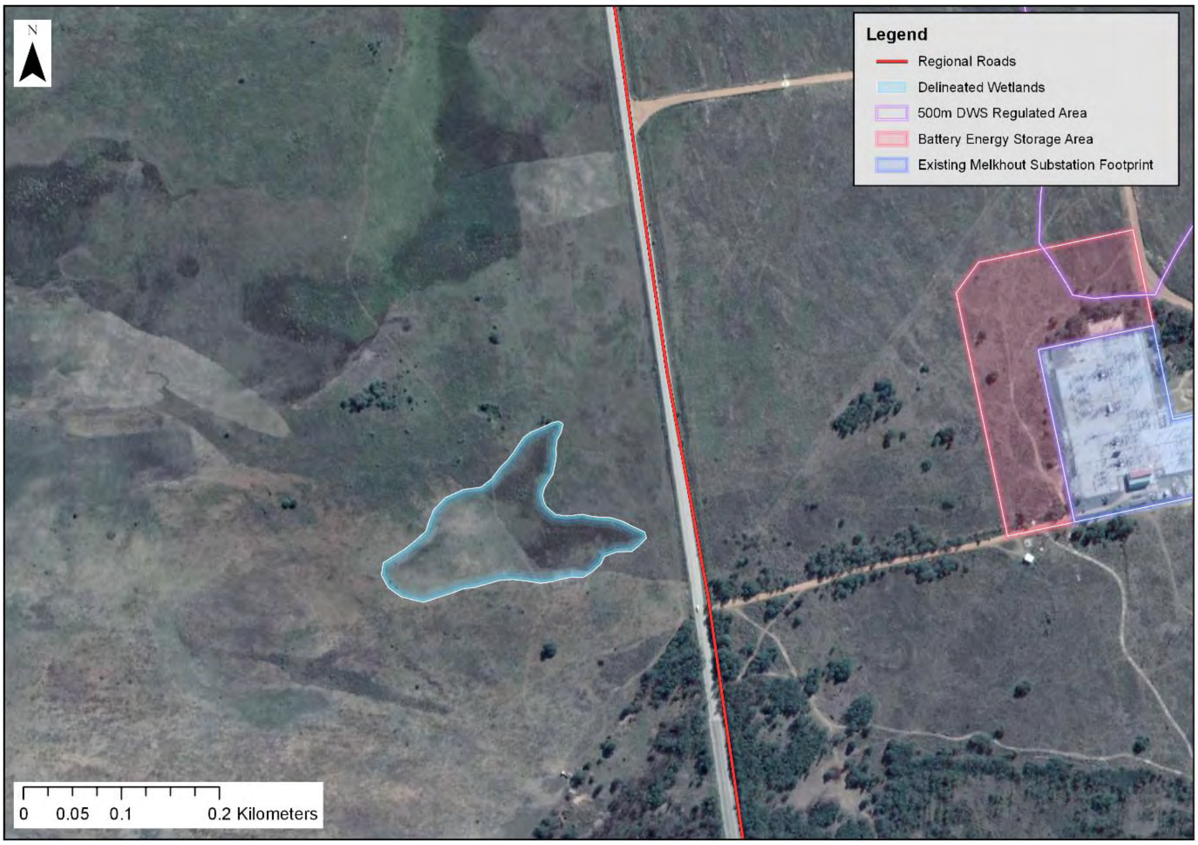

Figure 6-3: Delineation of Wetland 2

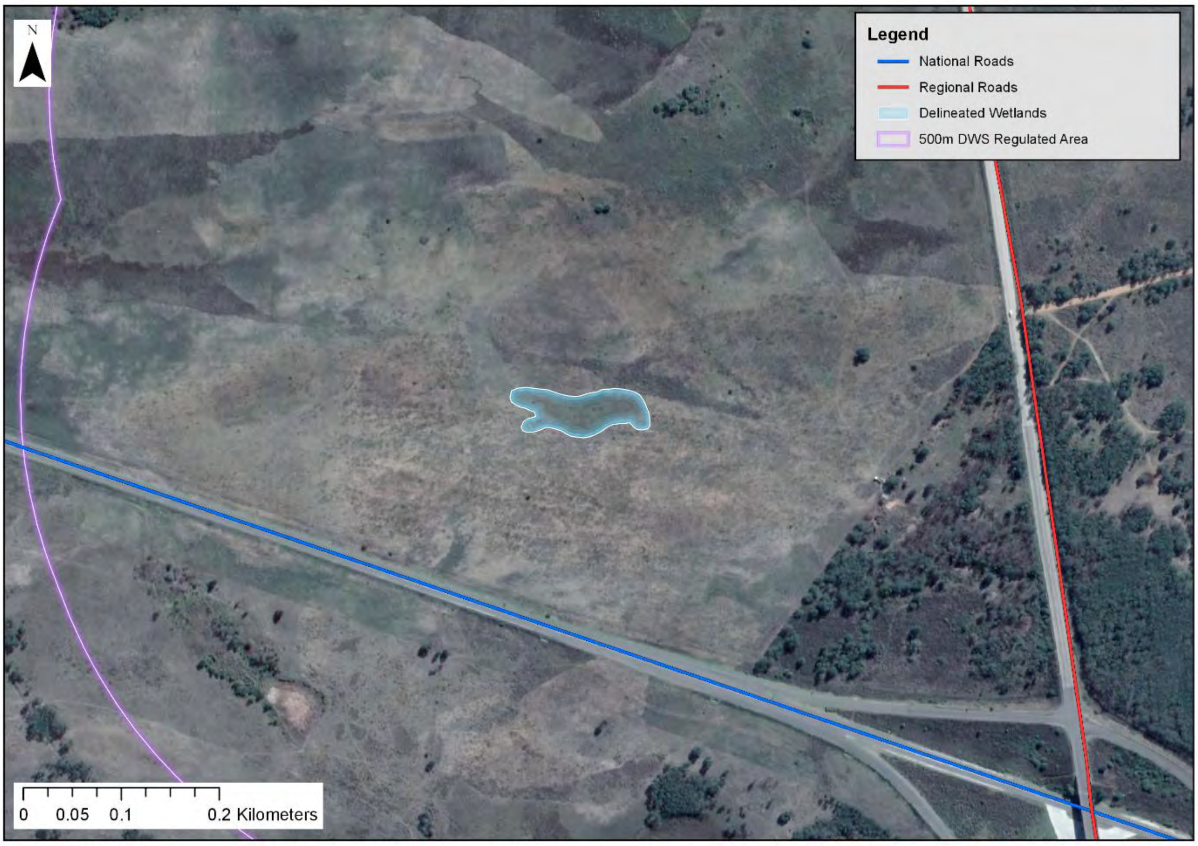

Figure 6-4: Delineation of Wetland 3

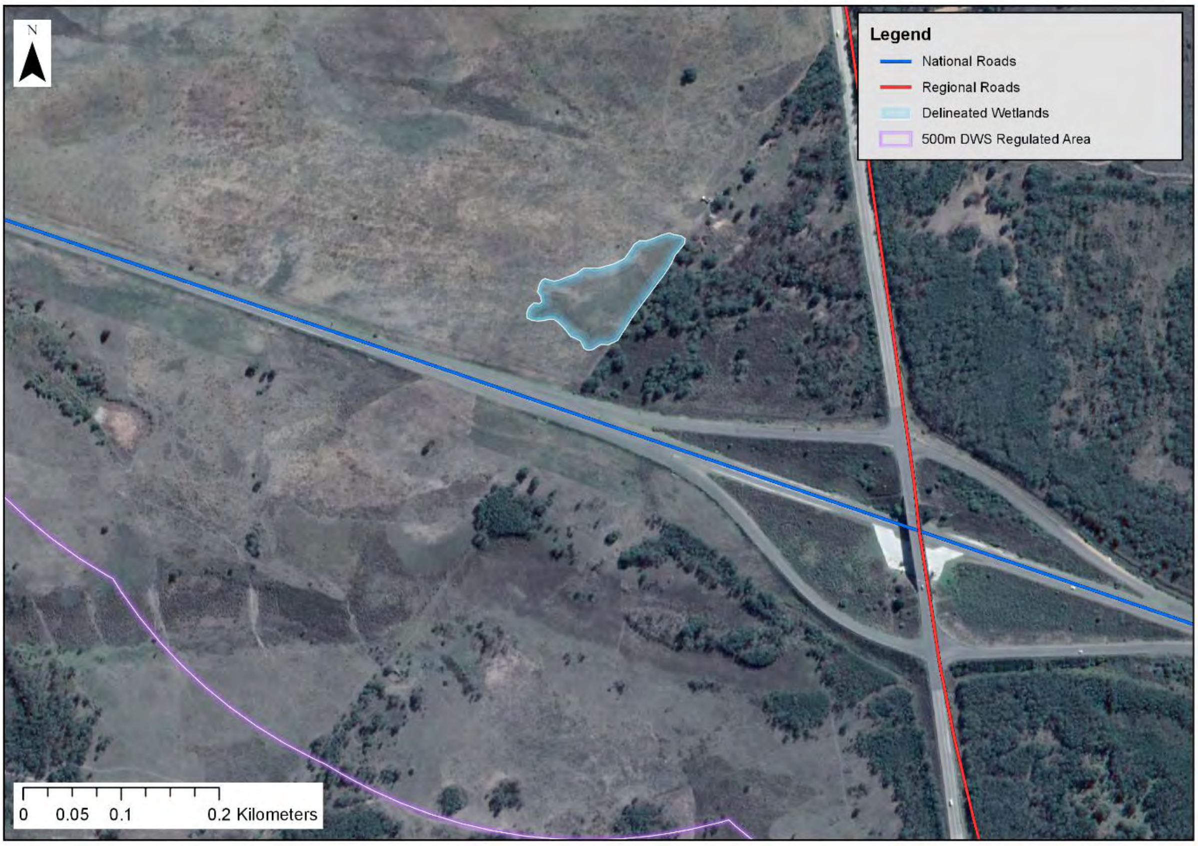

Figure 6-5: Delineation of Wetland 4

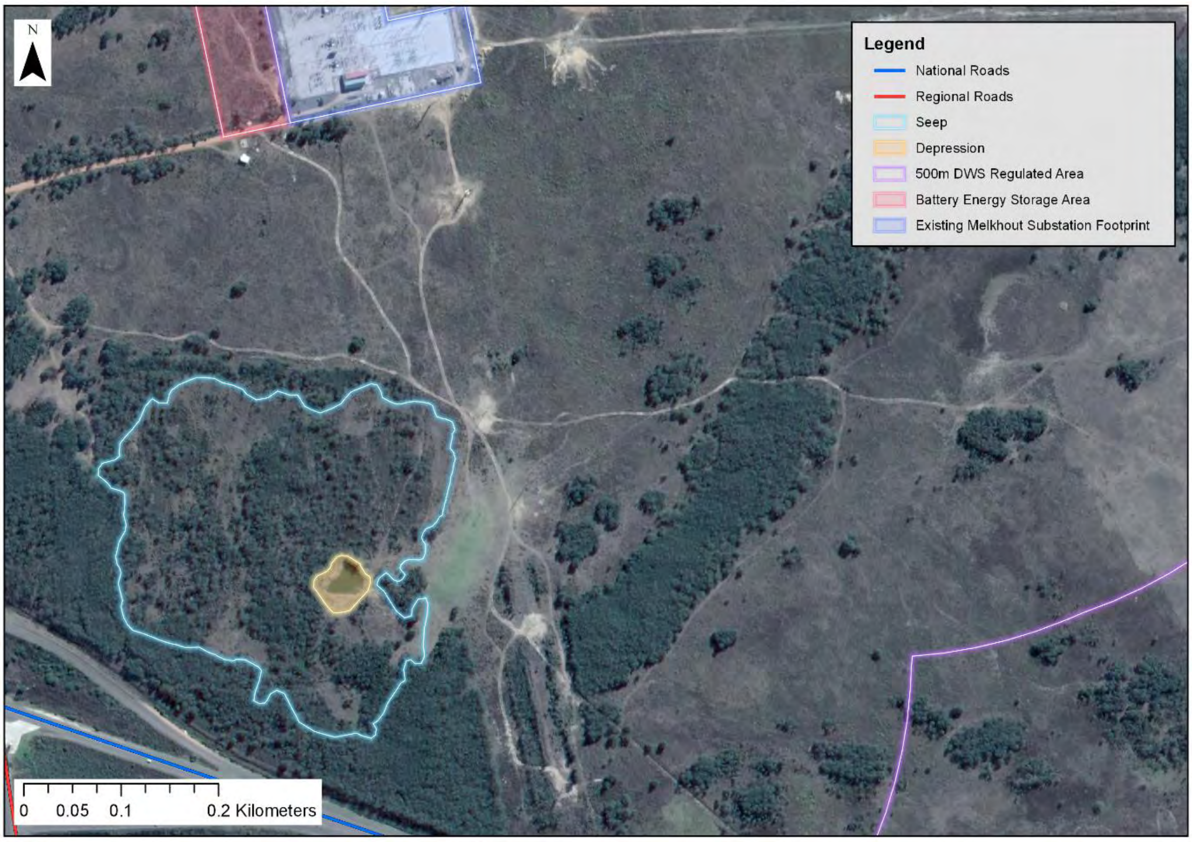

Figure 6-6: Delineation of Wetland 5

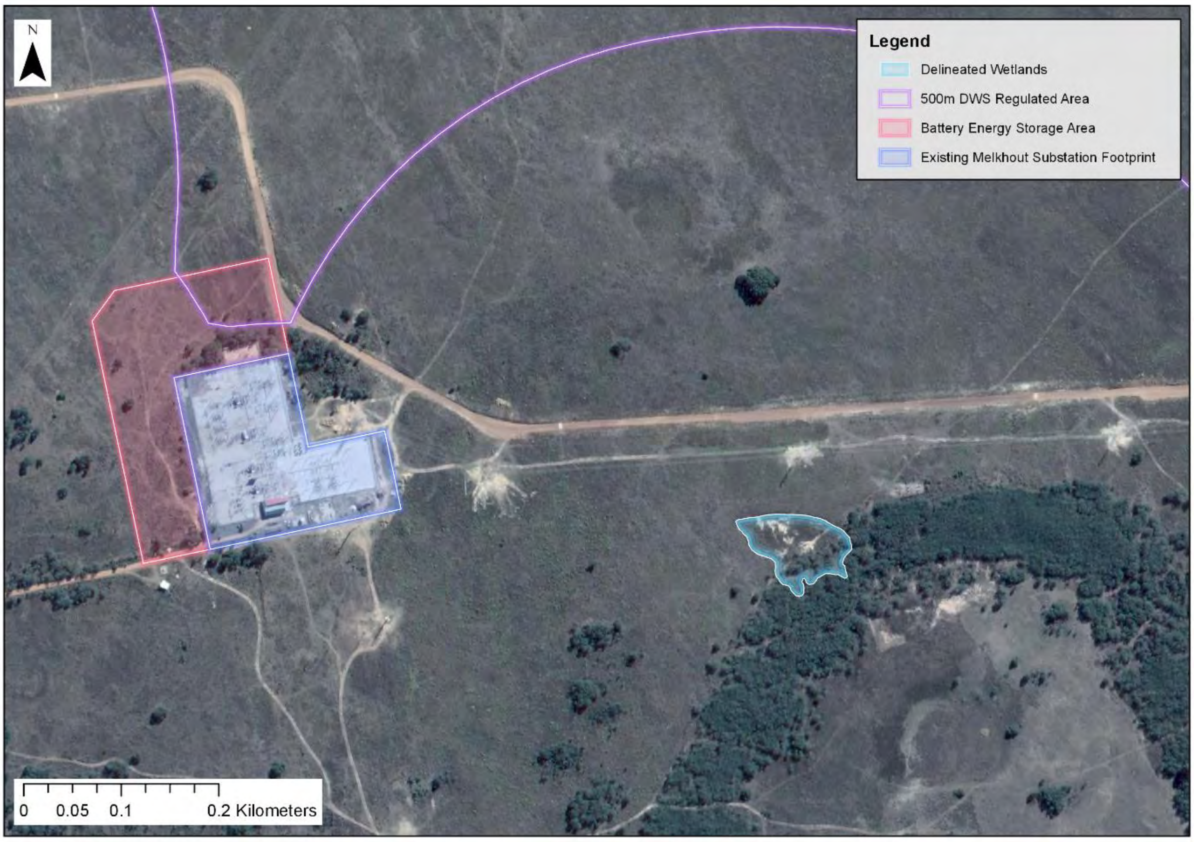

Figure 6-7: Delineation of Wetland 6

Table 6-1: Main plant species observed

WETLAND No.	FAMILY	SPECIES	CLASSIFICATION	INDIGENOUS / ALIEN	PROTECTED STATUS
Wetlands 1, 2, 3 & 4	ACANTHACEAE	Thunbergia capensis	Facultative	Indigenous	**Endemic**
	APIACEAE	Centella asiatica	Facultative	Indigenous	Not listed
	APONOGETONACEAE	Aponogeton junceus	Obligate	Indigenous	Not listed
	ASTERACEAE	Cotula coronopifolia	Obligate	Indigenous	Not listed
	ASTERACEAE	Cotula turbinata	Facultative	Indigenous	**Endemic**
	ASTERACEAE	Helichrysum anomolum	Facultative	Indigenous	Not listed
	ASTERACEAE	Plecostachys serpyllifolia	Facultative	Indigenous	**Endemic**
	ASTERACEAE	Pseudognaphalium luteo-album	Facultative	Indigenous	Not listed
	ASTERACEAE	Senecio pterophorus	Facultative	Indigenous	Not listed
	ASTERACEAE	Senecio speciosus	Facultative	Indigenous	Not listed
	ASTERACEAE	Stoebe plumosa	Terrestrial	Indigenous	Not listed
	ASTERACEAE	Syncarpha striata	Facultative	Indigenous	**Endemic**
	CAMPANULACEAE	Wahlenbergia rubens	Terrestrial	Indigenous	**Endemic**
	CYPERACEAE	Cyperus thunbergii	Obligate	Indigenous	**Endemic**
	CYPERACEAE	Eleocharis dregeana	Obligate	Indigenous	Not listed
	CYPERACEAE	Ficinia laciniata	Facultative	Indigenous	**Endemic**
	CYPERACEAE	Ficinia gracilis	Facultative	Indigenous	Not listed

WETLAND No.	FAMILY	SPECIES	CLASSIFICATION	INDIGENOUS / ALIEN	PROTECTED STATUS
	CYPERACEAE	Isolepis levynsiana	Obligate	Indigenous	**Endemic**
	CYPERACEAE	Isolepis marginata	Obligate	Indigenous	**Endemic**
	ERICACEAE	Erica glandulosa subsp. glandulosa	Facultative	Indigenous	**PNCO; Endemic**
	FABACEAE	Acacia mearnsii	Facultative	Alien	Not listed
	FABACEAE	Aspalathus angustifolia	Facultative	Indigenous	**Endemic**
	FABACEAE	Lotononis azurea	Facultative	Indigenous	**Endemic**
	FABACEAE	Psoralea pinnata	Facultative	Indigenous	**Endemic**
	IRIDACEAE	Babiana patersoniae	Terrestrial	Indigenous	**PNCO; Endemic**
	IRIDACEAE	Moraea algoensis	Facultative	Indigenous	**PNCO; Endemic**
	IRIDACEAE	Watsonia pillansii	Facultative	Indigenous	**PNCO; Endemic**
	JUNCACEAE	Juncus oxycarpus	Obligate	Indigenous	Not listed
	LEMNACEAE	Spirodela punctata	Obligate	Indigenous	Not listed
	LOBELIACEAE	Monopsis unidentata	Facultative	Indigenous	**Endemic**
	LOBELIACEAE	Grammatotheca bergiana	Facultative	Indigenous	**Endemic**
	MYRICACEAE	Morella serrata	Facultative	Indigenous	Not listed
	POACEAE	Miscanthus ecklonii	Obligate	Indigenous	**Endemic**
	POACEAE	Tristachya leucothrix	Facultative	Indigenous	Not listed
	POACEAE	Polypogon monspeliensis	Facultative	Alien	Not listed
	POACEAE	Cymbopogon marginatus	Facultative	Indigenous	Not listed
	POLYGALACEAE	Muraltia squarrosa	Facultative	Indigenous	**Endemic**
	POLYGALACEAE	Polygala sp	Facultative	Indigenous	Not listed
	RESTIONACEAE	Elegia fistulosa	Obligate	Indigenous	**Endemic**
	RESTIONACEAE	Restio sp	Facultative	Indigenous	Not listed
	RESTIONACEAE	Thamnochortus glaber	Facultative	Indigenous	**Endemic**
	ROSACEAE	Cliffortia ferruginea	Facultative	Indigenous	**Endemic**
	ROSACEAE	Rubus cuneifolius	Facultative	Alien	Not listed
	RUBIACEAE	Anthospermum aethiopicum	Facultative	Indigenous	Not listed
	SCROPHULARIACEAE	Limosella sp	Obligate	Indigenous	Not listed
	THYMELAEACEAE	Gnidia juniperifolia	Facultative	Indigenous	**Endemic**
Wetland 5	APIACEAE	Centella asiatica	Facultative	Indigenous	Not listed
	APIACEAE	Apiaceae sp	Obligate	Indigenous	Not listed
	APONOGETONACEAE	Aponogeton junceus	Obligate	Indigenous	Not listed
	ASTERACEAE	Pseudognaphalium luteo-album	Facultative	Indigenous	Not listed
	ASTERACEAE	Syncarpha striata	Facultative	Indigenous	**Endemic**

WETLAND No.	FAMILY	SPECIES	CLASSIFICATION	INDIGENOUS / ALIEN	PROTECTED STATUS
	ASTERACEAE	Athanasia dentata	Facultative	Indigenous	Not listed
	ASTERACEAE	Cotula turbinata	Facultative	Indigenous	Not listed
	ASTERACEAE	Helichrysum anomolum	Facultative	Indigenous	Not listed
	ASTERACEAE	Helichrysum cymosum subsp. calvum	Facultative	Indigenous	Not listed
	CYPERACEAE	Cyperus denudatus	Obligate	Indigenous	Not listed
	CYPERACEAE	Isolepis fluitans	Obligate	Indigenous	Not listed
	CYPERACEAE	Isolepis levynsiana	Obligate	Indigenous	**Endemic**
	CYPERACEAE	Isolepis marginata	Obligate	Indigenous	**Endemic**
	CYPERACEAE	Eleocharis dregeana	Obligate	Indigenous	Not listed
	CYPERACEAE	Eleocharis limosa	Obligate	Indigenous	Not listed
	CYPERACEAE	Cyperus mundtii	Obligate	Indigenous	Not listed
	CYPERACEAE	Ficinia gracilis	Facultative	Indigenous	Not listed
	CYPERACEAE	Schoenoplectus decipiens	Obligate	Indigenous	Not listed
	DROSERACEAE	Drosera cistiflora	Facultative	Indigenous	Not listed
	ERICACEAE	Erica glandulosa subsp. glandulosa	Facultative	Indigenous	**PNCO; Endemic**
	FABACEAE	Acacia mearnsii	Facultative	Alien	Not listed
	FABACEAE	Acacia saligna	Facultative	Alien	Not listed
	HYPOXIDACEAE	Paurida aquatica	Obligate	Indigenous	Not listed
	HYPOXIDACEAE	Hypoxis villosa	Facultative	Indigenous	Not listed
	IRIDACEAE	Tritonia gladiolaris	Facultative	Indigenous	**PNCO**
	LOBELIACEAE	Monopsis unidentata	Facultative	Indigenous	**Endemic**
	LOBELIACEAE	Grammatotheca bergiana	Facultative	Indigenous	**Endemic**
	POACEAE	Andropogon eucomus	Obligate	Indigenous	Not listed
	POACEAE	Sporobolus africanus	Facultative	Indigenous	Not listed
	POACEAE	Eragrostis capensis	Facultative	Indigenous	Not listed
	POACEAE	Cynodon dactylon	Facultative	Indigenous	Not listed
	POACEAE	Tristachya leaucothrix	Facultative	Indigenous	Not listed
	POLYGALACEAE	Muraltia squarrosa	Facultative	Indigenous	**Endemic**
	ROSACEAE	Cliffortia linearifolia	Facultative	Indigenous	Not listed
	THYMELAEACEAE	Passerina obtusifolia	Facultative	Indigenous	Not listed
Wetland 6	APIACEAE	Centella asiatica	Facultative	Indigenous	Not listed
	ASTERACEAE	Helichrysum anomolum	Facultative	Indigenous	Not listed
	ASTERACEAE	Helichrysum cymosum subsp. calvum	Facultative	Indigenous	Not listed
	ASTERACEAE	Syncarpha striata	Facultative	Indigenous	**Endemic**
	ASTERACEAE	Disparago ericoides	Terrestrial	Indigenous	Not listed
	FABACEAE	Acacia mearnsii	Facultative	Alien	Not listed

WETLAND No.	FAMILY	SPECIES	CLASSIFICATION	INDIGENOUS / ALIEN	PROTECTED STATUS
	IRIDACEAE	Ixia orientalis	Facultative	Indigenous	**PNCO; Endemic**
	POACEAE	Eragrostis curvula	Terrestrial	Indigenous	Not listed
	RESTIONACEAE	Restio capensis	Facultative	Indigenous	**Endemic**
	RESTIONACEAE	Restio tetragonus	Facultative	Indigenous	**Endemic**
	ROSACEAE	Cliffortia linearifolia	Facultative	Indigenous	Not listed

Table 6-2: Birds observed associated with the wetlands

Wetland	Scientific Name	Common Name
Wetlands 1,2,3 & 4	*Anas undulata*	Yellow-Billed Duck
	Ardea melanocephala	Black-Headed Heron
	Euplectes capensis	Yellow Bishop
Wetland 5	*Anas capensis*	Cape Teal
	Anas undulata	Yellow-Billed Duck
	Bostrychia hagedash	Hadeda Ibis

6.2 Wetland Classification

The latest classification system by SANBI, called a 'Classification System for Wetlands and other Aquatic Ecosystems in South Africa' was used in the study. The hydrogeomorphic (HGM) approach to the classification system is based on the premise that hydrology and geomorphology are the two fundamental features that determine the way in which an inland aquatic system functions regardless of climate, soils, vegetation and origin. Therefore, these characteristics are used to distinguish between wetland units (Ollis, *et al*., 2013). Table 6-3 includes the outcome of the six levels of the classification system for the identified aquatic systems.

Most of the wetlands identified exhibit characteristics indicative of a *Seep* (*HGM-type*). *Wetlands 1-5* have all been classified as *isolated seeps* since the characterises are typical to these systems, i.e. located on a gentle slope and dominated by colluvial (gravity-driven), unidirectional movement of water (Ollis, *et al*., 2013). It is considered likely that these systems are artificial naturalised systems that formed after the construction of the N2 National Road directly down-stream of these systems. However, to what degree this has contributed to its formation, cannot be established at this stage. Wetland 6 is considered to be a natural depression which is typically characterised by its closed (ir near-closed) contours (Ollis, *et al*., 2013).

The inflow and outflow drainage characteristics, the hydrological regime[3] of the wetlands and other descriptors are indicated in Table 6-3 below. Under Level 6 of SANBI's Classification System, wetlands are classified as either natural or artificial bodies.

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[3] The hydrological regime described the behaviour of the water within the system and, for wetlands, in the underlying soil (Ollis, *et al*., 2013)

Table 6-3: Wetland classification according to Ollis, *et al*., 2013

WETLAND ID	LEVEL 1 - SYSTEM	LEVEL 2 - REGIONAL SETTING	LEVEL 3 - LANDSCAPE SETTING	LEVEL 4 - HYDROGEOMORPHIC UNIT			LEVEL 5 - HYDROLOGICAL REGIME (& DEPTH OF INUNDATION)			LEVEL 6 - WETLAND CHARACTERISTICS (DESCRIPTORS)
				HGM Type	Longitudinal Zonation/ Landform/ Outflow drainage	Landform/ Inflow drainage	5A: Inundation periodicity	5B: Saturation periodicity	5C: Inundation Depth	Natural vs Artificial; Salinity; pH; Substratum; Vegetation; Geology
Wetland 1	Inland wetland	Ecoregion - South Eastern Coastal Belt	Slope (footslope)	Seep	Without channelled outflow	Not applicable	Seasonally inundated (High confidence)	Permanently saturated	Not applicable	Artificial (naturalised) – construction of N2 (medium confidence) Salinity –EC = 0.55 mS/m @ 31.5ºC pH – 8.6 @ 31.5ºC Substratum type – Sandy clay soil Vegetation - Herbaceous vegetation (Table 6-1) Geology – refer to section 4.2
Wetland 2	Inland wetland	Ecoregion - South Eastern Coastal Belt	Slope (footslope)	Seep	Without channelled outflow	Not applicable	Seasonally inundated (High confidence)	Seasonally saturated	Not applicable	Artificial (naturalised) – construction of N2 (medium confidence) Salinity – No water available pH – No water available Substratum type – Sandy clay soil Vegetation - Herbaceous vegetation (Table 6-1) Geology – refer to section 4.2
Wetland 3	Inland wetland	Ecoregion - South Eastern Coastal Belt	Slope (footslope)	Seep	Without channelled outflow	Not applicable	Intermittently inundated (Medium Confidence)	Intermittently saturated	Not applicable	Artificial (naturalised) – construction of N2 (medium confidence) Salinity – No water available pH – No water available Substratum type – Sandy clay soil Vegetation - Herbaceous vegetation (Table 6-1) Geology - refer to section 4.2
Wetland 4	Inland wetland	Ecoregion - South Eastern Coastal Belt	Slope (footslope)	Seep	Without channelled outflow	Not applicable	Intermittently inundated (Medium Confidence)	Intermittently saturated	Not applicable	Artificial (naturalised) – construction of N2 (medium confidence) Salinity – No water available pH – No water available Substratum type – Sandy clay soil Vegetation – Herbaceous and woody vegetation (Table 6-1) Geology – refer to section 4.2
Wetland 5	Inland wetland	Ecoregion - South Eastern Coastal Belt	Slope (footslope)	Seep & depression	Without channelled outflow Depression - Endorheic[4]	Not applicable	Seep: Seasonally inundated Depression: Permanently inundated (High confidence)	Seep: Seasonally saturated	Depression: Littoral (<2 m maximum depth at average annual low-water level)	Seep: Artificial (naturalised) – construction of N2 (medium confidence) Depression: Artificial – excavated dam Salinity –EC = 0.6 mS @ 21.6ºC pH – 8.82 @ 21.6ºC Substratum type – Sandy clay soil Vegetation - Herbaceous & woody vegetation (

[4] Inward-draining

WETLAND ID	**LEVEL 1 - SYSTEM**	**LEVEL 2 - REGIONAL SETTING**	**LEVEL 3 - LANDSCAPE SETTING**	**LEVEL 4 - HYDROGEOMORPHIC UNIT**			**LEVEL 5 - HYDROLOGICAL REGIME (& DEPTH OF INUNDATION)**			**LEVEL 6 - WETLAND CHARACTERISTICS (DESCRIPTORS)**
				HGM Type	**Longitudinal Zonation/ Landform/ Outflow drainage**	**Landform/ Inflow drainage**	**5A: Inundation periodicity**	**5B: Saturation periodicity**	**5C: Inundation Depth**	**Natural vs Artificial; Salinity; pH; Substratum; Vegetation; Geology**
										Table 6-1) Geology – refer to section 4.2
Wetland 6	Inland wetland	Ecoregion - South Eastern Coastal Belt	Slope (footslope)	Depression	Endorheic[5]	Not applicable	Seasonally inundated (High confidence)	Seasonally saturated	Not applicable	Natural wetland Salinity – No water available pH – No water available Substratum type – Sandy clay soil Vegetation - Herbaceous & woody vegetation (Table 6-1) Geology – refer to section 4.2

[5] Inward-draining

6.3 Condition and Present Ecological State of Aquatic Systems

6.3.1 General Condition and Existing Impacts

A general impression of the condition of each wetland unit and drainage line as well as the existing impacts or level of degradation/ transformation was noted during the site investigation. It is important to note that many of the wetlands assessed are artificial systems and was most likely formed as a result of human intervention at some stage. The description of the existing condition and impacts below therefore refer to impacts and modifications since the formation of the wetland (as best possible):

- Historical vegetation clearing in the catchment area (Wetlands 1 2,3 and 4);
- Alien vegetation species were observed in all wetlands. The intensity of the infestations is listed in Table 6-4 below;
- Old farm structure foundation (Wetland 5);
- Farming activities (crop cultivation) up-gradient within catchment (Wetlands 1,2,3 & 4);
- Gravel access road(s) in or in close proximity of the wetland (Wetlands 5 & 6);
- N2 National Road adjacent to wetland (Wetland 4);
- R330 Regional Road adjacent to wetlands (Wetlands 1 and 2);
- Impacts due to stock grazing (Wetlands 1, 2, 3, 4, 5, & 6);
- Electrical powerlines (pylons) and associated servitudes within or in close proximity to wetlands (Wetlands 1 and 5);
- Dumped electrical pylon materials such as steel stays, concrete slabs, etc. (Wetland 5);
- Fencing through or adjacent to wetland, including clearing activities associated with fence maintenance (Wetland 4);
- Firewood harvesting (*Acacia mearnsii* / Black Wattle)(Wetland 5);
- Frequent fires (Wetlands 1, 2, 3 & 4);
- Vehicle tracks (Wetlands 1 & 5); and
- Footpaths (Wetlands 5 & 6).

Table 6-4: Level of Invasive Alien Infestations

Wetland	Dominant Invasive Species	Level of Infestation
1	*Polypogon monspeliensis*	Minor. On the edges on inundated pools
2	*Rubus cuneifolius*	Minor. Scattered on western edge
3	None	N/A
4	*Acacia mearnsii*	Minor infestation within the wetland. Severe infestation in the area adjacent to the wetland.
5	*Acacia mearnsii & Acacia saligna*	Abundant throughout wetland and adjacent areas
6	*Acacia mearnsii*	Southern portion infested and severe infestation in adjacent areas.

Indirect impacts involve changes in the wetland catchment such as land use practices, etc. Current activities in the wetlands' catchments mainly involve wind farms and associated electrical supply infrastructure (pylons, servitudes, access roads, fencing, etc); crop agriculture, stock grazing, farm dams, single residences (and associated services infrastructure), adjacent roads and changes in surrounding land uses (e.g. pasture lands).

6.3.2 Present Ecological State (WET-Health)

Present Ecological State (PES) assessments are generally not conducted for artificial wetlands since there is no reference state to which the current state can be compared. However, ecological importance and ecological sensitivity are determined for all wetland habitats (artificial or natural), since, over time an artificially created wetland could potentially become an integral part of a new hydrological scheme while providing some valuable ecosystem services.

The health or integrity of the natural wetlands (Wetlands 3 & 4) was assessed using the Wet-Health tool as described by Macfarlane, *et al*. (2009). The results for the hydrology, geomorphology and vegetation assessments done are given in Table 6-5. Notice that the table gives an impact score for each of the modules as well as an overall impact score[6]. The overall health score is calculated by subtracting this number (overall impact score) from 10 (not shown below). Table 6-6 is used to obtain the equivalent ecological category and description. The assessment for each natural wetland was conducted individually to get an understanding of the relevant impacts affecting these systems.

From the tables below, the ecological category derived from the overall impacts scores (including the change score if relevant) for *Wetlands 1-4 is Category A*. The condition of a wetland in Category A is described as *unmodified or natural* as seen in Table 6-6. As seen from section 6.3.1 above that explains the existing impacts on the wetlands assessed, almost no existing impacts could be identified to these wetlands, outside some minor indications of grazing. Other impacts mostly occur in the catchment areas of these wetlands and are not on a scale that it will impact these wetlands in a significant way.

The PES for both Wetlands 5 & 6 was rated as *Category D*. The condition of a wetland in Category A is described as largely modified, meaning that a large loss of natural habitat, biota and basic ecosystem functions has occurred (see Table 6-6). These low scores are mostly attributed to the very high alien investigation, specifically in Wetland 5 and the south-eastern section of Wetland 6. In addition, the hydrology of Wetland 6 has been affected by the construction of an access road upstream from the wetland.

Water quality of the wetlands is not assessed as part of the WET-Health assessment due to the variation over time within a given wetland. However, Macfarlane, *et al*. (2009) notes that a coarse assessment can be included that entails the consideration of the extent of the wetland affected and the intensity of the impact. Water quality measurements were taken on site (see Table 6-3 for results), however, water quality impact observations in the systems are not deemed to be sufficient to change the PES scores of the wetland.

Table 6-5: Summary of the current overall health of the identified natural wetland(s)

ID	Module	Impact Score	Category	Change Score	Change Symbol	Health Class
Wetlands 1-4	**Hydrology**	1	B	0	→	B →
	Geomorphology	0	B	0	→	B →
	Vegetation	0.9	A	0	→	A →
	Overall Health	**0.69**	**A**	**0**	→	**A →**

[6] Overall impact score is calculated as follows: [(Hydrology score*3)+(Geomorphology Score*2)+(Vegetation Score*2)]/7

ID	Module	Impact Score	Category	Change Score	Change Symbol	Health Class
Wetland 5	**Hydrology**	6.467	E	-1	↓	E ↓
	Geomorphology	0.002	A	0	→	A →
	Vegetation	6.100	E	-0.711	↓	E ↓
	Overall Health	**4.52**	**D**	**-0.63**	↓	**D** ↓
Wetlands 6	**Hydrology**	6.5	E	-1	↓	E ↓
	Geomorphology	0	A	0	→	A →
	Vegetation	6.8	E	-1.333	↓↓	E ↓↓
	Overall Health	**0**	**D**	**-0.81**	↓	**D** ↓

Table 6-6: Ecological categories and descriptions according to the PES impact score (modified from Macfarlane, et al., 2009 & Kleynhans, et al. 1998)

Description	Pes Impact Score	Ecological Category
Unmodified, natural.	0-0.9	A
Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	1-1.9	B
Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	2-3.9	C
Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	4-5.9	D
Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	6-7.9	E
Critically / Extremely modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.	8-10	F

Table 6-7: Trajectory class, change scores and symbols used to represent trajectory of change to wetland condition (Macfarlane, et al., 2009)

Trajectory Class	Description	Change Score	Class Range	Symbol
Improve markedly	Condition is likely to improve substantially over the next 5 years	2	1.1 to 2.0	↑↑
Improve slightly	Condition is likely to improve slightly over the next 5 years	1	0.3 to 1.0	↑
Remain stable	Condition is likely to remain stable over the next 5 years	0	-0.2 to +0.2	→

Trajectory Class	Description	Change Score	Class Range	Symbol
Deteriorate slightly	Condition is likely to deteriorate slightly over the next 5 years	-1	-0.3 to -1.0	↓
Deteriorate greatly	Condition is likely to deteriorate greatly over the next 5 years	-2	-1.1 to -2.0	↓↓

6.4 Wetland Functions and Services

Kotze, *et al* (2008) describes a number of different functions and services that could potentially be provided by wetlands. These include: flood attenuation; streamflow regulation; sediment trapping; phosphate trapping; nitrate removal; toxicant removal; erosion control; carbon storage; maintenance of biodiversity; water supply for human use; natural resources; cultivated foods; cultural significance; tourism and recreation; and education and research. A summary of the hydrological benefits typically derived from the different wetland hydro-geomorphic units as provided in Kotze *et al*., 2008 are indicated in Table 6-8. Even if wetland systems have been modified through human intervention, the systems can still fulfil a variety of ecosystem services and functions.

Wetlands 1 to 5 exhibit characteristics indicative of a *Seep* (*HGM-type*) without channelled outflow. The main ecosystem services provided by these seep wetlands include erosion control and nitrate removal. Due to their location down-gradient from agricultural practices (specifically Wetlands 1,2,3 & 4), it is likely that they are important for nitrate and even phosphate removal as well.

Wetland 6 was classified as a *depression* (*HGM-type*) and Wetland 5 contains an artificial *depression* towards its southern toe. The classification of this W5 includes services attributed to both of these HGM-types. As a result the main ecosystem functions related to W5 & W6 includes nitrate removal, flood attenuation and toxicant removal.

Table 6-8: Preliminary rating of the hydrological benefits likely to be provided by a wetland based on its hydro-geomorphic type (Kotze *et al*., 2008)

Wetland Hydro-Geomorphic Type	Hydrological Benefits Potentially Provided by Wetland Types							
	Flood attenuation		Stream flow regulation	Enhancement of Water Quality				
	Early wet season	Late wet season		Erosion control	Sediment trapping	Phos-phates	Nitrates	Toxi-cants[7]
Floodplain	++	+	0	++	++	++	+	+
Valley-bottom - channelled	+	0	0	++	+	+	+	+
Valley-bottom - un-channelled	+	+	+?	++	++	+	+	++
Hillslope seepage connected to a stream channel	+	0	+	++	0	0	++	++
Isolated hillslope seepage	+	0	0	++	0	0	++	+
Pan/ Depression	+	+	0	0	0	0	+	+

[7] Toxicants are taken to include heavy metals and biocides (Kotze, *et al*., 2008)

Wetland Hydro-Geomorphic Type	Hydrological Benefits Potentially Provided by Wetland Types							
	Flood attenuation		Stream flow regulation	Enhancement of Water Quality				
	Early wet season	Late wet season		Erosion control	Sediment trapping	Phos-phates	Nitrates	Toxi-cants[7]
Rating: 0 Benefit unlikely to be provided to any significant extent + Benefit likely to be present at least to some degree ++ Benefit very likely to be present (and often supplied to a high level)								

6.5 Ecological Importance and Sensitivity (EIS) and Sensitivity Mapping/ Buffers

6.5.1 Wetland EIS

The Ecological Importance and Sensitivity (EIS) of each of the identified wetlands have been rated using a method as adapted from DWAF (1999) and described in section 2.2. The method takes into consideration PES scores and ecosystem service provision as well as a range of other determinants to determine an EIS Category for the system. Table 6-9 summarises the assessment outcome for each identified wetland in this study and also gives the final Recommended Ecological Class for each wetland according to the key in Table 6-10. The EIS of Wetland 1, 2, 3, 4 & 5 was assessed to be *Moderate*, , which implies that this system has moderate ecological importance and sensitivity, due mostly to the diversity of vegetation, the occurrence of unique species and conversely the presence of invasive alien species. Wetland 6 has a Low/Marginal EIS and is not ecologically important and sensitive at any scale. This rating is largely the result of lack in species richness and diversity due to changes in the hydrology. The score is also influenced by the low PES score that is also affected by the hydrology and alien infestation.

Table 6-9: Summary of findings and overall sensitivity

Wetland ID	EIS Score (Median)	Overall EIS Category	Recommended Ecological Category
Wetland 1 -4	2	Moderate	C
Wetland 5	2	Moderate	C
Wetland 6	1	Low/Marginal	D

Table 6-10: Ecological importance and sensitivity categories. Interpretation of median scores for biotic and habitat determinants (DWAF, 1999)

EIS Category	Range of Median	Recommended Ecological Management Class
Very high - Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications.	>3 and <=4	A
High - Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may	>2 and <=3	B

EIS Category	Range of Median	Recommended Ecological Management Class
be sensitive to flow and habitat modifications.		
Moderate - Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications.	>1 and <=2	C
Low/ marginal - Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications.	>0 and <=1	D

6.5.2 Sensitivity mapping (buffers)

Based on the information above and recommendations for buffer zones summarised in Table 2-1 above, it is recommended that a buffer of 50 m be maintained around all delineated wetlands (refer to Figure 6-8). Even though these wetlands will not be directly affected by the proposed BESS, the wetland buffers are recommended to prevent construction related activities (e.g. establishment of the construction camp site, stockpiling, driving of heavy vehicles, etc.) from causing unnecessary impacts in these areas.

The recommended buffers are mainly based on the detailed guidelines by the GDACE Requirements for Biodiversity Assessments: Version 2 (2008), City of Cape Town (CoCT) Prioritisation of City Wetlands Report (2009) and the ECBCP. The main function of these buffers would be to maintain basic hydrological processes, reduce impacts from the proposed development (mainly construction related activities) and to provide habitat for various aspects of biodiversity.

During the construction phase, the proposed work area should be clearly demarcated before the commencement of construction and all areas outside the demarcated area, specifically the recommended buffers, should be treated as no-go areas to prevent unnecessary impacts to watercourses. In addition to maintaining these buffers, the important recommendations for the mitigation of potential impacts, which are made in section 7.1 below, should be complied with. Ideally, during the operational phase, the buffer areas should be kept natural as far as possible and invasive alien species in the buffers should be eradicated on an ongoing basis, if possible.

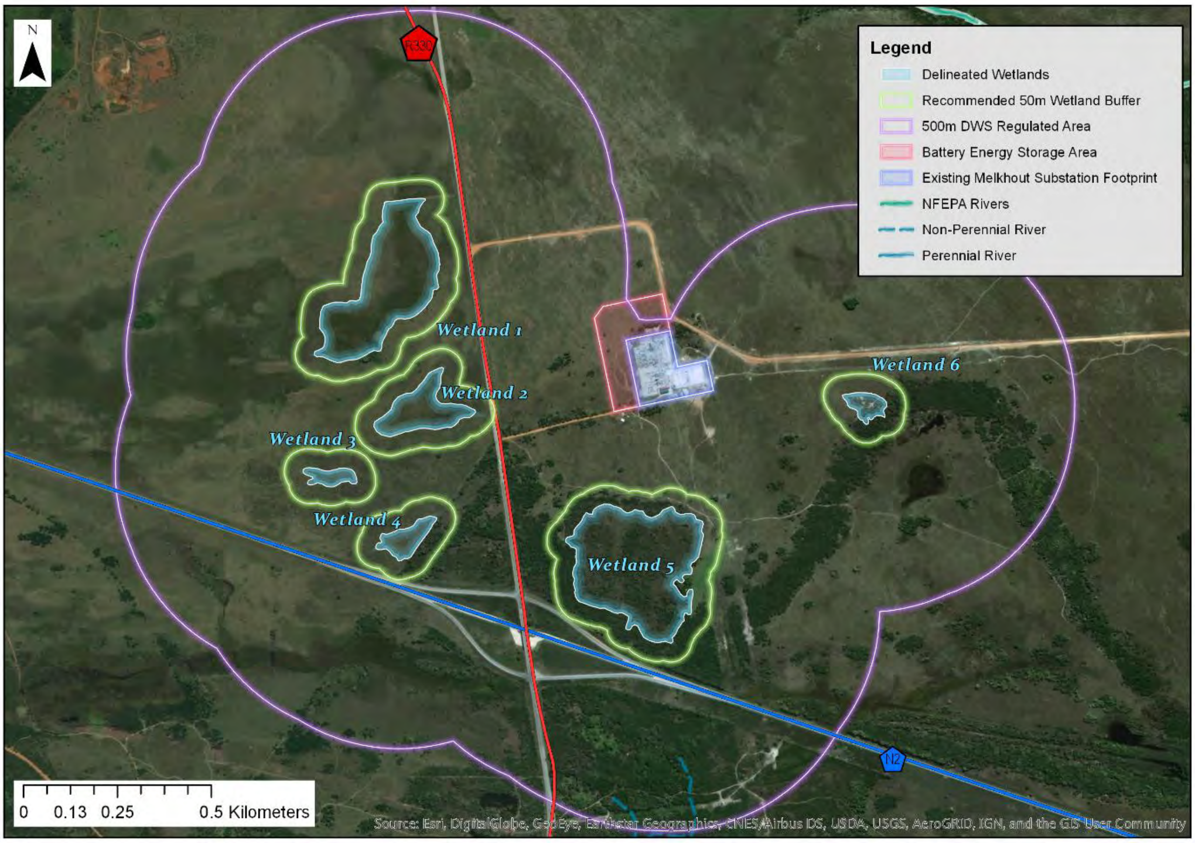

Figure 6-8: Recommended sensitivity buffers

7 Impact Assessment

7.1 Assessment of Potential Impacts

The potential impacts of the proposed activities (associated with the construction of the BESS) on the study wetlands have been identified considering the characteristics of the proposed activities, that of the surrounding environment (mainly the relevant catchment areas) and the results of the assessments discussed above. The impacts are described under three main headings:

- Impact 1: Wetland degradation due to decreased water quality during construction;
- Impact 2: Increased sedimentation of wetlands and watercourses during construction;
- Impact 3: Impact to hydrology of the aquatic system during operation;
- Impact 4: Wetland degradation due to decreased water quality during operation; and
- Impact 5: Wetland degradation due to fire.

7.1.1 Impact 1: Wetland degradation due to decreased water quality during construction

Construction activities could cause contamination of wetlands, watercourses and groundwater if proper management is not practiced. Accidental spills of hydrocarbons (oils, diesel, etc.) or leakage of such substances from construction machinery may enter wetlands directly, through surface runoff during rainfall events or subsurface movement (through groundwater) and then migrate to downstream systems. Such chemicals, fuels or pollutants would alter the water quality within the watercourse, having an effect on aquatic ecology in the form of biodiversity loss, i.e. the loss of vegetation and wetland fauna that are sensitive to changes in water quality (especially from toxicant inputs). Solid waste in the form of general litter left by labourers such as construction materials (gloves, excess materials, cement, etc.) can also affect the wetlands in close proximity and downstream. This can establish a barrier to water movement and may also alter the quality of water within the resource negatively.

Wetlands 5 & 6 could be affected by contaminated runoff from the construction activities as they occur down-gradient from the proposed site. Wetlands 1, 2, 3 & 4 should not be directly affected by contaminated runoff due to the location of the wetlands to the west of the R330. The hydrology of the surrounding area (shallow subsurface flow) could contribute to the transportation of contaminants to down-gradient wetlands relatively undetected. Due to its location directly south (down-gradient) of the site, Wetland 5 is at the highest risk of contamination if the pollutants are not contained on site. As mentioned above, contaminants in the wetland could result in a loss of vegetation and other biota inhabiting the wetland due to changes in the water and soil chemistry. It could also result in the loss of the several endemic species which inhabit the wetland.

Table 7-1: Impact rating for wetland and watercourse degradation due to decreased water quality during construction

Extent	Above-mentioned activities could have a *regional* impact should downstream water resources be contaminated. However, if mitigation is implemented, the impact should be *local*.
Intensity	The impact to wetlands in relation to their sensitivity and value, is considered to be *medium (negative)* without mitigation and *low* (*negative*) with mitigation being implemented.
Duration	The impact will be *temporary* during the course of construction.
Probability	Possible
Status (+ or -)	Negative
Reversibility	Medium

No-go	No impact

Recommended mitigation measures:

The following measures are recommended for the *construction phase*:

- The construction site camp and laydown areas for stockpiles etc. should be located on higher ground and not within the sensitivity buffers recommended for wetlands;
- The proper storage and handling of hazardous substances (hydrocarbons and chemicals) needs to be administered on site and at the construction camp site. If hazardous liquids are stored/ used on site, spill kits must be available;
- Hazardous materials must be stored on an impermeable, bunded surface within a weather-proof structure;
- Storage and maintenance of machinery and construction-related equipment should be done in the construction site camp and preferably on an impermeable surface;
- No wash water from washing of mechanical plant or equipment may be discharged into the surrounding environment. All wastewater must be collected in a container and allowed to evaporate. The resultant material must be disposed of as hazardous waste;
- Appropriate solid waste disposal facilities must be provided on-site during construction and adequate signage be provided;
- Spillages should be cleaned up immediately and contaminants properly contained and disposed of using appropriate waste facilities (not to be disposed of within the natural environment). Any contaminated soil from the construction site must be removed and disposed of appropriately;
- Cement batching activities should occur in the construction camp, as far as possible, and conducted on an impermeable surface. Cement products/ wash may not be disposed of into the natural environment;
- Drip-trays must be provided beneath standing vehicles and machinery, and routine checks should be done to ensure that these are in a good condition;
- Portable toilets must be provided where construction is occurring. Workers need to be encouraged to use these facilities and not the natural environment. Disposal slips should be kept for auditing purposes; and
- All construction plant equipment, general waste, surplus rock, and other foreign materials must be completely removed from site once construction has been completed.

7.1.2 Impact 2: Increased sedimentation of wetlands and watercourses during construction

Vegetation in the wetland catchment area not only stabilises soils, but also reduces surface water runoff velocities when rainfall occurs. Attenuation of surface water encourages permeation of the soils and reduces surface water runoff. During the construction phase when vegetation is cleared, large quantities of loose earth may easily be washed from the construction zone or be transported down slope during high rainfall events, resulting in increased sedimentation of aquatic systems occurring downstream. This would impact on aquatic biota, but could also influence the geomorphology of aquatic systems and overall functioning in severe circumstances.

Construction of the BESS is most likely to affect the wetlands in close proximity to the site, such as Wetlands 5 & 6. Wetlands 1, 2, 3 & 4 should not be directly affected by sedimentation in runoff as the stormwater from the site will be cut off and redirected by the R330 to the west. No BESS infrastructure will be constructed within any of the wetlands or wetland buffers identified, which reduces the risk of sedimentation and subsequent impacts on biota and geomorphology of these systems. In addition, due to the level of vegetation cover, the relatively flat topography of the area as well as the distance between the proposed site and the down-gradient wetlands it is likely that most of the sediment laden run-off will be attenuated within the terrestrial areas separating the site from the down-gradient wetlands, i.e. W5 & W6.

Table 7-2: Impact rating for increased sedimentation of wetlands and watercourses during construction

Extent	It is unlikely that the above-mentioned activities would have a *regional* impact and therefore it is anticipated that with or without mitigation, the impact should be *local*.
Intensity	The impact to wetlands is considered to be *low (negative)* with or without mitigation.
Duration	The main impact will be *temporary* during the clearing of vegetation and excavation activities, but the impact could also extend beyond the construction period (into the *medium to long term*) if proper rehabilitation and maintenance of access roads is not done.
Probability	Possible.
Status (+ or -)	Negative.
Reversibility	Low (irreversible)
No-go	Adjacent access roads and agricultural activities is likely causing additional sediment loads (however minor) within the wetlands. This is expected to continue with or without the proposed construction activities.

Recommended mitigation measures:

The following measures are recommended for the *construction phase*:

- Clearing of vegetation should be kept to a minimum as per the agreed design parameters;
- Excavated or spoil material (including any foreign materials) as well as topsoil stockpiles should not be placed within the recommended buffers (preferably further away) of the wetlands or drainage line in order to reduce the possibility of material being washed downstream;
- Disturbed areas should be rehabilitated immediately after construction in the relevant area (with indigenous vegetation or using topsoil);
- Rehabilitated areas should be monitored well and measures must be implemented to ensure that topsoil does not wash away, e.g. using swales; and
- Any erosion gullies/ channels created during construction should be filled immediately to ensure silt does not drain into aquatic systems and the area revegetated.

The following measure is recommended for the *operational phase*:

- Any erosion gullies/ channels should be filled and stabilised as soon as possible. Also, disturbed and bare ground surfaces should be rehabilitated with suitable indigenous vegetation to stabilise soils.

7.1.3 Impact 3: Impact to hydrology of the aquatic system during operation

The construction of the Battery Energy Storage System (BESS) (specifically the foundation work) could alter the surrounding hydrology, most importantly the subsurface flow regime. Considering the increase in wet areas up-gradient from the N2 national road located to the south of the proposed site, it is evident that compaction of soils in this area is likely to cause impoundment of water up-gradient. If surface or subsurface water flow is impounded due to the construction of the BESS, it could inhibit water from flowing to the down-gradient wetlands, at least partly. Decreased water input could result in negative effects (potential destruction) on aquatic biota dependent on current water supply regime. Additionally, the impounded water could create an artificial wetland up-gradient from the point of impoundment.

Wetlands 5 is mostly at risk of impacts related to changes to the surrounding hydrology as it occurs dirently down-gradient of the proposed site. Wetlands 1,2,3 & 4 are located on the opposite side of the R330 and should not be affected by hydrological changes resulting from the proposed development. Due to the limited footprint of the BESS, tt is unlikely that the construction thereof will completely block the surrounding surface and subsurface water flows, and therefore impoundment/ or deprivation of water down-gradient should be limited. No mitigation measures are recommended.

Table 7-3: Impact rating for the potential impact to hydrology of the aquatic system during operation

Extent	It is anticipated that all of the above-mentioned impacts affect the regional area regardless of mitigation or not.
Intensity	The intensity of the impact is considered low (negative) with or without mitigation measures implemented.
Duration	Permanent/ long-term
Probability	Possible
Status (+ or -)	Negative
Reversibility	Low (irreversible)
No-go	The location of the existing substation is likely already forming a barrier and this will remain in the no-go scenario.

Recommended mitigation measures:

There are no mitigation measures recommended for this impact.

7.1.4 Impact 4: Wetland degradation due to contamination during operation

Battery storage technology makes use of chemical storage technology. This involves the storage of large amounts of hazardous chemicals (within the battery cells as well as chemical storage areas). If the cells are damaged or deteriorate over time, this may lead to potential hazardous chemical leaking out of the cells and entering the surrounding environment. Additionally, if chemicals are incorrectly stored potential exists for chemical leaks which could enter the surrounding environment. Depending on the chemical technology used, the chemicals have the potential to change soil and subsurface water chemistry, which in turn can have negative impacts on the surrounding vegetation and biota. Changes in pH and corrosive abilities of the chemicals can have negative effects on aquatic biota.

Wetlands 5 & 6 could be affected by contaminated runoff from the construction activities as they occur down-gradient from the proposed site. Wetlands 1, 2, 3 & 4 should not be directly affected by contaminated runoff due to the location of the wetlands to the west of the R330. The hydrology of the surrounding area (shallow subsurface flow) could contribute to the transportation of contaminants to down-gradient wetlands relatively undetected. Due to its location directly south (down-gradient) of the site, Wetland 5 is at the highest risk of contamination if the pollutants are not contained on site. As mentioned above, contaminants in the wetland could result in a loss of vegetation and other biota inhabiting the wetland due to changes in the water and soil chemistry. This would alter the natural biological composition, reducing the wetland ecosystem's ability to react to disturbances (such as drought, fire, etc.). In the medium to long term, this could lead to continual degradation of the wetland, ultimately reducing the effectiveness of the ecosystem services provided by the wetland. It could also result in the loss of the several endemic species which inhabit the wetland.

Table 7-4: Impact rating for the potential impacts due to water degradation during operation

Extent	Due to the surrounding hydrology (and difficulty in detecting the spread of contaminants) if leaks or spills go undetected, the extent could be *Regional.* However, if leaks are detected immediately and the appropriate containment and clean-up activities are timeously applied the extent should remain *Local*.
Intensity	The intensity of the impact is considered *High* (negative) without mitigation measures implemented, however if mitigation measures are effectively implemented the intensity is considered to be *Low* (negative).
Duration	Medium-term
Probability	Possible
Status (+ or -)	Negative

Reversibility	Medium (reversible)
No-go	No impact

Recommended mitigation measures:

The following measure is recommended for the *operation phase*:

- The battery cells and chemical storage area should be contained within a bunded area with a capacity capable of containing at least 110% of the stored chemicals;
- Adequate spill kits must be kept on site and be accessible at all times;
- In the event of a spillage or leaks, the spilled liquid must be collected in a suitable container and disposed of at a licensed hazardous waste site. The general area should be treated with an absorbing agent if necessary;
- Regular visual inspections of all battery storage cells and the chemical storage area must conducted to check for wear and/or damage; and
- The correct chemical MSDS must be available on sit at all times.

7.1.5 Impact 5: Wetland degradation due to fire

Batteries are chemical storage devices subject to thermal runaway (cascading ignition) under abnormal conditions. Storing large amounts of energy, including the presence of flammable chemicals used in battery storage technology presents a risk of fire if the correct monitoring, maintenance and operation is not applied. Additionally, if fire controls are not adequately implemented during the construction phase, indiscriminate fires may spread to the surrounding area. If fire were to spread through the wetland (particularly during a dry period) the wetland vegetation and dependent biota could be significantly disturbed. Cleared vegetation as a result of fire could lead to an infestation of Invasive Alien Species (IAPs). The ability of the wetland to provide effective ecosystem services will also be affected.

The surrounding vegetation is a mixture of fynbos and Renosterveld vegetation species, both of which are prone to veld fires. If a fire were to spread to the surrounding area it could potentially reach all the identified wetlands. Wetland 5 and 6 are most at risk due to their location as well as the level of invasive alien species within or surrounding the wetlands.

If the appropriate monitoring and maintenance are carried out on a regular basis, and an effective fire response procedure is in place, it is unlikely that a fire will occur. According to the United States Department of Energy (2012), if redox-flow batteries are used, the risk is lower.

Table 7-5: Impact rating for the potential impacts related to wetland degradation due to fire during operation

Extent	Due to the surrounding vegetation (and associated fire risk) if fire were to spread to the surrounding vegetation (especially during windy conditions), the extent could be *Regional.* However, if fires are detected immediately and the appropriate fire-fighting procedures are timeously executed the extent should remain *Local*.
Intensity	The intensity of the impact is considered *Medium* (negative) without mitigation measures implemented, however if mitigation measures are effectively implemented the intensity is considered to be *Low* (negative).
Duration	Short to Medium term
Probability	Possible
Status (+ or -)	Negative
Reversibility	Medium (reversible)
No-go	All current fire risks associated with the existing substation will remain in the no-go scenario.

Recommended mitigation measures:

The following measure is recommended for the *operational phase*:

- A fire officer shall be appointed and shall be responsible for co-ordinating rapid, appropriate responses in the event of a fire;
- No burning of vegetation, whether to clear the vegetation and specifically IAPs, or of cleared vegetation, shall be permitted;
- No open fires should be allowed on site;
- A designated smoking area, outside of any areas where the risk of fire is prevalent, must be designated. Smoking shall not be permitted outside of designated smoking area;
- All invasive alien species currently surrounding the substation should be removed and disposed of as waste at a registered landfill site;
- An appropriate fire management system, as per the MSDS and the onsite Emergency Response Plan, should be implemented;
- Appropriate fire-fighting equipment must be available on site at all times and serviced at regular intervals; and
- It is recommended that an eight meter fire break be maintained around the perimeter of the battery storage facility for the duration of the operational phase. The fire break should be maintained on a regular basis.

8 Key Findings and Recommendations

The Applicant, Eskom Holdings SOC Ltd., proposes to build a Battery Energy Storage System (BESS) system at the Melkhout substation, located near Humansdorp in the Eastern Cape, to optimise excess Independent Power Producer (IPP) in-feeds into the distribution network.

In this study, the site is located within the DWS Regulated Area of several surrounding wetlands. Six wetlands have been delineated and assessed that could potentially be affected by the development. Wetlands 1-4 are similar in nature (in terms of geomorphology, vegetation, ecosystem services, etc) and thus have been rated and assessed together. Wetland 5 and 6 are slightly different in nature and have been assessed separately. A summary of the information and assessments conducted for all aquatic systems appear in Table 8-1.

Table 8-1: Summary of aquatic systems identified and their classification, PES, EIS & REC

Watercourse ID	Area (ha)	Natural/ Artificial	HGM Type	PES	EIS	REC
Wetland 1	7.27	Natural (modified)	Seep	Class A	Moderate	C
Wetland 2	2.18	Natural (modified)	Seep	Class A	Moderate	C
Wetland 3	0.51	Natural (modified)	Seep	Class A	Moderate	C
Wetland 4	0.89	Natural (modified)	Seep	Class A	Moderate	C
Wetland 5	9.05	Natural (modified)	Seep and Depression	Class D	Moderate	C
Wetland 6	0.60	Natural (modified)	Seep	Class D	Low/ Marginal	D

Based on the information above and recommendations for buffer zones summarised in Table 2-1 above, it is recommended that a buffer of 50 m be maintained around all delineated wetlands (refer to Figure 6-8). Even though these wetlands will not be directly affected by the proposed BESS, the wetland buffers are recommended to prevent construction related activities (e.g. establishment of the construction camp site, stockpiling, driving of heavy vehicles, etc.) from causing unnecessary impacts in these areas.

Five potential impacts were identified and assessed with regards to the construction and operational phases of the proposed activities related to the proposed BESS. Potential impacts are as follows:

- Impact 1: Wetland degradation due to decreased water quality during construction;
- Impact 2: Increased sedimentation of wetlands and watercourses during construction;
- Impact 3: Impact to hydrology of the aquatic system during operation;
- Impact 4: Wetland degradation due to decreased water quality during operation; and
- Impact 5: Wetland degradation due to fire.

Mitigation measures are proposed to lower the significance of these impacts. Provided these mitigation measures are fully adhered to and implemented as part of the Environmental Management Programme (EMPr) during the construction and operational phases the proposed BESS is expected to have a low to insignificant long term impact on wetlands in the area.

Consultation with the Department of Water and Sanitation is recommended to determine the requirements for Water Use Authorisation.

Prepared by

Luc Strydom

Environmental Scientist

Karissa Nel MEM, CEAPSA

Senior Environmental Scientist

Reviewed by

Rob Gardiner Pr Sci Nat

Principal Environmental Scientist, Partner

All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

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Appendix A: Photographs

Photo 1: Wetland 1 – View of Wetland 1 (from the northern boundary looking south).

Photo 2: Wetland 1 – View of Wetland 1 from the center of the wetland looking south.

Photo 3: At Wetland 1 – Soil sample (0 – 10 cm).

Photo 4: Wetland 1 – *Cliffortia ferruginea*

Photo 5: Wetland 1 – *Cotula coronopifolia.*

Photo 6: Wetland 1 – *Cyperus thunbergii*.

Photo 7: Wetland 1 – *Isolepis levynsiana.*

Photo 8: Wetland 1 – *Polypogon monspeliensis*.

	
Photo 9: Wetland 1 – One of several permanently inundated pools of water scattered around the western boundary of the wetland.	Photo 10: Wetland 1 – View of western boundary of the wetland.
	
Photo 11: Wetland 2 – View of southern portion of Wetland 2 looking from the south-eastern corner.	Photo 12: Wetland 2 – View of Wetland 2 from the western boundary looking east.
	
Photo 13: Wetland 2 –.*Elegia fistulosa*	Photo 14: Wetland 2 – *Watsonia pillansii.*
	
Photo 15: Wetland 2 –.*Morella serrata*	Photo 16: Wetland 2 – *Plecostachys serpyllifolia.*

	
Photo 17: Wetland 3 – View of Wetland 3 from the northern boundary looking south.	Photo 18: Wetland 3 – Soil sample taken at 0 – 10 cm. Note the mottles and soil colour.
	
Photo 19: Wetland 3 – *Thamnochortus glaber*.	Photo 20: Wetland 3 – *Erica glandulosa.*
	
Photo 21: Wetland 4 – View of of Wetland 4.	Photo 22: Wetland 4 – Artesian well up-gradient from Wetland 4-.
	
Photo 23: Wetland 4 – *Moraea algoensis*	Photo 24: Wetland 4 – *Babiana patersoniae.*

	
Photo 25: Wetland 5 – View of northern portion of Wetland 5.	Photo 26: Wetland 5 – View of inundated pool near south-eastern toe of Wetland 5
	
Photo 27: Wetland 5 – View of excavated tank at the south-eastern toe of the wetland.	Photo 28: Wetland 5 – View of wetland infested with *Acacia mearnsii* and *Acacia saligna*.
	
Photo 29: Wetland 5 – View of wetland within the open spaces (not infested with invasive species).	Photo 30: Wetland 5 – Presence of coliforms in the water.

Photo 31: Wetland 5 – View of western portion of the wetland

Photo 32: Wetland 5 – View of vehicle tracks through southern portion of the wetland.

Photo 33: Wetland 5 – *Drosera cistiflora*

Photo 34: Wetland 5 – *Pauridia aquatica*.

Photo 35: Wetland 5 – *Cyperus denudatus*

Photo 36: Wetland 5 – *Isolepis levynsiana*.

Photo 37: Wetland 5 – *Cyperus mundtii*

Photo 38: Wetland 5 – *Isolepis fluitans*.

Photo 39: Wetland 5 – *Schoenoplectus decipiens*

Photo 40: Wetland 5 – *Eleocharis limosa*

Photo 41: Wetland 6 – View of northern edge of wetland (note the terrestrial vegetation dominating this section)

Photo 42: Wetland 6 – View of northern portion of wetland.

Photo 43: Wetland 6 – View of southern portion of wetland

Photo 44: Wetland 6 – View of southern portion adjacent to the drainage line and *Acacia mearnsii* infestation.

Photo 45: Wetland 6 – Soil sample (0 – 10 cm). Note the mottles.

Photo 46: Wetland 6 – Soil sample (30 – 40 cm). Note the mottles.

Photo 47: Wetland 6 – *Ixia orientalis*.

Photo 48: Wetland 6 –*Helichrysum appendiculatum*.

Appendix B: Impact assessment methodology descriptions

Impact Rating Methodology

Impact Rating Procedure

The assessment of impacts will be based on the professional judgement of specialists at SRK Consulting, fieldwork, and desk-top analysis. The criteria that are used to determine impact consequences are presented below.

Table 9-1: Criteria used to determine the Consequence of the Impact

Rating	Definition of Rating
A. Extent – the area over which the impact will be experienced	
None	
Local	Confined to project or study area or part thereof (e.g. site)
Regional	The region, which may be defined in various ways, e.g. cadastral, catchment, topographic
(Inter) national	Nationally or beyond
B. Intensity – the magnitude of the impact in relation to the sensitivity of the receiving environment	
None	
Low	Site-specific and wider natural and/or social functions and processes are negligibly altered
Medium	Site-specific and wider natural and/or social functions and processes continue albeit in a modified way
High	Site-specific and wider natural and/or social functions or processes are severely altered
C. Duration – the time frame for which the impact will be experienced	
None	
Short-term	Up to 2 years
Medium-term	2 to 15 years
Long-term	More than 15 years
D. Probability – the likelihood of the impact occurring	
Improbable	< 40% chance of occurring
Possible	40% - 70% chance of occurring
Probable	> 70% - 90% chance of occurring
Definite	> 90% chance of occurring
E. Status of impact	
+ ve	Positive (a benefit)
- ve	Negative (a cost)
F. Reversibility - Ability of the impacted environment to return to its pre-impacted state	
High	Reversible within the short-term
Medium	Reversible within the medium to long term
Low	Will never return to pre-impacted state

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