Wetland / Aquatic Assessment:

Swan Lake development amendment, Aston Bay

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SPECIALIST REPORT DETAILS

This report has been prepared as per the requirements of the Environmental Impact Assessment Regulations and the National Environmental Management Act (Act 107 of 1998), any subsequent amendments and any relevant National and / or Provincial Policies related to biodiversity assessments.

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I, **Dr. Brian Michael Colloty** declare that this report has been prepared independently of any influence or prejudice as may be specified by the National Department of Environmental Affairs

Signed:… ……………… Date:…10 September 2018…………

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ACRONYMS

AIS	Alien Invasive Species as defined by NEM:BA & CARA
CBD	Central Business District
CSIR	Council for Scientific and Industrial Research
DWS	Department of Water and Sanitation
EIS	Ecological Importance and Sensitivity
FEPA	Freshwater Ecosystem Priority Area (NFEPA Atlas - Nel et al., 2012)
GA	General Authorisation
GIS	Geographic Information System
HGM	Hydrogeomorphic Approach
NSBA	National Spatial Biodiversity Assessment
NWA	National Water Act (Act 36of 1998)
NWCS	National Wetland Classification System
PES	Present Ecological State
SABIF	South African Biodiversity Information Facility, a SANBI database that contains both faunal and floral species records
SANBI	South African National Biodiversity Institute
WUL	Water Use License
WULA	Water Use License Application

Glossary

(source DWAF – RDM Wetland Ecosystems 1999, unless otherwise stated)

Aerobic: having molecular oxygen (O2) present.

Anaerobic: not having molecular oxygen (O2) present.

Anthropogenic: of human creation

Biota: living things; plants, animals, bacteria

Bottomland: the lowlands along streams and rivers, on alluvial (river deposited) soil.

Chroma: the relative purity of the spectral colour, which decreases with increasing greyness.

Delineation (of a wetland): to determine the boundary of a wetland based on soil, vegetation, and/or hydrological indicators (see definition of a wetland).

Endorheic: closed drainage e.g. a pan.

Floristic: of flora (plants).

Floodplain: Wetland inundated when a river overtops its banks during flood events resulting in the wetland soils being saturated for extended periods of time.

Gley: soil material that has developed under anaerobic conditions as a result of prolonged saturation with water. Grey and sometimes blue or green colours predominate but mottles (yellow, red, brown and black) may be present and indicate localised areas of better aeration.

Groundwater: subsurface water in the zone in which permeable rocks, and often the overlying soil, are saturated under pressure equal to or greater than atmospheric.

Groundwater table: the upper limit of the groundwater.

Horizon: see soil horizons.

Hydric soil: soil that in its undrained condition is saturated or flooded long enough during the growing season to develop anaerobic conditions favouring the growth and regeneration of hydrophytic vegetation (vegetation adapted to living in anaerobic soils).

Hydrophyte: any plant that grows in water or on a substratum that is at least periodically deficient in oxygen as a result of soil saturation or flooding; plants typically found in wet habitats.

Hydrology: the study of water, particularly the factors affecting its movement on land.

Hue (of colour): the dominant spectral colour (e.g. red).

Infilling or Fill: dumping of soil or solid waste onto the wetland surface. Infilling generally has a very high and permanent impact on wetland functioning and is similar to drainage in that the upper soil layers are rendered less wet, usually so much so that the area no longer functions as a wetland.

Lacustrine: Lacustrine systems (e.g. lakes & dams) are wetlands that are situated in a topographic depression or a dammed river channel, have a total area greater than 8 ha and surface area coverage by mosses, lichens, trees, shrubs or persistent emergents of less than 30%.

Marsh: a wetland dominated by emergent herbaceous vegetation (usually taller than 1 m), such as the common reed (*Phragmites australis*) which may be seasonally wet but are usually permanently or semi-permanently wet.

Mottles: soils with variegated colour patters are described as being mottled, with the "background colour" referred to as the matrix and the spots or blotches of colour referred to as mottles.

Munsell colour chart: A standardized colour chart which can be used to describe hue (i.e. its relation to red, yellow, green, blue, and purple), value (i.e. its lightness) and chroma (i.e. its purity). Munsell colour charts are available which show that portion commonly associated with soils, which is about one fifth of the entire range.

Organic soil material: soil material with a high abundance of undecomposed plant material and humus. According to the Soil Classification Working Group (1991) an organic soil horizon must have at least 10% organic carbon by weight throughout a vertical distance of 200 mm and be saturated for long periods in the year unless drained. According to the Soil Survey Staff (1975) definition, in order for a soil to be classed as organic it must have >12% organic carbon by weight if it is sandy and >18% if it is clay-rich.

Permanently wet soil: soil which is flooded or waterlogged to the soil surface throughout the year, in most years.

Riparian: the area of land adjacent to a stream or river that is influenced by stream-induced or related processes. Riparian areas which are saturated or flooded for prolonged periods would be considered wetlands and could be described as riparian wetlands. However, some riparian areas are not wetlands (e.g. an area where alluvium is periodically deposited by a stream during floods but which is well drained).

Runoff: total water yield from a catchment including surface and subsurface flow.

Seasonally wet soil: soil which is flooded or waterlogged to the soil surface for extended periods (>1 month) during the wet season, but is predominantly dry during the dry season.

Sedges: Grass-like plants belonging to the family Cyperaceae, sometimes referred to as nutgrasses. Papyrus is a member of this family.

Soil drainage classes: describe the soil moisture conditions as determined by the capacity of the soil and the site for removing excess water. The classes range from very well drained, where excess water is removed very quickly, to very poorly drained, where excess water is removed very slowly. Wetlands include all soils in the very poorly drained and poorly drained classes, and some soils in the somewhat poorly drained class. These three classes are roughly equivalent to the permanent, seasonal and temporary classes

Soil horizons: layers of soil that have fairly uniform characteristics and have developed through pedogenic processes; they are bound by air, hard rock or other horizons (i.e. soil material that has different characteristics).

Soil profile: the vertically sectioned sample through the soil mantle, usually consisting of two or three horizons (Soil Classification Working Group, 1991).

Soil saturation: the soil is considered saturated if the water table or capillary fringe reaches the soil surface (Soil Survey Staff, 1992).

Temporarily wet soil: The soil close to the soil surface (i.e. within 50 cm) is wet for periods > 2 weeks during the wet season in most years. However, it is seldom flooded or saturated at the surface for longer than a month.

Terrain unit classes: areas of the land surface with homogenous form and slope. Terrain may be seen as being made up of all or some of the following units: crest (1), scarp (2), midslope (3), footslope (4) and valley bottom (5).

Transpiration: the transfer of water from plants into the atmosphere as water vapour

Value (soil colour): the relative lightness or intensity of colour.

Vlei: a colloquial South African term for wetland.

Water regime: When and for how long the soil is flooded or saturated.

Water quality: the purity of the water.

Waterlogged: soil or land saturated with water long enough for anaerobic conditions to develop.

Wetland: land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which under normal circumstances supports or would support vegetation typically adapted to life in saturated soil (Water Act 36 of 1998); land where an excess of water is the dominant factor determining the nature of the soil development and the types of plants and animals living at the soil surface (Cowardin *et al*., 1979).

Wetland catchment: the area up-slope of the wetland from which water flows into the wetland and including the wetland itself.

Wetland delineation: the determination and marking of the boundary of a wetland on a map

1 INTRODUCTION

Scherman Colloty & Associates (SC&A) was appointed to assess the potential impact on wetlands and or waterbodies, for the **approved residential development and related infrastructure within the site,** thus assisting in any constraints analysis to develop the final layout (Figure 1). SC&A conducted a Present Ecological State (PES) assessment of any protentional aquatic systems within the site boundary as well as within a 500m radius. This was based on a one-day site visit conducted in June 2018. This report will thus also form part of the Water Use License Application (WULA) if required by the National Department of Water and Sanitation (DWS).

Note: Should all impacts be considered LOW as shown in this report and the attached DWS Risk Assessment Matrix, then a General Authorisation (GA) may be appropriate for Section 21 c & i water uses (i.e. impeding / diverting flows or disturbance of any beds or banks of a water course) or any activity within 500m of a wetland boundary. Although the process and documentation required for a GA submission is similar to a WULA, the processing timeframes vary (60 vs 300 days respectively).

1.2 Terms of Reference

The following scope of work was thus used as the basis of this study in order to fulfil the above requirements:

- A desktop aquatic biodiversity assessment of the study area. This covers the site footprint in relation to the wetland and saltmarsh ecosystems functioning within the region.
- Provide a map demarcating the relevant local drainage area of the respective wetland/s, i.e. the wetland, its respective catchment and other wetland areas within a 500m radius of the study area. This will demonstrate, from a holistic point of view the connectivity between the site and the surrounding regions, i.e. the zone of influence.
- The maps depicting demarcated wetland areas delineated to a scale of 1:10 000, following the methodology described by the DWAF (2005), together with a classification of delineated wetland areas, according to the methods contained in the Level 1 WET-Health methodology and the latest National Wetland Classification System (Ollis *et al*. 2013).
- The determination of the ecological state of any wetland areas, estimating their biodiversity, conservation and ecosystem function importance with regard ecosystem services and linkages to other systems.
- A separate Risk Assessment Matrix in the required DWS format (Appendix A), for them to determine if a General Authorisation (GA) A versus a full Water License for any Section 21 c & i activities.
- Provide mitigations regarding project related impacts, including engineering services that could negatively affect demarcated wetland areas.
- Supply the client with geo-referenced GIS shape files of the wetland / riverine areas.
- Provide one draft report for comment, with a maximum of two rounds of comments addressed.

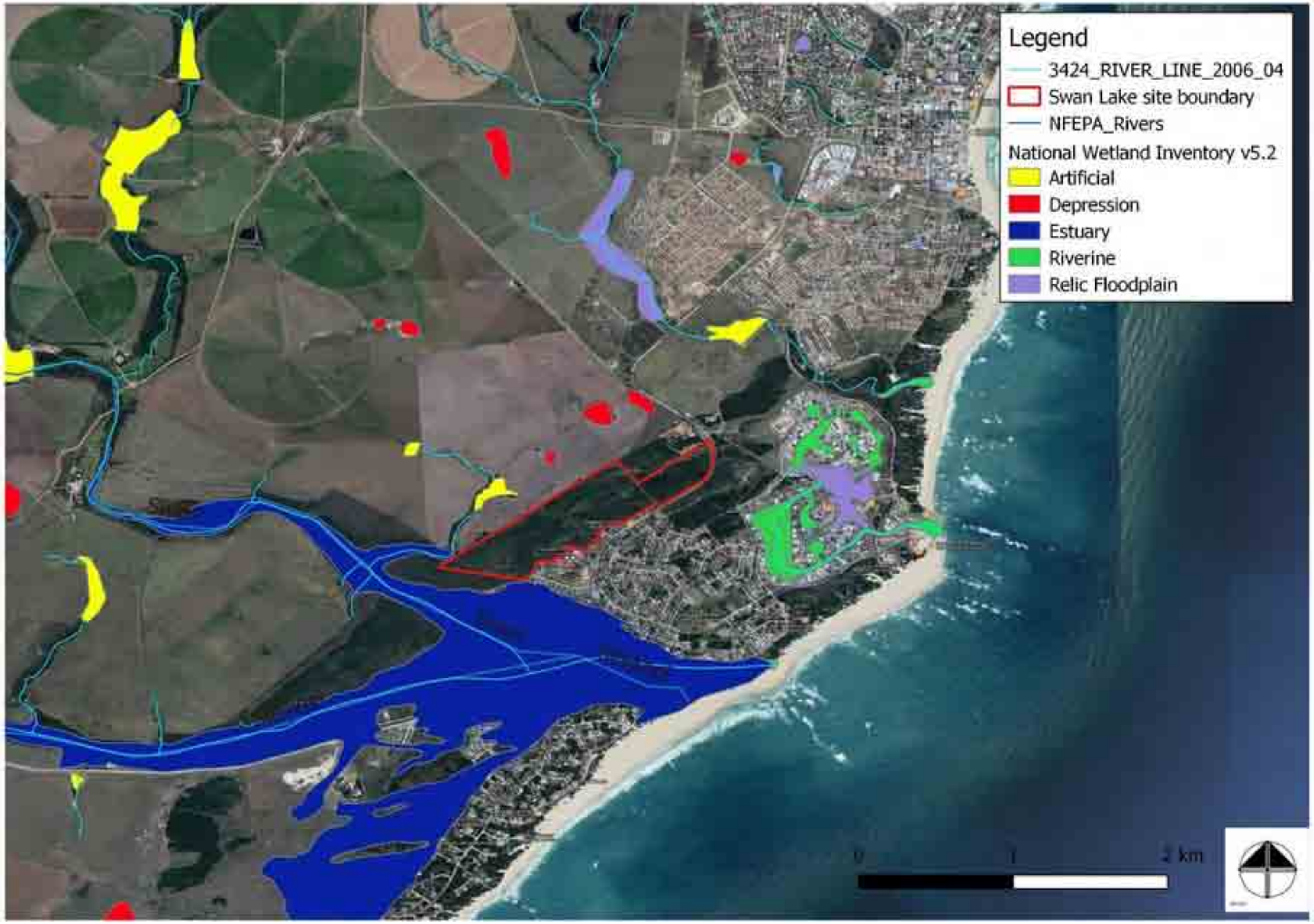

Figure 1: Locality map with the proposed development boundary (red box) in relation to the surrounding environment and potential waterbodies

2 STUDY APPROACH

This study will follow the approaches of several national guidelines with regards to wetland assessment. These have been modified by the author, to provide a relevant mechanism of assessing the present state of the study systems, applicable to the specific environment and in a clear and objective means assess the potential impacts.

Current water resource classification systems make use of the Hydrogeomorphic (HGM) approach, and for this reason, the National Wetland Classification System approach will be used in this study. It is also important to understand wetland definition, means of assessing wetland conservation and importance as well as understanding the pertinent legislation with regards to protecting wetlands. These aspects will be discussed in greater depth in this section of report, as they form the basis of the study approach to assessing wetland impacts.

1.1 Wetland classification systems

Since the late 1960‟s, wetland classification systems have undergone a series of international and national revisions. These revisions allowed for the inclusion of additional wetland types, ecological and conservation rating metrics, together with a need for a system that would allude to the functional requirements of any given wetland (Ewart-Smith *et al*., 2006). Wetland function is a consequence of biotic and abiotic factors, and wetland classification should strive to capture these aspects.

The South African National Biodiversity Institute (SANBI) in collaboration with a number of specialists and stakeholders developed the newly revised and now accepted National Wetland Classification Systems (Ollis *et al*., 2013). This system comprises a hierarchical classification process of defining a wetland based on the principles of the hydrogeomorphic (HGM) approach at higher levels, with including structural features at the finer or lower levels of classification (Ollis *et al*., 2013).

Wetlands develop in a response to elevated water tables, linked either to rivers, groundwater flows or seepage from aquifers (Parsons, 2004). These water levels or flows then interact with localised geology and soil forms, which then determines the form and function of the respective wetlands. Water is thus the common driving force, in the formation of wetlands (DWAF, 2005). It is significant that the HGM approach has now been included in wetland classification as the HGM approach has been adopted throughout the water resources management realm with regards to the determination of the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) and WET-Health assessments for aquatic environments. All of these systems are then easily integrated using the HGM approach in line with the Eco-classification process of river and wetland reserve determinations used by the Department of Water Affairs. The Ecological Reserve of a wetland or river is used by DWS to assess the water resource allocations when assessing water use license applications (WULA).

The NWCS process is provided in more detail in the methods section of the report, but some of the terms and definitions used in this document are present below:

Definition Box

Present Ecological State is a term for the current ecological condition of the resource. This is assessed relative to the deviation from the Reference State. Reference State/Condition is the natural or pre-impacted condition of the system. The reference state is not a static condition, but refers to the natural dynamics (range and rates of change or flux) prior to development. The PES is determined per component - for rivers and wetlands this would be for the drivers: flow, water quality and geomorphology; and the biotic response indicators: fish, macroinvertebrates, riparian vegetation and diatoms. PES categories for every component would be integrated into an overall PES for the river reach or wetland being investigated. This integrated PES is called the EcoStatus of the reach or wetland.

EcoStatus is the overall PES or current state of the resource. It represents the totality of the features and characteristics of a river and its riparian areas or wetland that bear upon its ability to support an appropriate natural flora and fauna and its capacity to provide a variety of goods and services. The EcoStatus value is an integrated ecological state made up of a combination of various PES findings from component EcoStatus assessments (such as for invertebrates, fish, riparian vegetation, geomorphology, hydrology and water quality).

Reserve: The quantity and quality of water needed to sustain basic *human needs* and *ecosystems* (e.g. estuaries, rivers, lakes, groundwater and wetlands) to ensure ecologically sustainable development and utilisation of a water resource. The *Ecological Reserve* pertains specifically to aquatic ecosystems.

Reserve requirements: The quality, quantity and reliability of water needed to satisfy the requirements of basic human needs and the Ecological Reserve (inclusive of instream requirements).

Ecological Reserve determination study: The study undertaken to determine Ecological Reserve requirements.

Licensing applications: Water users are required (by legislation) to apply for licenses prior to extracting water resources from a water catchment.

Ecological Water Requirements: This is the quality and quantity of water flowing through a natural stream course that is needed to sustain instream functions and ecosystem integrity at an acceptable level as determined during an EWR study. These then form part of the conditions for managing achievable water quantity and quality conditions as stipulated in the **Reserve Template**

Water allocation process (compulsory licensing): This is a process where all existing and new water users are requested to reapply for their licenses, particularly in stressed catchments where there is an over-allocation of water or an inequitable distribution of entitlements.

Ecoregions are geographic regions that have been delineated in a top-down manner on the basis of physical/abiotic factors. • NOTE: For purposes of the classification system, the 'Level I Ecoregions' for South Africa, Lesotho and Swaziland (Kleynhans *et al.* 2005), which have been specifically developed by the Department of Water Affairs & Forestry (DWAF) for rivers but are used for the management of inland aquatic ecosystems more generally, are applied at Level 2A of the classification system. These Ecoregions are based on physiography, climate, geology, soils and potential natural vegetation.

2.2 Wetland definition

Although the National Wetland Classification System (Ollis *et al*., 2013) is used to classify wetland types it is still necessary to understand the definition of a wetland. Terminology currently strives to characterise a wetland not only on its structure (visible form), but also to relate this to the function and value of any given wetland.

The Ramsar Convention definition of a wetland is widely accepted as **"areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres"** (Davis 1994). South Africa is a signatory to the Ramsar Convention and therefore its extremely broad definition of wetlands has been adopted for the proposed NWCS, with a few modifications.

Whereas the Ramsar Convention included marine water to a depth of six metres, the definition used for the NWCS extends to a depth of ten metres at low tide, as this is recognised as the seaward boundary of the shallow photic zone (Lombard *et al*., 2005). An additional minor adaptation of the definition is the removal of the term „fen" as fens are considered a type of peatland. The adapted definition for the NWCS is, therefore, as follows (Ollis *et al*., 2013):

WETLAND: an area of marsh, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed ten metres.

This definition encompasses all ecosystems characterised by the permanent or periodic presence of water other than marine waters deeper than ten metres. The only legislated definition of wetlands in South Africa, however, is contained within the National Water Act (Act No. 36 of 1998) (NWA), where wetlands are defined as "land which is transitional between terrestrial and aquatic systems, where the water table is usually at, or near the surface, or the land is periodically covered with shallow water and which land in normal circumstances supports, or would support, vegetation adapted to life in saturated soil." This definition is consistent with more precise working definitions of wetlands and therefore includes only a subset of ecosystems encapsulated in the Ramsar definition. It should be noted that the NWA definition is not concerned with marine systems and clearly distinguishes wetlands from estuaries, classifying the later as a water course (Ollis *et al*., 2013). Table 1 provides a comparison of the various wetlands included within the main sources of wetland definitions used in South Africa.

Although a subset of Ramsar-defined wetlands was used as a starting point for the compilation of the first version of the National Wetland Inventory (i.e. "wetlands", as defined by the National Water Act, together with open waterbodies), it is understood that subsequent versions of the Inventory include the full suite of Ramsar-defined wetlands in order to ensure that South Africa meets its wetland inventory obligations as a signatory to the Convention (Ollis *et al*., 2013).

Wetlands must therefore have one or more of the following attributes to meet the above definition (DWAF, 2005):

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

It should be noted that riparian systems that are not permanently or periodically inundated are not considered true wetlands, i.e. those associated with the drainage lines.

Table 1: Comparison of ecosystems considered to be „wetlands" as defined by the proposed NWCS, the National Water Act (Act No. 36 of 1998), and ecosystems included in DWAF"s (2005) delineation manual.

Ecosystem	NWCS "wetland"	National Water Act wetland	DWAF (2005) delineation manual
Marine	YES	NO	NO
Estuarine	YES	NO	NO
Waterbodies deeper than 2 m (i.e. limnetic habitats often describes as lakes or dams)	YES	NO	NO
Rivers, channels and canals	YES	NO[1]	NO
Inland aquatic ecosystems that are not river channels and are less than 2 m deep	YES	YES	YES
Riparian[2] areas that are permanently / periodically inundated or saturated with water within 50 cm of the surface	YES	YES	YES[3]
Riparian [2] areas that are not permanently / periodically inundated or saturated with water within 50 cm of the surface	NO	NO	YES[3]

[1] Although river channels and canals would generally not be regarded as wetlands in terms of the National Water Act, they are included as a „watercourse" in terms of the Act

[2] According to the National Water Act and Ramsar, riparian areas are those areas that are saturated or flooded for prolonged periods would be considered riparian wetlands, opposed to non –wetland riparian areas that are only periodically inundated and the riparian vegetation persists due to having deep root systems drawing on water many meters below the surface.

[3] The delineation of „riparian areas" (including both wetland and non-wetland components) is treated separately to the delineation of wetlands in DWAF"s (2005) delineation manual.

2.3 National Wetland Classification System method

During this study due to the nature of the wetlands and watercourses observed, it was decided that the newly accepted National Wetlands Classification System (NWCS) be adopted. This classification approach has integrated aspects of the HGM approach used in the WET-Health system as well as the widely accepted eco-classification approach used for rivers.

The NWCS (Ollis *et al*., 2013) as stated previously, uses hydrological and geomorphological traits to distinguish the primary wetland units, i.e. direct factors that influence wetland function. Other wetland assessment techniques, such as the DWAF (2005) delineation method, only infer wetland function based on abiotic and biotic descriptors (size, soils & vegetation) stemming from the Cowardin approach (OLLIS *ET AL*., 2013).

The classification system used in this study is thus based on Ollis *et al*. (2013) and is summarised below:

The NWCS has a six tiered hierarchical structure, with four spatially nested primary levels of classification (Figure 2). The hierarchical system firstly distinguishes between Marine, Estuarine and Inland ecosystems (**Level 1**), based on the degree of connectivity the particular system has with the open ocean (greater than 10 m in depth). Level 2 then categorises the regional wetland setting using a combination of biophysical attributes at the landscape level, which operate at a broad bioregional scale.

This is opposed to specific attributes such as soils and vegetation. **Level 2** has adopted the following systems:

- Inshore bioregions (marine)
- Biogeographic zones (estuaries)
- Ecoregions (Inland)

Level 3 of the NWCS assess the topographical position of inland wetlands as this factor broadly defines certain hydrological characteristics of the inland systems. Four landscape units based on topographical position are used in distinguishing between Inland systems at this level. No subsystems are recognised for Marine systems, but estuaries are grouped according to their periodicity of connection with the marine environment, as this would affect the biotic characteristics of the estuary.

Level 4 classifies the hydrogeomorphic (HGM) units discussed earlier. The HGM units are defined as follows:

(i) Landform – shape and localised setting of wetland
(ii) Hydrological characteristics – nature of water movement into, through and out of the wetland
(iii) Hydrodynamics – the direction and strength of flow through the wetland

These factors characterise the geomorphological processes within the wetland, such as erosion and deposition, as well as the biogeochemical processes.

Level 5 of the assessment pertains to the classification of the tidal regime within the marine and estuarine environments, while the hydrological and inundation depth classes are determined for the inland wetlands. Classes are based on frequency and depth of inundation, which are used to determine the functional unit of the wetlands and are considered secondary discriminators within the NWCS.

Level 6 uses six descriptors to characterise the wetland types on the basis of biophysical features. As with Level 5, these are non-hierarchal in relation to each other and are applied in any order, dependent on the availability of information. The descriptors include:

(i) Geology;
(ii) Natural vs. Artificial;
(iii) Vegetation cover type;
(iv) Substratum;
(v) Salinity; and
(vi) Acidity or Alkalinity.

It should be noted that where sub-categories exist within the above descriptors, hierarchical systems are employed, and these are thus nested in relation to each other.

The HGM unit (Level 4) is the **focal point of the NWCS**, with the upper levels (Figure 3 – Inland systems only) providing means to classify the broad bio-geographical context for grouping functional wetland units at the HGM level, while the lower levels provide more descriptive detail on the particular wetland type characteristics of a particular HGM unit. Therefore Level 1 – 5 deals with functional aspects, while Level 6 classifies wetlands on structural aspects.

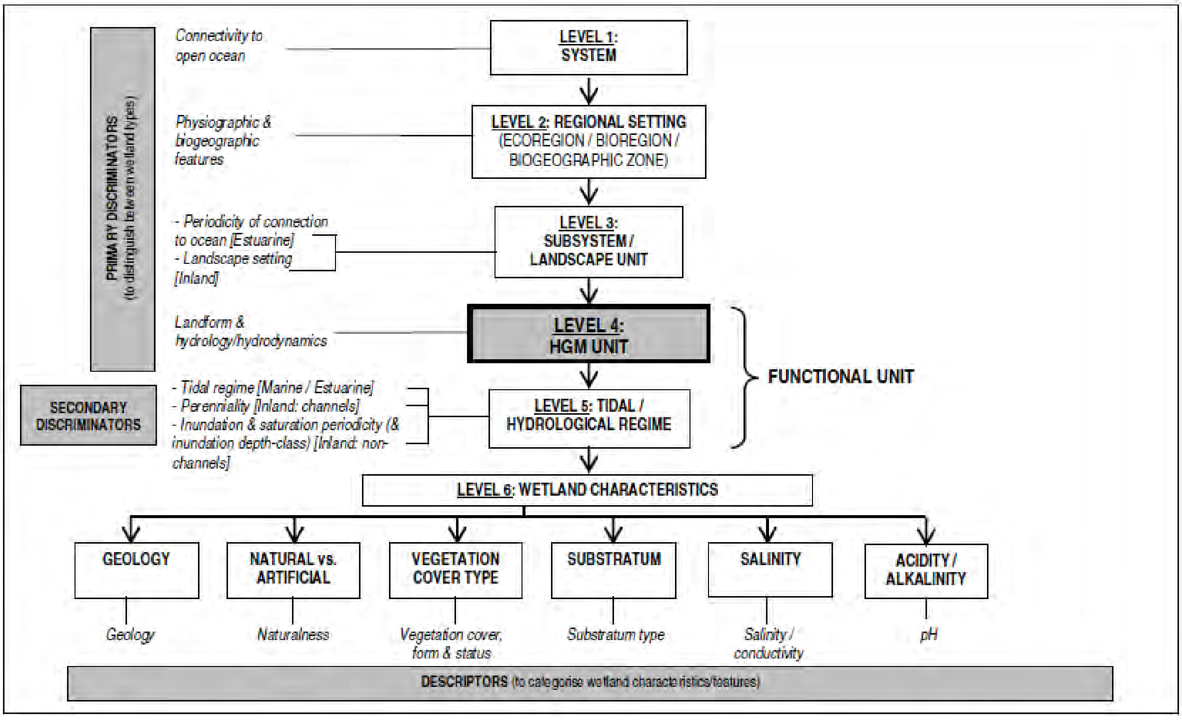

Figure 2: Basic structure of the National Wetland Classification System, showing how „primary discriminators" are applied up to Level 4 to classify Hydrogeomorphic (HGM) Units, with „secondary discriminators" applied at Level 5 to classify the tidal/hydrological regime, and „descriptors" applied at Level 6 to categorise the characteristics of wetlands classified up to Level 5 (From Ollis *et al*., 2013).

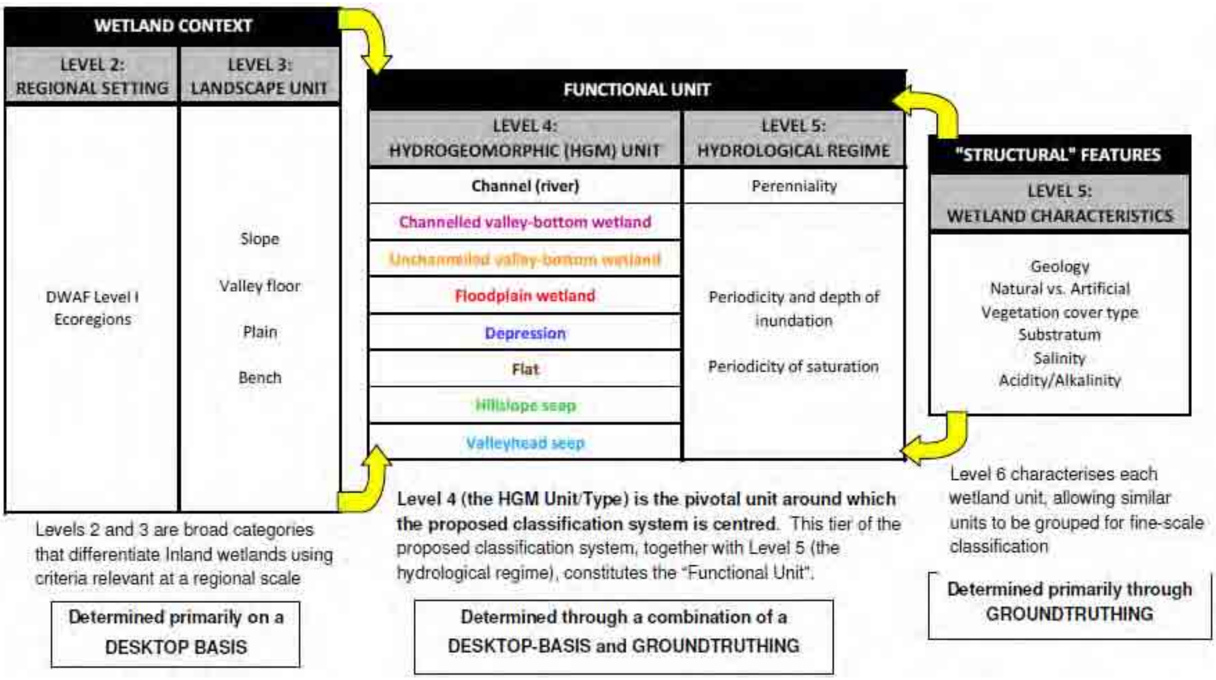

Figure 3: Illustration of the conceptual relationship of HGM Units (at Level 4) with higher and lower levels (relative sizes of the boxes show the increasing spatial resolution and level of detail from the higher to the lower levels) for Inland Systems (from Ollis *et al*., 2013).

2.4 Wetland condition

To assess the Present Ecological State (PES) or condition of the observed wetlands, a modified Wetland Index of Habitat Integrity (DWAF, 2007) was used. The Wetland Index of Habitat Integrity (WETLAND-IHI) is a tool developed for use in the National Aquatic Ecosystem Health Monitoring Programme (NAEHMP), formerly known as the River Health Programme (RHP). The output scores from the WETLAND-IHI model are presented in the standard DWAF A-F ecological categories (Table 2), and provide a score of the Present Ecological State of the habitat integrity of the wetland system being examined. The author has included additional criteria into the model based system to include additional wetland types. This system is preferred when compared to systems such as WET-Health – wetland management series (WRC 2009), as WET-Health (Level 1) was developed with wetland rehabilitation in mind, and is not always suitable for impact assessments. This coupled with the degraded state of the wetlands in the study area, indicated that a complex study approach was not warranted, i.e. conduct a Wet-Health Level 2 and WET-Ecosystems Services study required for an impact assessment.

Table 2: Description of A – F ecological categories based on Kleynhans *et al*., (2005)

ECOLOGICAL CATEGORY	ECOLOGICAL DESCRIPTION	MANAGEMENT PERSPECTIVE
A	Unmodified, natural.	Protected systems; relatively untouched by human hands; no discharges or impoundments allowed
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	Some human-related disturbance, but mostly of low impact potential
C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	**Multiple disturbances associated with need for socio-economic development, e.g. impoundment, habitat modification and water quality degradation**
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	**Often characterized by high human densities or extensive resource exploitation. Management intervention is needed to improve health, e.g. to restore flow patterns, river habitats or water quality**
F	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.	

The WETLAND-IHI model is composed of four modules. The “Hydrology”, “Geomorphology” and “Water Quality” modules all assess the contemporary driving processes behind wetland formation and maintenance. The last module, “Vegetation Alteration”, provides an indication of the intensity of human landuse activities on the wetland surface itself and how these may have modified the condition of the wetland. The integration of the scores from these 4 modules provides an overall Present Ecological State (PES) score for the wetland system being examined. The WETLAND-IHI model is an MS Excel-based model, and the data required for the assessment are generated during a rapid site visit.

Additional data may be obtained from remotely sensed imagery (aerial photos; maps and/or satellite imagery) to assist with the assessment. The interface of the WETLAND-IHI has been developed in a format which is similar to DWA‟s River EcoStatus models which are currently used for the assessment of PES in riverine environments.

2.5 Wetland importance and function

South Africa is a Contracting Party to the Ramsar Convention on Wetlands, signed in Ramsar, Iran, in 1971, and has thus committed itself to this intergovernmental treaty, which provides the framework for the national protection of wetlands and the resources they could provide. Wetland conservation is now driven by the South African National Biodiversity Institute, a requirement under the National Environmental Management: Biodiversity Act (No 10 of 2004).

Wetlands are among the most valuable and productive ecosystems on earth, providing important opportunities for sustainable development (Davies and Day, 1998). However, wetlands in South Africa are still rapidly being lost or degraded through direct human induced pressures (Nel *et al.,* 2004).

The most common attributes or goods and services provided by wetlands include:

- Improve water quality;
- Impede flow and reduce the occurrence of floods;
- Reeds and sedges used in construction and traditional crafts;
- Bulbs and tubers, a source of food and natural medicine;
- Store water and maintain base flow of rivers;
- Trap sediments; and
- Reduce the number of water borne diseases.

In terms of this study, the wetlands provide ecological (environmental) value to the area acting as refugia for various wetland associated plants, butterflies and birds.

In the past wetland conservation has focused on biodiversity as a means of substantiating the protection of wetland habitat. However not all wetlands provide such motivation for their protection, thus wetland managers and conservationists began assessing the importance of wetland function within an ecosystem.

Table 3 summarises the importance of wetland function when related to ecosystem services or ecoservices (Kotze *et al*., 2008). One such example is emergent reed bed wetlands that function as transformers converting inorganic nutrients into organic compounds (Mitsch and Gosselink, 2000).

Table 3: Summary of direct and indirect ecoservices provided by wetlands from Kotze *et al.*, 2008

<table>
<tr><td rowspan="15">Ecosystem services supplied by wetlands</td><td rowspan="9">Indirect benefits</td><td rowspan="8">Hydro-geochemical benefits</td><td colspan="2">Flood attenuation</td></tr>
<tr><td colspan="2">Stream flow regulation</td></tr>
<tr><td rowspan="5">Water quality enhancement benefits</td><td>Sediment trapping</td></tr>
<tr><td>Phosphate assimilation</td></tr>
<tr><td>Nitrate assimilation</td></tr>
<tr><td>Toxicant assimilation</td></tr>
<tr><td>Erosion control</td></tr>
<tr><td colspan="2">Carbon storage</td></tr>
<tr><td colspan="3">Biodiversity maintenance</td></tr>
<tr><td rowspan="6">Direct benefits</td><td colspan="3">Provision of water for human use</td></tr>
<tr><td colspan="3">Provision of harvestable resources[2]</td></tr>
<tr><td colspan="3">Provision of cultivated foods</td></tr>
<tr><td colspan="3">Cultural significance</td></tr>
<tr><td colspan="3">Tourism and recreation</td></tr>
<tr><td colspan="3">Education and research</td></tr>
</table>

Conservation importance of the individual wetlands was based on the following criteria:

- Habitat uniqueness
- Species of conservation concern
- Habitat fragmentation with regard ecological corridors
- Ecosystem service (social and ecological)

The presence of any or a combination of the above criteria would result in a HIGH conservation rating if the wetland was found in a near natural state (high PES). Should any of the habitats be found modified the conservation importance would rate as MEDIUM, unless a Species of conservation concern was observed (HIGH). Any system that was highly modified (low PES) or had none of the above criteria, received a LOW conservation importance rating. Wetlands with HIGH and MEDIUM ratings should thus be excluded from development with incorporation into a suitable open space system, with the maximum possible buffer being applied. Natural wetlands or Wetlands that resemble some form of the past landscape, but receive a LOW conservation importance rating could be included into stormwater management features, and should not be developed so as to retain the function of any ecological corridors. The proposed treatment facility and roads upgrades is not located in any of these areas, i.e. transformed wetland, no longer resembling the estuarine floodplain systems.

2.6 Relevant wetland legislation and policy

Locally the South African Constitution, seven (7) Acts and two (2) international treaties allow for the protection of wetlands and rivers. These systems are protected from destruction or pollution by the following:

- Section 24 of The Constitution of the Republic of South Africa;
- Agenda 21 – Action plan for sustainable development of the Department of Environmental Affairs and Tourism (DEAT) 1998;
- The Ramsar Convention, 1971 including the Wetland Conservation Programme (DEAT) and the National Wetland Rehabilitation Initiative (DEAT, 2000);
- National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998) inclusive of all amendments, as well as the NEM: Biodiversity Act;
- National Water Act, 1998 (Act No. 36 of 1998);
- Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983); and

- Minerals and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002).
- Nature and Environmental Conservation Ordinance (No. 19 of 1974)
- National Forest Act (No. 84 of 1998)
- National Heritage Resources Act (No. 25 of 1999)

NEMA and the Conservation of Agricultural Resources Act (CARA), 1983 (Act No. 43 of 1983) would also apply to this project. These Acts have categorised a large number of invasive plants together with associated obligations of the land owner. A number of Category 1 & 2 plants were found at all of the sites investigated, thus the contractors must take extreme care to ensure the further spread of these plants doesn"t occur. This should be done through proper stockpile management (topsoil) and suitable rehabilitation of disturbed areas after construction.

Alien Invasive Plant Species observed included amongst others:

- *Acacia longifolia*
- *Cortaderia selloana*
- *Pennisetum clandestinum*
- *Pinus spp*

2.7 Provincial legislation and policy

The buffer model as described Macfarlane *et al*., 2017 rivers, wetlands and estuaries, based on the condition of the relevant system, the state of the site, coupled to the type of development provided the following buffer recommendations:

Rivers and watercourses

1. Construction period: 10m
2. Operation period: 10m
3. Final: 10m

Wetlands (None on site, depressions were found adjacent to the site)

1. Construction period: 10m
2. Operation period: 12m
3. Final: 12m

Estuary (Seekoei Estuary functional zone adjacent to farm portion boundary)

1. Construction period: 14m
2. Operation period: 10m
3. Final: 14m from the estimated functional zone as defined by CSIR/SANBI – Figure 1)

However, study area is unique in terms of it landscape position and how it has functions / developed, it is recommended that no development occur within the certified 1:100-year flood line.

Other policies that are relevant include:

- Provincial Nature Conservation Ordinance (PNCO) – Protected Flora.
- Eastern Cape Biodiversity Conservation Plan (Berliner & Desmet, 2007)
- National Freshwater Ecosystems Priority Areas – (Nel *et al.*, 2011). This mapping product highlights potential rivers and wetlands that should be earmarked for conservation on a national basis.

3 DESCRIPTION OF THE POTENTIALLY AFFECTED ENVIRONMENT

The study site is located approximately 4 km South West of the Jeffreys Bay CBD along Dolphin Rd, Aston Bay. The site spans two Quaternary catchments (Figure 4), namely the Kabeljous River (K90G) and the Swart/Seekoei (K90F), within a largely intact portion of dune fynbos/thicket (Plate 1).

Figure 4 also indicates the functional zone of the Seekoei estuary, located directly adjacent to the study area. The CSIR has defined these zones as any area below the 5m contour. Note the CSIR spatial data is also contained in the latest version of the National Wetland Inventory v5.2 curated by the CSIR and SANBI (Figure 5).

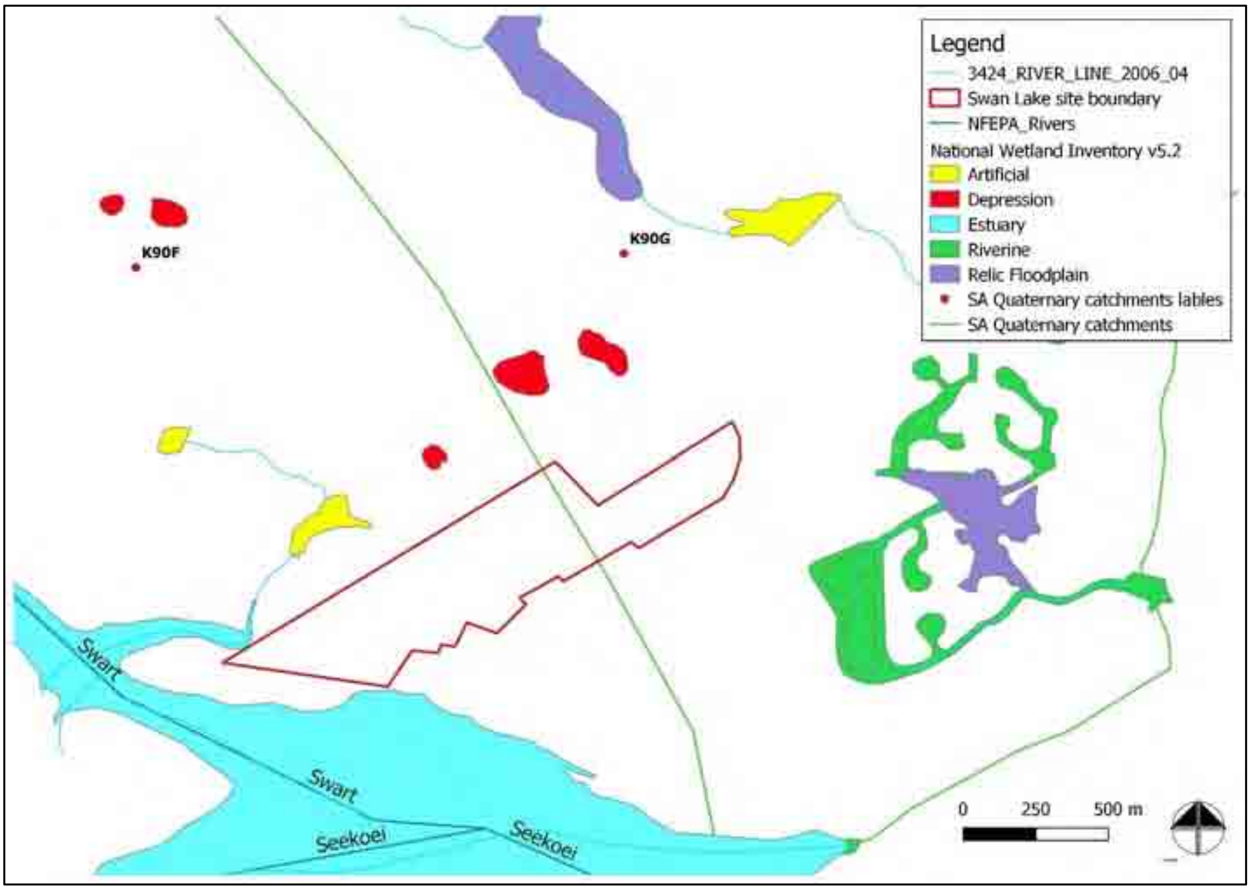

Figure 4: Project locality map indicating the relevant quaternary catchment boundaries (green lines) (Source DWS, NGI and CSIR)

Figure 5: Aerial image of the study site, indicating the current state of the surroundings (i.e. transformed and fragmented)

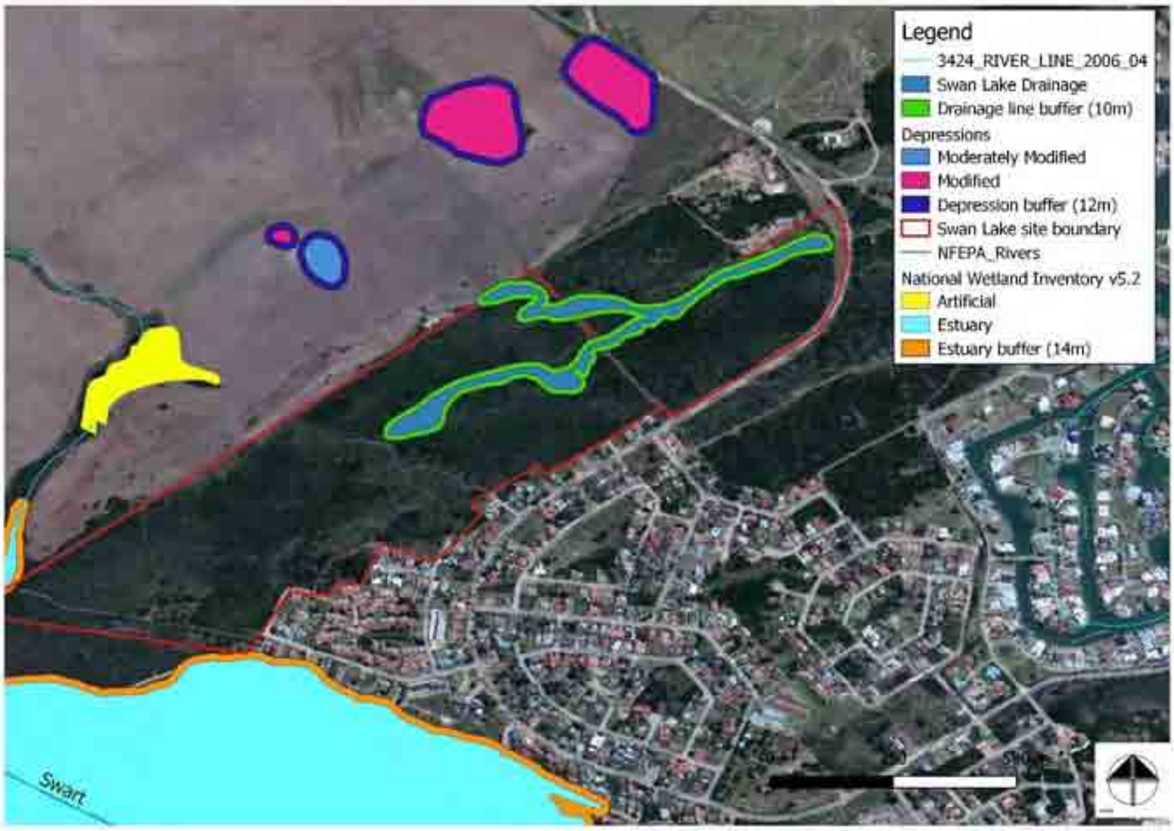

Figure 6: The delineated waterbodies (drainage lines), wetland depressions and estuary functional zone with the respective buffers.

The site was dominated by vegetated dunes, with the interdunal areas being characterized drainage features (Plate 2). None of these areas, exhibited any obligate wetland plant species (Plate 2) or any soils that conformed to any hydromorphic criteria (gleys or mottles) thus indicating an overall lack of any wetland characteristics (Plate 3), as shown in trial pits / excavations existing within the site.

Based then on the 6 levels of the National Wetland Classification System, the observed wetland areas are typical of Inland Systems (Level 1), within the South Eastern Coastal Belt Ecoregion (Level 2), associated with ephemeral drainage lines that would only contain water for short periods during extreme rainfall events (Level 4). These however have not direct connection with any other systems downstream and cut off from the remainder of the localised catchments either by natural dune formations or developments such as roads and Marina Martinique.

This was also substantiated by the National Wetland Inventory (v 5.2) (Figure 4 and 5), although several wetland depressions did occur within 500m of the site boundary (Figures 4 – 6). These endorheic pans have been converted into dams, while the localised catchments have been modified into grazing areas, with the exception of one that has not been converted into a dam. The pan / dam nearest Dolphin Rd is also fed by a leaking pump station, hence the high inundation levels (Plate 4).

Plate 1: A view of the vegetated dune to the south of the site, with typical coastal thicket species

Plate 2: Interdunal area, that would have surface water flows during heavy rainfall periods, although lacks any obligate aquatic species or watercourse characteristics

Plate 3: Excavations within drainage lines, indicating the lack of permanent soil saturation features such as gleys or mottles to a depth of 2m

Plate 4: A the pan near Dolphin Rd, which has been converted into a dam and is currently fed by a leaking pump station

2.1 Present Ecological State and conservation importance

In this study several other sources of information were also considered, which included the National Freshwater Ecosystems Priority Areas project completed by the CSIR (Nel *et al*., 2011), regional and national biodiversity assessments, and the latest being the National Biodiversity Assessment released by SANBI (Driver *et al*., 2012). Note these are being updated for the 2018 National Biodiversity Assessment due later this year, but spatial information being used for the update was interrogated for this assessment.

The Department of Water and Sanitation, as part of a Water Research Commission (WRC) project has initiated the revision of the 1999 Present Ecological State (PES) assessment of all rivers and riparian associated "wetlands" on a national basis. A team lead by the SC&A has completed the assessment of the sub-quaternary catchment found in the study region. Their assessment has indicated that the systems found in the study area all have a PES of C (Moderately Modified) or D (Largely modified). This is due to current estimates that between 18 – 45 % of the natural catchment remains within the Subquaternary catchments associated within the study area. The drainage line, although large not an aquatic systems for the purposes of the buffer modelling, was rated as B (Largely Natural), which coincided with the rating of the terrestrial systems provided by the ecologist (Pote, 2018).

The estuarine portion of the catchment (functional zone was rated as PES = D or Largely Modified, by the CSIR lead team (DWS 2014).

In this assessment the wetlands which were located beyond the site, which are modified would be still be assigned a MODERATE – HIGH Ecological Importance and Sensitivity Score due to the habitat created and these area trap and filter any surface run-off downstream areas. This conservation rating is further substantiated as none of the site, is located within any aquatic Critical Biodiversity Areas (Figure 7).

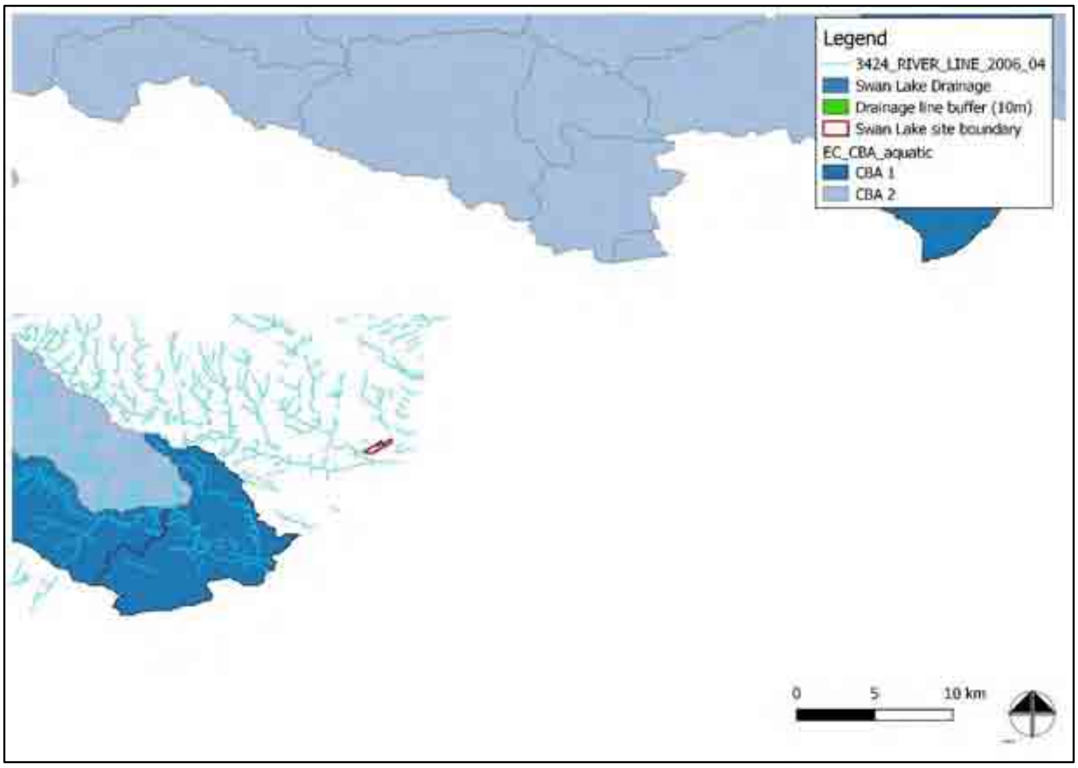

Figure 7: Aquatic Critical Biodiversity Areas as per the Eastern Cape Biodiversity Conservation Plan (Berliner & Desmet, 2007)

4 PERMIT REQUIREMENTS

The following documents (amongst others) will be needed for a Water Use License Application due to the project being within 500m of a wetland area, as required by the Department of Water and Sanitation (DWS):

- Wetland areas delineation supplied together with a desktop analysis and potential sensitivity identification, i.e. this report.
- Application forms for Section 21 (c) and (i) use and the DWS Risk Assessment Matrix (Appendix A)
- Supporting documentation in terms of the activity and applicant

The following activities associated with the development require a water use license, as stipulated by the legislation shown below:

- NWA (Act 36 of 1998) Section 21
  - (c) impeding or diverting the flow of water in a water course
  - (i) altering the beds, banks, course or characteristics of a water course

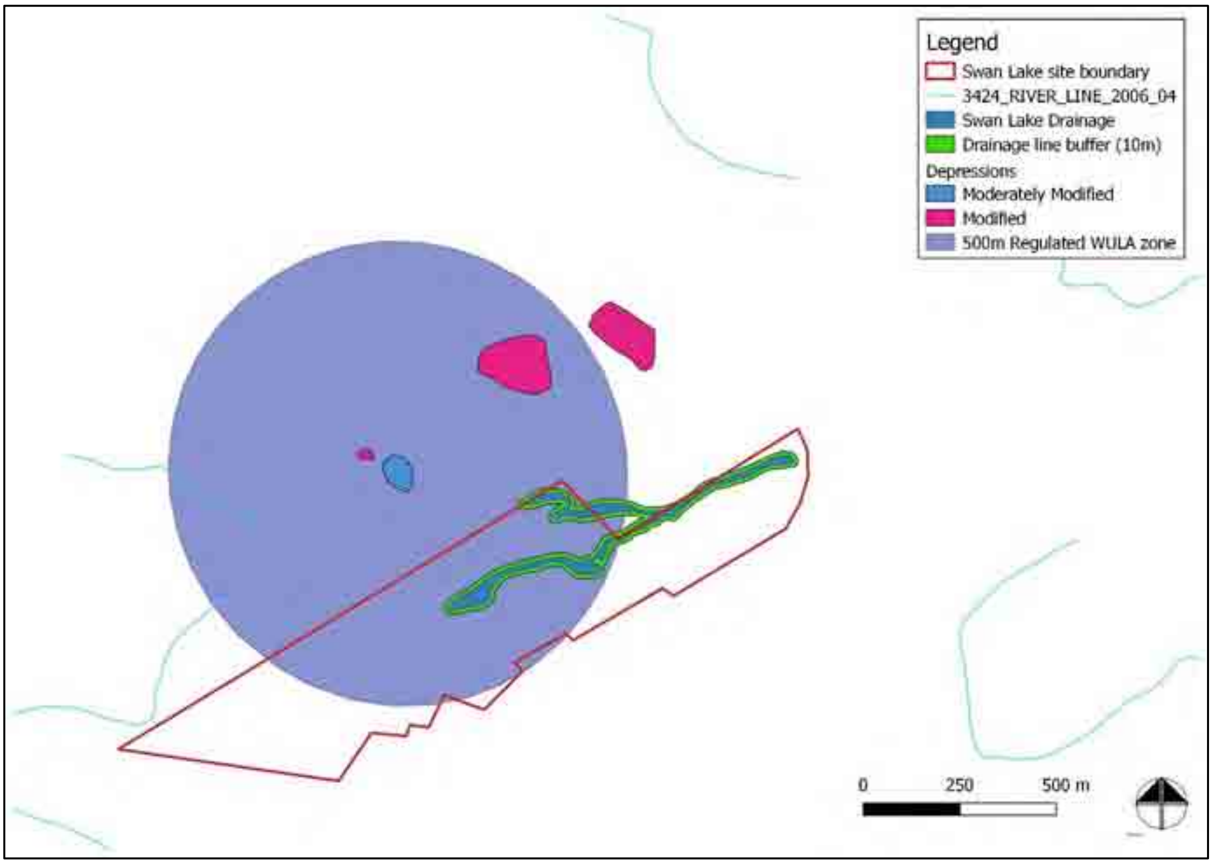

Figure 8: Regulated 500m from wetland boundary zone – remaining largely natural system

5 IMPACT ASSESSMENT

5.1.1 Impact 1: Changes to the hydrological regime due to increase hard surfaces with an increased potential for erosion

Nature of the impact

Due to the nature of the proposed project this would be an operational phase impact, limited to once the development has been completed, i.e. any hard surfaces will increase the rate and volume of surface water runoff

Significance of impacts without mitigation

Due to the nature of the study area hydrology, its present state and the present impacts the overall significance of the impact would be rated as **Negative**, change

Proposed mitigation

- Clearing of the remaining vegetation as it has been proposed in the layout plan will be kept to a minim and the grass species, will be replaced with trees.
- The proposed road crossing should be designed in such a manner to improve the flow of water between the main channel. This will reinstate some of the tidal flows, improving the available habitat and quality of the water.

Significance of impact with mitigation

Due to the nature of the study area hydrology, its present state and the present impacts the overall significance of the impact would be rated as **Slight**, Positive (Table 4).

Table 4: The potential impact of changes to the local hydrological regimes and increased potential of erosion post mitigation

Group A (Condition criteria)		
Extent (A1)		
A measure of the importance of the condition, which is assessed against the spatial boundaries or human interests it will affect.		
National / International interests	4	1
Regional / National interests	3	
Areas immediately outside the local condition	2	
Important only to the local condition	1	
No importance	0	
Magnitude of change / effect (A2)		
Magnitude is defined as a measure of the scale of benefit/dis-benefit of an impact or a condition.		
Major positive benefit	3	1
Significant improvement in status quo	2	
Improvement in status quo	1	
No change / Status quo	0	
Negative change to status quo	-1	
Significant negative dis-benefit or change	-2	
Major dis-benefit or change	-3	
Group A Score:		1
Group B (Situation criteria)		
Duration / Permanence (B1)		
This defines whether a condition is temporary or permanent, and should be seen only as a measure of the temporal status of the condition.(e.g.: an embankment is a permanent condition even if it may one day be breached or abandoned; whilst a coffer dam is a temporary condition, as it will be removed).		
No change / Not Applicable	1	3
Temporary	2	
Permanent	3	
Reversibility (B2)		
This defines whether the condition can be changed and is a measure of the control over the effect of the condition. It should not be confused or equated with permanence. (e.g.: an accidental toxic spillage into a river is a temporary condition (B1) but its effect (death of fish) is irreversible (B2); a town's sewage treatment works is a permanent condition (B1), the effect of its effluent can be changed (reversible condition) (B2))		
No change / Not Applicable	1	2
Reversible	2	
Irreversible	3	
Cumulative (B3)		
This is a measure of whether the effect will have a single direct impact or whether there will be a cumulative effect over time, or a synergistic effect with other conditions. The cumulative criterion is a means of judging the sustainability of a condition, and is not to be confused with a permanent /irreversible situation.		
No change / Not Applicable	1	2
Non-cumulative / single	2	

Cumulative / synergistic	3	
Group B Score:		7
Final Assessment score		**7**

5.1.2 Impact 2: Impact of changes to water quality

Nature of the impact

Presently, little is known about the water quality of the watercourses, but it is assumed that due to the activities in the study area, grazing, road storm water runoff the aquatic systems will contain some pollutants.

During construction, various materials, such as sediments, diesel, oils and cement, could also pose a threat to the continued functioning of downstream areas, if by chance it is dispersed via surface run-off, or are allowed to permeate into the groundwater.

In the operational phase the only potential issues are related to the any leaks or spills from any conservancy tanks (if required).

Significance of impacts without mitigation

Due to the nature of the study area hydrology, its present state and the present impacts, the overall significance of the impact would be rated as **Negative** (Table 5).

Proposed mitigation

- Chemicals used for construction must be stored safely on site and surrounded by bunds. Chemical storage containers must be regularly inspected so that any leaks are detected early.
- Littering and contamination of water sources during construction must be prevented by effective construction camp and on-site management.
- Emergency plans must be in place in case of spillages onto road surfaces and wetlands /water courses.
- No stockpiling should take place within a water course or wetland.
- All stockpiles must be protected from erosion, stored on flat areas where run-off will be minimised, and be surrounded by bunds.
- Stockpiles must be located away from river channels / wetlands.
- Erosion and sedimentation into channels must be minimised through the effective stabilisation (gabions and Reno mattresses) and the re-vegetation of any disturbed riverbanks, such as at the proposed road crossing.
- The construction camp and necessary ablution facilities meant for construction workers must not be in any of the delineated watercourses or wetland areas (including 20m buffer).
- For the operational phase, any sewer lines and or conservancy tanks must be inspected on a regular basis or emptied prior to becoming full.

Significance of impact with mitigation

Due to the nature of the study area hydrology, its present state and the present impacts the overall significance of the impact would be rated as **Slight**, negative (Table 5).

Table 5: The potential impact of changes to the local water quality

Group A (Condition criteria)		
Extent (A1)		
A measure of the importance of the condition, which is assessed against the spatial boundaries or human interests it will affect.		
National / International interests	4	1
Regional / National interests	3	
Areas immediately outside the local condition	2	
Important only to the local condition	1	
No importance	0	
Magnitude of change / effect (A2)		
Magnitude is defined as a measure of the scale of benefit/dis-benefit of an impact or a condition.		
Major positive benefit	3	-1
Significant improvement in status quo	2	
Improvement in status quo	1	
No change / Status quo	0	
Negative change to status quo	-1	
Significant negative dis-benefit or change	-2	
Major dis-benefit or change	-3	
Group A Score:		-1
Group B (Situation criteria)		
Duration / Permanence (B1)		
This defines whether a condition is temporary or permanent, and should be seen only as a measure of the temporal status of the condition.(e.g.: an embankment is a permanent condition even if it may one day be breached or abandoned; whilst a coffer dam is a temporary condition, as it will be removed).		
No change / Not Applicable	1	3
Temporary	2	
Permanent	3	
Reversibility (B2)		
This defines whether the condition can be changed and is a measure of the control over the effect of the condition. It should not be confused or equated with permanence. (e.g.: an accidental toxic spillage into a river is a temporary condition (B1) but its effect (death of fish) is irreversible (B2); a town's sewage treatment works is a permanent condition (B1), the effect of its effluent can be changed (reversible condition) (B2))		
No change / Not Applicable	1	2
Reversible	2	
Irreversible	3	
Cumulative (B3)		

This is a measure of whether the effect will have a single direct impact or whether there will be a cumulative effect over time, or a synergistic effect with other conditions. The cumulative criterion is a means of judging the sustainability of a condition, and is not to be confused with a permanent /irreversible situation.		
No change / Not Applicable	1	2
Non-cumulative / single	2	
Cumulative / synergistic	3	
Group B Score:		7
Final Assessment score		**-7**

5.1.3 Impact 3: Loss of any bed / banks or wetlands areas due to clearing of vegetation of infilling

Nature of the impact

Due to the nature of the proposed project this would no occur as no aquatic systems will be directly affected, assuming that the 1:100 year floodline or / water course whichever is larger is avoided.

Significance of impacts without mitigation

Due to the nature of the study area hydrology, its present state and the present impacts the overall significance of the impact would be rated as **Slight**, negative (Table 6).

Proposed mitigation

- The current layout should be adhered which will minimise the overall loss of any aquatic / watercourse habitat
- Suitable erosion protection such as gabions or stone pitching should also be included, to prevent any erosion/sedimentation, where it is envisaged that surface water flows will increase

The most recent layout shown below, takes cognisance of this and has excluded any development from these areas, while it is assumed that a detailed stormwater management plan will be developed

Significance of impact with mitigation

Due to the nature of the study area hydrology, its present state and the present impacts the overall significance of the impact would be rated as **N/A,** i.e. no wetlands or waterbodies will be lost (Table 6).

Table 6: The potential impact due to loss of wetlands and or aquatic systems

<table>
<tr><th colspan="3">Group A (Condition criteria)</th></tr>
<tr><td colspan="3">Extent (A1)</td></tr>
<tr><td colspan="3">A measure of the importance of the condition, which is assessed against the spatial boundaries or human interests it will affect.</td></tr>
<tr><td>National / International interests</td><td>4</td><td rowspan="5">0</td></tr>
<tr><td>Regional / National interests</td><td>3</td></tr>
<tr><td>Areas immediately outside the local condition</td><td>2</td></tr>
<tr><td>Important only to the local condition</td><td>1</td></tr>
<tr><td>No importance</td><td>0</td></tr>
<tr><td colspan="3">Magnitude of change / effect (A2)</td></tr>
<tr><td colspan="3">Magnitude is defined as a measure of the scale of benefit/dis-benefit of an impact or a condition.</td></tr>
<tr><td>Major positive benefit</td><td>3</td><td rowspan="7">0</td></tr>
<tr><td>Significant improvement in status quo</td><td>2</td></tr>
<tr><td>Improvement in status quo</td><td>1</td></tr>
<tr><td>No change / Status quo</td><td>0</td></tr>
<tr><td>Negative change to status quo</td><td>-1</td></tr>
<tr><td>Significant negative dis-benefit or change</td><td>-2</td></tr>
<tr><td>Major dis-benefit or change</td><td>-3</td></tr>
<tr><td colspan="2">Group A Score:</td><td>0</td></tr>
<tr><th colspan="3">Group B (Situation criteria)</th></tr>
<tr><td colspan="3">Duration / Permanence (B1)</td></tr>
<tr><td colspan="3">This defines whether a condition is temporary or permanent, and should be seen only as a measure of the temporal status of the condition.(e.g.: an embankment is a permanent condition even if it may one day be breached or abandoned; whilst a coffer dam is a temporary condition, as it will be removed).</td></tr>
<tr><td>No change / Not Applicable</td><td>1</td><td rowspan="3">1</td></tr>
<tr><td>Temporary</td><td>2</td></tr>
<tr><td>Permanent</td><td>3</td></tr>
<tr><td colspan="3">Reversibility (B2)</td></tr>
<tr><td colspan="3">This defines whether the condition can be changed and is a measure of the control over the effect of the condition. It should not be confused or equated with permanence. (e.g.: an accidental toxic spillage into a river is a temporary condition (B1) but its effect (death of fish) is irreversible (B2); a town's sewage treatment works is a permanent condition (B1), the effect of its effluent can be changed (reversible condition) (B2))</td></tr>
<tr><td>No change / Not Applicable</td><td>1</td><td rowspan="3">1</td></tr>
<tr><td>Reversible</td><td>2</td></tr>
<tr><td>Irreversible</td><td>3</td></tr>
<tr><td colspan="3">Cumulative (B3)</td></tr>
<tr><td colspan="3">This is a measure of whether the effect will have a single direct impact or whether there will be a cumulative effect over time, or a synergistic effect with other conditions. The cumulative criterion is a means of judging the sustainability of a condition, and is not to be confused with a permanent /irreversible situation.</td></tr>
<tr><td>No change / Not Applicable</td><td>1</td><td rowspan="3">1</td></tr>
<tr><td>Non-cumulative / single</td><td>2</td></tr>
<tr><td>Cumulative / synergistic</td><td>3</td></tr>
<tr><td colspan="2">Group B Score:</td><td>4</td></tr>
<tr><td colspan="2">Final Assessment score</td><td>0</td></tr>
</table>

6 CONCLUSION AND RECOMMENDATIONS

Various water bodies dominated the regional and study area landscape. All of the observed aquatic features showed some form of impact due to the land uses and land reclamation that has taken place over a period of time. However no true aquatic systems were confirmed within the site, only an area that would flood during extreme rainfall events.

Based then on the potential impacts addressed in the DWS Risk Assessment Matrix (Appendix A), with proper design and mitigation and avoidance of aquatic areas / areas within the 1:100 year flood line, all impacts were rated as LOW. This assumes that the channel areas will be excluded from the development footprint and the growth of indigenous species must be promoted, either through planting (terrestrial habitats.

All of the construction area will occur within 500m of wetland boundaries and would thus require WULA or GA, but this must be confirmed by the DWS.

Further recommendations and monitoring guidelines include:

- Vegetation clearing should occur in parallel with the construction progress to minimise erosion and/or run-off. Large tracts of bare soil will either cause dust pollution or quickly erode and then cause sedimentation in the lower portions of the catchment.
- Only indigenous plant species must be used in the re-vegetation process. The species list mentioned in this and the vegetation study should be used a guide
- All construction materials including fuels and oil should be stored in demarcated areas that are contained within berms / bunds to avoid spread of any contamination into wetlands. watercourses or rivers. Washing and cleaning of equipment should also be done within berms or bunds, in order to trap any cement and prevent excessive soil erosion. These sites must be re-vegetated after construction has been completed. The following list of plants would be suitable for rehabilitation, with most readily found in the nursery trade or are located within the site:
    - *Cynodon dactylon,*
    - *Digitaria eriantha,*
    - *Eragrostis curvula,*
    - *Imperata cylindrica,*
    - *Panicum deustum,*
    - *Themeda triandra,*
    - *Tristachya leucothrix* and
    - *Isolepis spp*
- Mechanical plant and tankers/bowsers must not be refuelled or serviced within or directly adjacent to any river channel or wetland area.
- Erosion control measures must be put in place prior to any construction activities that would result in soil being exposed.
- Weather forecasts from the South African Weather Bureau of up to three days in advance must be monitored on a daily basis to avoid exposing soil, works or materials during a storm event
- Appropriate action must be taken in advance to protect works should a storm event be forecasted;
- Any damage and loss of soil resulting from a storm is to be remedied immediately.
- The construction camp and necessary ablution facilities meant for construction workers must be well removed from the wetlands.
- All stockpiled material must be located outside wetlands.
- There should be no toilet facilities placed close to wetlands areas or water courses.
- No maintenance of machinery is to take place close to wetland areas unless adequate measures have been instituted to ensure that no hydrocarbons ingress into the soil or water.

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8 APPENDIX A – DWS RISK ASSESSMENT MATRIX

RISK MATRIX (Based on DWS 2016 publication: Section 21 c and I water use Risk Assessment Protocol)

NAME and REGISTRATION No of SACNASP Professional member: ......Dr Brian Colloty........................ Reg no. ......Ecologist 400268/07.................................

Risk to be scored for construction and operational phases of the project. MUST BE COMPLETED BY SACNASP PROFESSIONAL MEMBER REGISTERED IN AN APPROPRIATE FIELD OF EXPERTISE.

					Severity																		
No.	Phases	Activity	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph + Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	Borderline LOW MODERATE Rating Classes	PES AND EIS OF WATERCOURSE
1	Construction phase	Clearing of terrestrial vegetation	Clearing of remaining vegetation for housing and roads	Unstable soils will erode and create sedimentation downstream	2	2	2	0	1.5	1	1	3.5	2	2	5	1	10	35	LOW	90-100	Construction EMP, Monitoring and Rehabilitation Plan		Ranged C - D & High to Moderate
2	Construction phase	Loss of wetlands or water courses	Clearing of remaining vegetation for housing and roads	Direct loss of wetland or water courses	4	2	2	0	2	1	1	4	2	2	5	1	10	40	LOW	90-100	Acceptance of current layout Construction EMP, Monitoring and Rehabilitation Plan		Ranged C - D & High to Moderate
3	Construction phase	Loss of Species of Special Concern	Several plant species within the region are conservation worthy or are protected by the Provincial Nature Conservation Ordinance or NEA	Loss of threatened or protected plant species, although NO aquatic related species were observed within the site	0	0	0	0	0	0	0	0	0	0	0	0	0	0	LOW	100	Construction EMP, Monitoring and Rehabilitation Plan		Ranged C - D & High to Moderate
4	Construction phase	Spills and leaks from construction vehicles / machinery	Impact on localised surface water quality	Leaks from plant / machinery during the construction phase	2	1	1	1	1.25	1	1	3.25	2	2	5	1	10	32.5	LOW	90-100	Construction EMP, Monitoring and Rehabilitation Plan		Ranged C - D & High to Moderate
5	Operational Phase	Water quality impacts	Any spills or leaks from the package plant, pond or irrigation return flow	All designs should include bunds or other suitable mechanisms to prevent any additional water quality impacts together with effective maintenance and monitoring	1	2	1	2	1.5	2	2	5.5	3	1	5	1	10	55	LOW	90-100	Construction EMP, Monitoring and Rehabilitation Plan		Ranged C - D & High to Moderate
6	Operational Phase	Hard surface areas	Clearing of remaining vegetation for housing and roads	Poor stormwater management could lead to downstream erosion and sedimentation	1	2	2	1	1.5	1	3	5.5	2	2	5	1	10	55	LOW	90-100	Construction EMP, Monitoring and Rehabilitation Plan		Ranged C - D & High to Moderate

9 APPENDIX B – BUFFER MODEL RESULTS

Adjacent endorheic pans

SITE-BASED TOOL: DETERMINATION OF BUFFER ZONE REQUIREMENTS FOR WETLAND ECOSYSTEMS

Note: For further guidance on the application of this tool, users should refer to the guideline for the determination of buffer zones. It is also important to note that buffer widths calculated by the model only cater for impacts associated with diffuse-source surface runoff. Additional mitigation measures should therefore be defined to cater for other potential impacts. Finally, please note that this buffer zone tool has been designed to be completed sequentially for a single site - users must therefore use a new template for each assessment rather than "tweaking" previous assessments.

Name of Assessor	Brian Colloty	Project Details	Swan Lake	Date of Assessment	Jun-18

Step 1: Define objectives and scope of assessment and determine the most appropriate level of assessment

Level of assessment	Site-based

Step 2: Map and categorize water resources in the study area

Approach used to delineate the wetland boundary?	Site-based delineation	Wetland type	Depression

Step 3: Refer to the DWA management objectives for mapped water resources or develop surrogate objectives

Present Ecological State	C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.
Ecological importance & sensitivity	Medium	Features that are considered to be ecologically important and sensitive at a local scale. The functioning and/or biodiversity of these features is not usually sensitive to anthropogenic disturbances. They typically play a small role in providing ecological services at the local scale.
Management Objective	Maintain	

Step 4: Assess the risks from proposed developments and define mitigation measures necessary for protecting mapped water resources in the study area

Assess threats of planned activities on water resources and determine desktop buffer requirements

Proposed development / activity	Sector	Residential	Provides for land and buildings for a variety of housing types, ranging from areas that are almost entirely residential to those areas having a mix of other compatible land uses, where the predominant land use is residential.
	Sub-Sector	Residential Low impact / Residential only	Includes buildings for a variety of housing types with a limited number of compatible ancillary land uses permissible so as to cater for every day needs of the residents. The building density is likely to be low (<1unit/acre) and the amenity high, and generally in harmony with the natural environment.

Climatic factors	MAP Class	601 - 800mm	Rainfall Intensity	Zone 4

Phase	Threat Posed by the proposed land use / activity	Desktop Threat Rating	Specialist Threat Rating	Justification for changes in threat ratings
Construction Phase	1. Alteration to flow volumes	VL	VL	Potential for increases due to roads and buidlings, and inadequate measures to prevent stormwater discharges.
	2. Alteration of patterns of flows (increased flood peaks)	VL	VL	
	3. Increase in sediment inputs & turbidity	M	M	
	4. Increased nutrient inputs	VL	VL	Worse case scenario - sewage leakages
	5. Inputs of toxic organic contaminants	VL	VL	Worse case scenario - sewage leakages
	6. Inputs of toxic heavy metal contaminants	L	VL	Worse case scenario - sewage leakages, vehicles
	7. Alteration of acidity (pH)	VL	VL	
	8. Increased inputs of salts (salinization)	N/A	N/A	
	9. Change (elevation) of water temperature	VL	VL	
	10. Pathogen inputs (i.e. disease-causing organisms)	VL	VL	
Operational Phase	1. Alteration to flow volumes	L	VL	As above
	2. Alteration of patterns of flows (increased flood peaks)	L	VL	
	3. Increase in sediment inputs & turbidity	VL	VL	
	4. Increased nutrient inputs	VL	VL	
	5. Inputs of toxic organic contaminants	VL	VL	
	6. Inputs of toxic heavy metal contaminants	VL	Vl	
	7. Alteration of acidity (pH)	VL	VL	
	8. Increased inputs of salts (salinization)	VL	VL	
	9. Change (elevation) of water temperature	VL	VL	
	10. Pathogen inputs (i.e. disease-causing organisms)	L	L	

Assess the sensitivity of water resources to threats posed by lateral land-use impacts

Overall size	**Size of the wetland relative to (as a percentage of) its catchment**	**Average slope of the wetland's catchment**	**The inherent runoff potential of the soil in the wetland's catchment**	**The extent to which the wetland (HGM) setting is generally characterized by sub-surface water input**
0.5-5 ha	2-5%	<3%	Low (A & A/B)	Moderately low
Perimeter to area ratio	**Vulnerability of the HGM type to sediment accumulation**	**Vulnerability of the wetland to erosion given the wetland's slope and size**	**Extent of open water in relation to the extent of the HGM unit**	**Sensitivity of the vegetation to burial under sediment**
Intermediate (1200m- 801 m per ha)	Depression – exhoreic	Low (Vulnerability score 0)	Very low (<0.5%)	Moderately high
Peat / high organic content versus mineral soils	**Inherent level of nutrients in the landscape**	**Sensitivity of the vegetation to increased availability of nutrients**	**Sensitivity of the vegetation to toxic inputs, changes in acidity & salinization**	**Natural wetness regimes**
Mineral	Moderate base status	Moderately low	Moderately low	Dominated by temporarily saturated soils
Natural salinity levels	**Level of domestic, livestock and contact recreational use**	**Mean Annual Temperature**	Note: See the *Technical Manual* for further information on the rationale for indicator selection and how these attributes affect the sensitivity of wetlands to lateral inputs.	
Slightly Saline (200-400 mS/m)	High	Zone 4 (18.2 - 19.5 Deg C)		

Assess the sensitivity of important biodiversity elements to threats posed by lateral land-use impacts

Phase	Threat Posed by the proposed land use / activity	Sensitivity: Water Resource	Sensitivity: Biodiversity	Site-Based Risk Class	Justification for increasing the sensitivity to cater for any important biodiversity elements including special habitats and species of conservation concern.
Construction Phase	1. Alteration to flow volumes	M		VL	
	2. Alteration of patterns of flows (increased flood peaks)	H		VL	
	3. Increase in sediment inputs & turbidity	M		M	
	4. Increased nutrient inputs	M		VL	
	5. Inputs of toxic organic contaminants	M		VL	
	6. Inputs of toxic heavy metal contaminants	M		VL	
	7. Alteration of acidity (pH)	H		VL	
	8. Increased inputs of salts (salinization)	M		N/A	
	9. Change (elevation) of water temperature	M		VL	
	10. Pathogen inputs (i.e. disease-causing organisms)	H		VL	
Operational Phase	1. Alteration to flow volumes	M		VL	
	2. Alteration of patterns of flows (increased flood peaks)	H		VL	
	3. Increase in sediment inputs & turbidity	M		VL	
	4. Increased nutrient inputs	M		VL	
	5. Inputs of toxic organic contaminants	M		VL	
	6. Inputs of toxic heavy metal contaminants	M		VL	
	7. Alteration of acidity (pH)	H		VL	
	8. Increased inputs of salts (salinization)	M		VL	
	9. Change (elevation) of water temperature	M		VL	
	10. Pathogen inputs (i.e. disease-causing organisms)	H		L	

Refine desktop buffer requirements based on site-based investigations

Buffer attributes	Buffer Segment 1	Buffer Segment 2	Buffer Segment 3	Buffer Segment 4
Slope of the buffer	Very Gentle (0 - 2%)			
Vegetation characteristics (Construction phase)	Good: Moderately robust vegetation with good interception potential (e.g. good condition tufted grass stands).			
Vegetation characteristics (Operational phase)	Good: Moderately robust vegetation with good interception potential (e.g. good condition tufted grass stands).			
Soil permeability	Low: Deep fine textured soils with low permeability (e.g. clay, sandy clay & clay loam) OR shallow (<30cm) soils with low to moderately low permeability.			
Micro-topography of the buffer zone	Uniform topography: Smooth topography with no concentrated flow paths anticipated.			
Site-based aquatic impact buffer requirements (without additional mitigation measures)				
Construction Phase	12	Not Assessed	Not Assessed	Not Assessed
Operational Phase	10	Not Assessed	Not Assessed	Not Assessed

Where appropriate, identify additional mitigation measures and refine aquatic impact buffer width accordingly

Phase	Threat Posed by the proposed land use / activity	Specialist Threat Rating	Description of any additional mitigation measures	Refined Threat Class	Specialist justification for refined threat ratings with clear reference to supporting documentation.
Construction Phase	1. Alteration to flow volumes	VL			
	2. Alteration of patterns of flows (increased flood peaks)	VL			
	3. Increase in sediment inputs & turbidity	M			
	4. Increased nutrient inputs	VL			
	5. Inputs of toxic organic contaminants	VL			
	6. Inputs of toxic heavy metal contaminants	VL			
	7. Alteration of acidity (pH)	VL			
	8. Increased inputs of salts (salinization)	N/A			
	9. Change (elevation) of water temperature	VL			
	10. Pathogen inputs (i.e. disease-causing organisms)	VL			
Operational Phase	1. Alteration to flow volumes	VL			
	2. Alteration of patterns of flows (increased flood peaks)	VL			
	3. Increase in sediment inputs & turbidity	VL			
	4. Increased nutrient inputs	VL			
	5. Inputs of toxic organic contaminants	VL			
	6. Inputs of toxic heavy metal contaminants	Vl			
	7. Alteration of acidity (pH)	VL			
	8. Increased inputs of salts (salinization)	VL			
	9. Change (elevation) of water temperature	VL			
	10. Pathogen inputs (i.e. disease-causing organisms)	L			

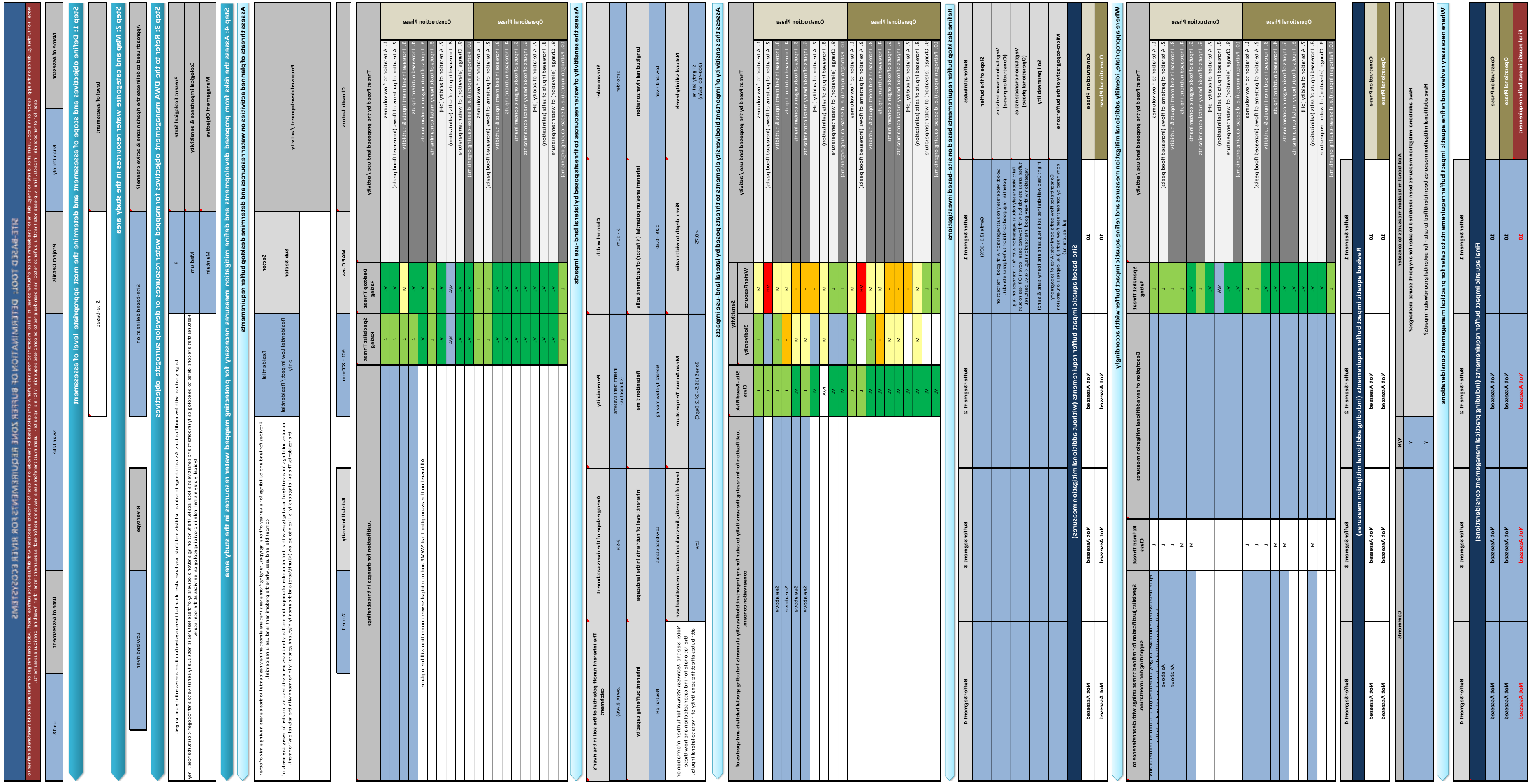
	Buffer Segment 1	Buffer Segment 2	Buffer Segment 3	Buffer Segment 4
Revised aquatic impact buffer requirements (including additional mitigation measures)				
Construction Phase	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Operational Phase	Not Assessed	Not Assessed	Not Assessed	Not Assessed

Additional mitigation measures to consider	Y/N	Comments
Have additional mitigation measures been identified to cater for any point-source discharges?	Y	
Have additional mitigation measures been identified to cater for potential groundwater impacts?		

Where necessary review and refine aquatic impact buffer requirements to cater for practical management considerations

	Buffer Segment 1	Buffer Segment 2	Buffer Segment 3	Buffer Segment 4
Final aquatic impact buffer requirements (including practical management considerations)				
Construction Phase	12	Not Assessed	Not Assessed	Not Assessed
Operational Phase	10	Not Assessed	Not Assessed	Not Assessed
Final aquatic impact buffer requirement	12	Not Assessed	Not Assessed	Not Assessed

Water courses (Drainage areas)



SITE-BASED TOOL: DETERMINATION OF BUFFER ZONE

Name of Assessor	Brian Colloty	Project Details	Swan Lake

Step 1: Define objectives and scope of assessment and determine the most appropriate level of assessment

Level of assessment	Site-based

Step 2: Map and categorize water resources in the study area

Approach used to delineate the riparian zone & active channel?	Site-based delineation

Step 3: Refer to the DWA management objectives for mapped water resources or develop surrogate objectives

Present Ecological State	B	Largely natural with few modifications
Ecological importance & sensitivity	Medium	Features that are considered to be ecologically important
Management Objective	Maintain	

Step 4: Assess the risks from proposed development and define mitigation measures necessary for protecting mapped water resources

Assess threats of planned activities on water resources and determine desktop buffer requirements

Proposed development / activity	Sector	Residential
	Sub-Sector	Residential Low impact / Residential only

Climatic factors	MAP Class	601 - 800mm

Estuaries (Seekoie)

SITE-BASED TOOL: DETERMINATION OF BUFFER ZONE REQUIREMENTS FOR FOR ESTUARINE SYSTEMS

Note: For further guidance on the application of this tool, users should refer to the guideline for the determination of buffer zones. It is also important to note that buffer widths calculated by the model only cater for impacts associated with diffuse-source surface runoff. Additional mitigation measures should therefore be defined to cater for other potential impacts. Finally, please note that this buffer zone tool has been designed to be completed sequentially for a single site - users must therefore use a new template for each assessment rather than "tweaking" previous assessments.

Name of Assessor	Brian	Project Details	Swan Lake	Date of Assessment	01-Jun-18

Step 1: Define objectives and scope of assessment and determine the most appropriate level of assessment

Level of assessment	Site-based

Note: Site-based delineation of watercourses must be undertaken for detailed planning and authorization purposes

Step 2: Map and categorize water resources in the study area

Approach used to delineate the estuary boundary & supratidal zone?	Desktop mapping using available datasets	Estuary type	Closed Estuary

Step 3: Refer to the DWA management objectives for mapped water resources or develop surrogate objectives

Name of Estuary	Seekoei	
Present Ecological State	D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.
Estuary Importance	High	Features that are considered to be ecologically important and sensitive at a regional scale. The functioning and/or biodiversity of these features are typically moderately sensitive to anthropogenic disturbances. They typically play an important role in providing ecological services at the local scale.
Management Objective		

Step 4: Assess the risks from proposed developments and define mitigation measures necessary for protecting mapped water resources in the study area

Assess threats of planned activities on water resources and determine desktop buffer requirements

Proposed development / activity	Sector	Residential	Provides for land and buildings for a variety of housing types, ranging from areas that are almost entirely residential to those areas having a mix of other compatible land uses, where the predominant land use is residential.
	Sub-Sector	Residential Low impact / Residential only	Includes buildings for a variety of housing types with a limited number of compatible ancillary land uses permissible so as to cater for every day needs of the residents. The building density is likely to be low (<1unit/acre) and the amenity high, and generally in harmony with the natural environment.

Climatic factors	MAP Class	601 - 800mm	Rainfall Intensity	Zone 2

Phase	Threat Posed by the proposed land use / activity	Desktop Threat Rating	Specialist Threat Rating	Justification for changes in threat ratings
Construction Phase	1. Alteration to flow volumes	VL	VL	
	2. Alteration of patterns of flows (increased flood peaks)	VL	VL	
	3. Increase in sediment inputs & turbidity	M	M	
	4. Increased nutrient inputs	VL	VL	
	5. Inputs of toxic organic contaminants	VL	VL	
	6. Inputs of toxic heavy metal contaminants	L	L	
	7. Alteration of acidity (pH)	VL	VL	
	8. Increased inputs of salts (salinization)	N/A	N/A	
	9. Change (elevation) of water temperature	VL	VL	
	10. Pathogen inputs (i.e. disease-causing organisms)	VL	VL	
Operational Phase	1. Alteration to flow volumes	L	L	
	2. Alteration of patterns of flows (increased flood peaks)	L	L	
	3. Increase in sediment inputs & turbidity	VL	VL	
	4. Increased nutrient inputs	VL	VL	
	5. Inputs of toxic organic contaminants	VL	VL	
	6. Inputs of toxic heavy metal contaminants	VL	VL	
	7. Alteration of acidity (pH)	VL	VL	
	8. Increased inputs of salts (salinization)	VL	VL	
	9. Change (elevation) of water temperature	VL	VL	
	10. Pathogen inputs (i.e. disease-causing organisms)	L	L	

Assess the sensitivity of water resources to threats posed by lateral land-use impacts

Estuary size	Estuary Length	Perenniality of river inflows	The inherent runoff potential of the soil in the estuaries catchment	Mouth closure
<10 ha	<5 km	Intermittent	Mod. High (C)	>80%
Water Clarity	**Presence of submerged macrophytes**	**Biogeographic zone**	**Level of domestic, livestock and contact recreational use**	Note: See the *Technical Guide* for further information on the rationale for indicator selection and how these attributes affect the sensitivity of Estuaries to lateral inputs.
Blackwater	No	Warm temperate	High	

Assess the sensitivity of important biodiversity elements to threats posed by lateral land-use impacts

Phase	Threat Posed by the proposed land use / activity	Sensitivity: Water Resource	Sensitivity: Biodiversity	Site-Based Risk Class	Justification for increasing the sensitivity to cater for any important biodiversity elements including special habitats and species of conservation concern.
Construction Phase	1. Alteration to flow volumes	H	VL	VL	
	2. Alteration of patterns of flows (increased flood peaks)	H	VL	VL	
	3. Increase in sediment inputs & turbidity	M	VL	M	
	4. Increased nutrient inputs	H	VL	VL	
	5. Inputs of toxic organic contaminants	H	VL	VL	
	6. Inputs of toxic heavy metal contaminants	H	VL	L	
	7. Alteration of acidity (pH)	H	VL	VL	
	8. Increased inputs of salts (salinization)	H	VL	N/A	
	9. Change (elevation) of water temperature	H	VL	VL	
	10. Pathogen inputs (i.e. disease-causing organisms)	H	VL	VL	
Operational Phase	1. Alteration to flow volumes	H	VL	L	
	2. Alteration of patterns of flows (increased flood peaks)	H	VL	L	
	3. Increase in sediment inputs & turbidity	M	VL	VL	
	4. Increased nutrient inputs	H	VL	VL	
	5. Inputs of toxic organic contaminants	H	VL	VL	
	6. Inputs of toxic heavy metal contaminants	H	VL	VL	
	7. Alteration of acidity (pH)	H	VL	VL	
	8. Increased inputs of salts (salinization)	H	VL	VL	
	9. Change (elevation) of water temperature	H	VL	VL	
	10. Pathogen inputs (i.e. disease-causing organisms)	H	VL	L	

Refine desktop buffer requirements based on site-based investigations

Buffer attributes	Buffer Segment 1	Buffer Segment 2	Buffer Segment 3	Buffer Segment 4
Slope of the buffer	Moderate(10.1 - 20%)			
Vegetation characteristics (Construction phase)	Good: Moderately robust vegetation with good interception potential (e.g. good condition tufted grass stands).			
Vegetation characteristics (Operational phase)	Poor: Vegetation either short (<5cm) (e.g. maintained lawns) or robust but widely spaced plants with poor interception (e.g. trees or shrubs with poorly vegetated understory).			
Soil permeability	High: Deep well-drained soils (e.g. sand and loamy sand & sand).			
Micro-topography of the buffer zone	Concentrated flow paths dominate: Area of topography dominated by concentrated flow paths (i.e. depression, erosion gullies, drains)			
Site-based aquatic impact buffer requirements (without additional mitigation measures)				
Construction Phase	14	Not Assessed	Not Assessed	Not Assessed
Operational Phase	10	Not Assessed	Not Assessed	Not Assessed

Where appropriate, identify additional mitigation measures and refine aquatic impact buffer width accordingly

Phase	Threat Posed by the proposed land use / activity	Specialist Threat Rating	Description of any additional mitigation measures	Refined Threat Class	Specialist justification for refined threat ratings with clear reference to supporting documentation.
Construction Phase	1. Alteration to flow volumes	VL			
	2. Alteration of patterns of flows (increased flood peaks)	VL			
	3. Increase in sediment inputs & turbidity	M			
	4. Increased nutrient inputs	VL			
	5. Inputs of toxic organic contaminants	VL			
	6. Inputs of toxic heavy metal contaminants	L			
	7. Alteration of acidity (pH)	VL			
	8. Increased inputs of salts (salinization)	N/A			
	9. Change (elevation) of water temperature	VL			
	10. Pathogen inputs (i.e. disease-causing organisms)	VL			
Operational Phase	1. Alteration to flow volumes	L			
	2. Alteration of patterns of flows (increased flood peaks)	L			
	3. Increase in sediment inputs & turbidity	VL			
	4. Increased nutrient inputs	VL			
	5. Inputs of toxic organic contaminants	VL			
	6. Inputs of toxic heavy metal contaminants	VL			
	7. Alteration of acidity (pH)	VL			
	8. Increased inputs of salts (salinization)	VL			
	9. Change (elevation) of water temperature	VL			
	10. Pathogen inputs (i.e. disease-causing organisms)	L			

	Buffer Segment 1	Buffer Segment 2	Buffer Segment 3	Buffer Segment 4
Revised aquatic impact buffer requirements (including additional mitigation measures)				
Construction Phase	Not Assessed	Not Assessed	Not Assessed	Not Assessed
Operational Phase	Not Assessed	Not Assessed	Not Assessed	Not Assessed

Additional mitigation measures to consider	Y/N	Comments
Have additional mitigation measures been identified to cater for any point-source discharges?	Y	
Have additional mitigation measures been identified to cater for potential groundwater impacts?	Y	

Where necessary review and refine aquatic impact buffer requirements to cater for practical management considerations

	Buffer Segment 1	Buffer Segment 2	Buffer Segment 3	Buffer Segment 4
Final aquatic impact buffer requirements (including practical management considerations)				
Construction Phase	14	Not Assessed	Not Assessed	Not Assessed
Operational Phase	10	Not Assessed	Not Assessed	Not Assessed
Final aquatic impact buffer requirement	14	Not Assessed	Not Assessed	Not Assessed

CURRICULUM VITAE
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083 498 3299

Profession: Ecologist & Environmental Assessment Practitioner (Pr. Sci. Nat. 400268/07 & EAPSA certified). Member of the South African Wetland Society
Specialisation: Ecology and conservation importance rating of inland habitats, wetlands, rivers & estuaries
Years experience: 21 years

SKILLS BASE AND CORE COMPETENCIES

- 21 years experience in environmental sensitivity and conservation assessment of aquatic and terrestrial systems inclusive of Index of Habitat Integrity (IHI), WET Tools, Riparian Vegetation Response Assessment Index (VEGRAI) for Reserve Determinations, estuarine and wetland delineation throughout Africa. Experience also includes biodiversity and ecological assessments with regard sensitive fauna and flora, within the marine, coastal and inland environments. Countries include Mozambique, Kenya, Namibia, Central African Republic, Zambia, Eritrea, Mauritius, Madagascar, Angola, Ghana, Guinea-Bissau and Sierra Leone. Current projects also span all nine provinces in South Africa.
- 12 years experience in the coordination and management of multi-disciplinary teams, such as specialist teams for small to large scale EIAs and environmental monitoring programmes, throughout Africa and inclusive of marine, coastal and inland systems. This includes project and budget management, specialist team management, client and stakeholder engagement and project reporting.
- GIS mapping and sensitivity analysis

TERTIARY EDUCATION

- 1994: B Sc Degree (Botany & Zoology) - NMMU
- 1995: B Sc Hon (Zoology) - NMMU
- 1996: M Sc (Botany - Rivers) - NMMU
- 2000: Ph D (Botany – Estuaries & Mangroves) – NMMU

EMPLOYMENT HISTORY

- 1996 – 2000 Researcher at Nelson Mandela Metropolitan University – SAB institute for Coastal Research & Management. Funded by the WRC.
- 2001 – January 2003 Training development officer AVK SA (reason for leaving – sought work back in the environmental field rather than engineering sector)
- February 2003- June 2005 Project manager & Ecologist for Strategic Environmental Focus (Pretoria) – (reason for leaving – sought work related more to experience in the coastal environment)
- July 2005 – June 2009 Principal Environmental Consultant Coastal & Environmental Services (reason for leaving – company restructuring)
- June 2009 – present Owner / Ecologist of Scherman Colloty & Associates cc

SELECTED RELEVANT PROJECT EXPERIENCE

World Bank IFC Standards

- Kenmare Mining Pilivilli, Mozambique - wetland (mangroves, peatlands and estuarine) assessment and biodiversity offset analysis - current
- Botswana South Africa 400kv transmission line (400km) biodiversity assessment on behalf of Aurecon - current
- Farim phosphate mine and port development, Guinea Bissau – biodiversity and estuarine assessment on behalf of Knight Piesold Canada – 2016.
- Tema LNG offshore pipeline EIA – marine and estuarine assessment for Quantum Power (2015).
- Colluli Potash South Boulder, Eritrea, SEIA marine baseline and hydrodynamic surveys co-ordinator and coastal vegetation specialist (coastal lagoon and marine) (on-going).
- Wetland, estuarine and riverine assessment for Addax Biofeuls Sierra Leone, Makeni for Coastal & Environmental Services: 2009
- ESHIA Project manager and long-term marine monitoring phase coordinator with regards the dredge works required in Luanda bay, Angola. Monitoring included water quality and biological changes in the bay and at the offshore disposal outfall site, 2005-2011

South African

- Wetland specialist appointed to update the Eastern Cape Biodiversity Conservation Plan, for the Province on behalf of EOH CES appointment by SANBI – current. This includes updating the National Wetland Inventory for the province, submitting the new data to CSIR/SANBI.

- Nelson Mandela Bay Municipality Baakens River Integrated Wetland Assessment (Inclusive of Rehabilitation and Monitoring Plans) for CEN IEM Unit - Current
- Rangers Biomass Gasification Project (Uitenhage), wetland assessment and wetland rehabilitation / monitoring plans for CEM IEM Unit – current.
- Gibson Bay Wind Farm implementation of the wetland management plan during the construction and operation of the wind farm (includes surface / groundwater as well wetland rehabilitation & monitoring plan) on behalf of Enel Green Power - current
- Gibson Bay Wind Farm 133kV Transmission Line wetland management plan during the construction of the transmission line (includes wetland rehabilitation & monitoring plan) on behalf of Eskom – 2016.
- Tsitsikamma Community Wind Farm implementation of the wetland management plan during the construction of the wind farm (includes surface / biomonitoring, as well wetland rehabilitation & monitoring plan) on behalf of Cennergi – completed May 2016.
- Alicedale bulk sewer pipeline for Cacadu District, wetland and water quality assessment, 2016
- Mogalakwena 33kv transmission line in the Limpopo Province, on behlaf of Aurecon, 2016
- Cape St Francis WWTW expansion wetland and passive treatment system for the Kouga Municipality, 2015
- Macindane bulk water and sewer pipelines wetland and wetland rehabilitation plan for the Indwe 2015
- Eskom Prieska to Copperton 132kV transmission line aquatic assessment, Northern Cape on behalf of Savannah Environmental 2015.
- Joe Slovo sewer pipeline upgrade wetland assessment for Nelson Mandela Bay Municipality 2014
- Cape Recife Waste Water Treatment Works expansion and pipeline aquatic assessment for Nelson Mandela Bay Municipality 2013
- Pola park bulk sewer line upgrade aquatic assessment for Nelson Mandela Bay Municipality 2013
- Transnet Freight Rail – Swazi Rail Link (Current) wetland and ecological assessment on behalf of Aurecon for the proposed rail upgrade from Ermelo to Richards Bay
- Eskom Transmission wetland and ecological assessment for the proposed transmission line between Pietermaritzburg and Richards Bay on behalf of Aurecon (2012).
- Port Durnford Exarro Sands biodiversity assessment for the proposed mineral sands mine on behalf of Exxaro (2009)
- Fairbreeze Mine Exxaro (Mtunzini) wetland assessment on behalf of Strategic Environmental Services (2007).
- Wetland assessment for Richards Bay Minerals (2013) – Zulti North haul road on behalf of RBM.
- Biodiversity and aquatic assessments for 85 renewable projects in the past four years in the Western, Eastern, Northern Cape, KwaZulu-Natal and Free State provinces. Clients included RES-SA, RedCap, ACED Renewables, Mainstream Renewable, GDF Suez, Globeleq, ENEL, Abengoa amongst others. Particular aquatic sensitivity assessment and Water Use License Applications on behalf of Mainstream Renewable Energy (8 wind farms and 3 PV facilities.), Cennergi / Exxaro (2 Wind farm), WKN Wind current (2 wind farms & 2 PV facilities), ACED (6 wind farms) and Windlab (3 Wind farms) were also conducted. Several of these projects also required the assessment of the proposed transmission lines and switching stations, which were conducted on behalf of Eskom.
- Vegetation assessments on the Great Brak rivers for Department of Water and Sanitation, 2006 and the Gouritz Water Management Area (2014)
- Proposed FibreCo fibre optic cable vegetation assessment along the N2, PE to Cape Town, 2012 on behalf of SRK (2013).

RISK MATRIX (Based on DWS 2016 publication: Section 21 c and I water use Risk Assessment Protocol)

NAME and REGISTRATION No of SACNASP Professional member: ......Dr Brian Colloty.............................. Reg no. ......Ecologist 400268/07...................................

Risk to be scored for construction and operational phases of the project. MUST BE COMPLETED BY SACNASP PROFESSIONAL MEMBER REGISTERED IN AN APPROPRIATE FIELD OF EXPERTISE.

					Severity																		
No.	Phases	Activity	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph + Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	Borderline LOW MODERATE Rating Classes	PES AND EIS OF WATERCOURSE
1	Construction phase	**Clearing of terrestrial vegetation**	Clearing of remaining vegetation for housing and roads	Unstable soils will erode and create sedimentation downstream	2	2	2	0	1,5	1	1	3,5	2	2	5	1	10	35	LOW	90-100	Construction EMP, **Monitoring and Rehabilitation** Plan		Ranged C - D & High to Moderate
2	Construction phase	**Loss of wetlands or water courses**	Clearing of remaining vegetation for housing and roads	Direct loss of wetland or water courses	4	2	2	0	2	1	1	4	2	2	5	1	10	40	LOW	90-100	Acceptance of current layout Construction EMP, **Monitoring and Rehabilitation** Plan		Ranged C - D & High to Moderate
3	Construction phase	**Loss of Species of Special Concern**	Several plant species within the region are conservation worthy or are protected by the Provincial Nature Conservation Ordinance or NFA	Loss of threatened or protected plant species, although NO aquatic related species were observed within the site	0	0	0	0	0	0	0	0	0	0	0	0	0	0	LOW	100	Construction EMP, **Monitoring and Rehabilitation** Plan		Ranged C - D & High to Moderate
4	Construction phase	**Spills and leaks from construction vehicles / machinery**	Impact on localised surface water quality	Leaks from plant / machinery during the construction phase	2	1	1	1	1,25	1	1	3,25	2	2	5	1	10	32,5	LOW	90-100	Construction EMP, **Monitoring and Rehabilitation** Plan		Ranged C - D & High to Moderate
5	Operational Phase	**Water quality impacts**	Any spills or leaks from the package plant, pond or irrigation return flow	All designs should include bunds or other suitable mechanisms to prevent any additional water quality impacts together with effective maintenance and monitoring	1	2	1	2	1,5	2	2	5,5	3	1	5	1	10	55	LOW	90-100	Construction EMP, **Monitoring and Rehabilitation** Plan		Ranged C - D & High to Moderate
6	Operational Phase	**Hard surface areas**	Clearing of remaining vegetation for housing and roads	Poor stormwater management could lead to downstream erosion and sedimentation	1	2	2	1	1,5	1	3	5,5	2	2	5	1	10	55	LOW	90-100	Construction EMP, **Monitoring and Rehabilitation** Plan		Ranged C - D & High to Moderate