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FRESHWATER HABITAT IMPACT ASSESSMENT

for the

PROPOSED MIXED-USE DEVELOPMENT OF PORTION 9 OF FARM 432, KRANSHOEK

PREPARED FOR: Mr Lance Del Monte
Metroplan Town and Regional Planners

PREPARED BY: Sharples Environmental Services cc
Contact Person: Debbie Bekker
Email: debbie@sescc.net

DATE: 12 March 2019

Declaration of Independence

I, Debbie Bekker, declare that I:

- Act as an independent specialist consultant, in this application, in the field of wetland ecology;
- Do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the amended EIA Regulations, 2014 (amended);
- Have, and will have, no vested interest in the proposed activity proceeding;
- Have no, and will not engage in, conflicting interests in the undertaking of the activity;
- Undertake to disclose, to the competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the amended EIA Regulations, 2014; and
- Will provide the competent authority with access to all the information at my disposal regarding the application, whether such information is favourable to the applicant or not.

The following report has been prepared:

- As per the requirements of Section 32 (3) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) Environmental Impact Assessment Regulations 2017 as per Government Notice No. 326 Government Gazette, 7 April 2017.
- In accordance with Section 13: General Requirements for Environmental Assessment Practitioners (EAPs) and Specialists as well as per Appendix 6 of GNR 982 - Environmental Impact Assessment 2014 Regulations and the National Environmental Management Act, 1998.
- With consideration to Cape Nature’s standard requirements for biodiversity assessments.
- In accordance with DEA&DP’s Guideline on Involving biodiversity specialists in the EIA process
- Independently of influence or prejudice by any parties.

Project Team

The author of this report, Debbie Bekker, is in agreeance with the ‘Declaration of Independence’.

Specialist	**Qualifications**	**Details**
Debbie Bekker M.Sc	M.Sc - Environmental Science BA (Hons) - Environmental Science BA - Environmental Science and Geography	Debbie is a qualified aquatic ecologist and environmental scientist. Debbie holds a BA (Environmental Science and Geography), BA (Hons) and M.Sc in Environmental Science from Rhodes University. She was awarded her Master of Science degree, by thesis, in Wetland Science, entitled: The origin and evolution of the Tierkloof Wetland, a peatland dominated by *Prionium serratum* in the Western Cape. She has specialised in aquatic habitat assessment and has produced numerous aquatic habitat impact assessment reports. She is well established in her specialist field and has worked in various provinces within South Africa.
Consultant	**Qualifications**	**Details**
Marita Burger B.Sc (Hons)	BSc (Hons) – Environmental Science BSc - Environmental and Biological Science	Marita is an environmental assessment practitioner. She holds a BSc in Environmental and Biological Sciences and a BSc Hons in Environmental Science. Her key interests are water resource management and GIS mapping.

INDEMNITY AND COPYRIGHT

Report citation:
Sharples Environmental Services cc, 2019. Freshwater Habitat Impact Assessment for the mixed use development of Portion 9 of Farm 432, Kranshoek.

EXECUTIVE SUMMARY

The study area of the proposed project is located within the DWS Quaternary Catchment K60G and falls within the Gouritz Water Management Area. A screening assessment identified seven wetland systems within a 500 m radius of the site. Following this, the watercourses that may potentially be impacted upon by the proposed project were verified through infield soil samples and documentation of vegetation communities and species and key features within the landscape. The two wetlands that traverse the site, named WET/3 and WET/4 for the purposes of this study, will be directly impacted upon by the proposed development. WET/7, located near the southern boundary of the site is likely to be indirectly impacted upon. Any development within the site is likely to impact the habitat, biota, and water quality of these three wetlands and they therefore underwent full impact assessment. It was determined that the current proposed layout, even if some form of mitigation is implemented, will potentially result in unacceptably high impacts and irreversible resource loss. The proposed development could result in complete destruction of patterns and permanent cessation of wetland processes and thus the impact must have an influence on the decision process to develop the area.

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1 INTRODUCTION

Sharples Environmental Services cc (SES) has been appointed by Metroplan Town and Regional Planners, to conduct a Freshwater Specialist Impact Assessment for the proposed mixed-use development of Portion 9 of Farm 432, Kranshoek (Figure 1). Kranshoek is a residential township located west of the town of Plettenberg Bay in the Bitou Municipal Area. It is to the south of Robberg Road which connects the western parts of Plettenberg Bay to the N2 further west of Kranshoek, and north of the Indian Ocean coast. Portion 9 is found to the east of Kranshoek, just opposite Trekkerspad which borders urban development. Kranshoek is comprised of township extensions linked by gravel and tar roads. Urban development to the west of the proposed site are affordable housing and a school. North of Portion 9 is mostly vacant land and east and south agricultural farm portions can be found.

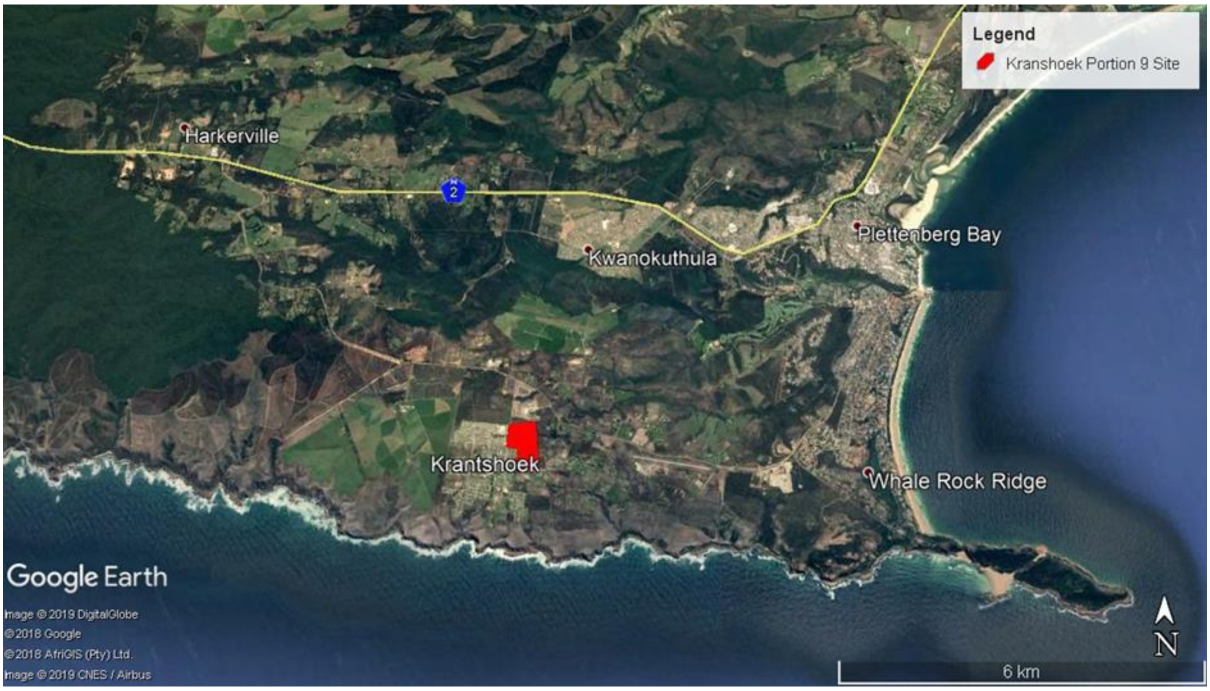

Figure 1: Google Earth image of the location of the site in relation to Plettenberg Bay and the Atlantic Ocean

There is a need to address the housing backlog within the Kranshoek area therefore it is proposed to develop the land on Portion 9 of Farm Kranshoek 432. This application for development is only aimed at Portion 9 of Farm 432, but the long term intend is to develop Portion 7 and 8 together with Portion 9. These portions will be about 65.77Ha in total which is enough space for about 1720 housing units. The proposed development has a mixed-use component incorporating a residential, recreational and retail component (Figure 2).

It will have 558 Residential Zone I erven for mainly the Affordable Housing market aimed specifically, but not exclusively at first time home owners who are eligible for the Finance Linked Individual Subsidy Programme (FLISP), as well as fully bonded home ownership under Freehold Title for the nonsubsidised market. Provision is also made for a site of approximately 2,9Ha, for the accommodation of up to 316 families in walk-up apartment accommodation for both subsidised (Social Housing) and unsubsidised rental accommodation. Other facilities include a Shopping Centre, a corner shop, two sites for Churches, a site for a Crèche, a Health Clinic and a School. The intention is to provide additional housing opportunities in the Kranshoek area together with associated Social and Economic facilities which would be of benefit to Kranshoek as a whole, enabling fulfilment of the Bitou's Planning Policy which proposes to strengthen Kranshoek to becoming a significant self-sustaining node, connected to the main centres of Plettenberg Bay.

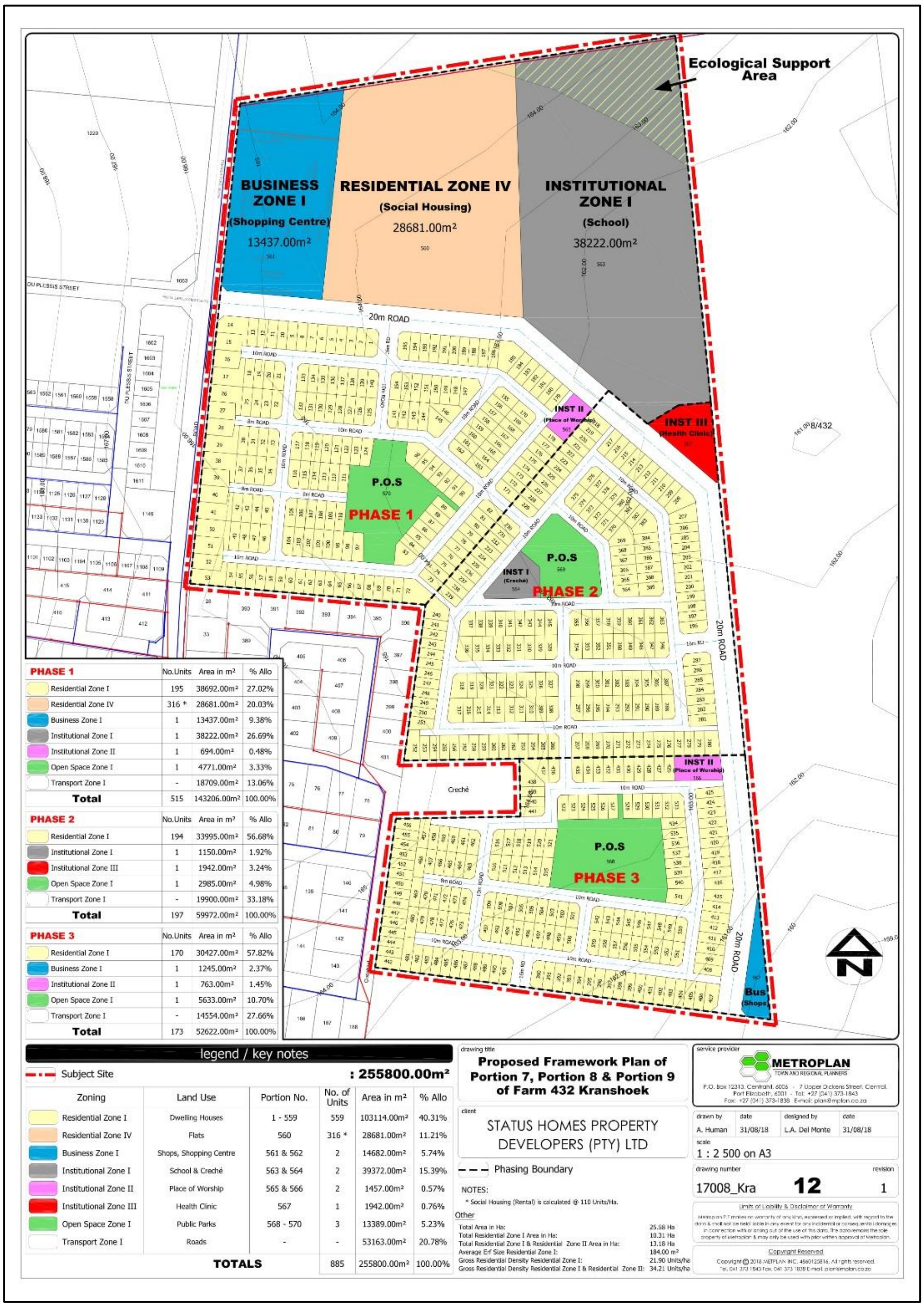

Figure 2: The proposed layout of the development

According to the 2018 Bitou Local Municipality Spatial Development Framework (Bitou SDF), and Figure 3 below:

- Future expansion of Kranshoek should be towards the north (closer to Robberg Road) and to the east (closer to the airport); The site to the north-east(8) between Kranshoek and Robberg Road is already approved as an industrial area;
- The land to the north-east of Kranshoek is earmarked for a future Industrial Park and already accommodates a chicken broiler. The site to the south thereof is earmarked for future housing and the land adjacent to the south thereof for a future tea farm.

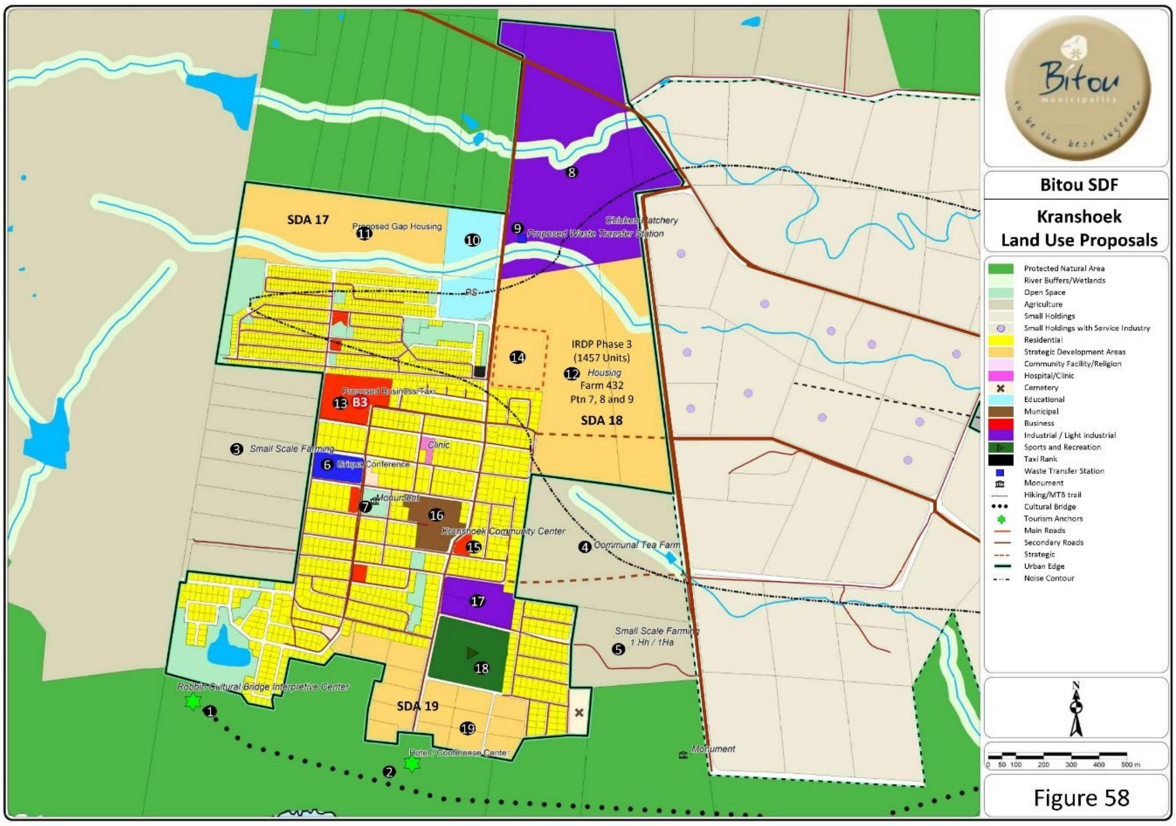

Figure 3: The Bitou SDF land use proposal for the Kranshoek areas indicating the site as a strategic development area.

In this respect, the proposed development is in alignment with the Bitou SDF. However, the SDF also discusses the Eden District Municipality Wetland Report 2017, which highlights the high value of critical ecological services the wetlands provide to the municipality. These include flood attenuation, water filtration, erosion control and water storage (regulatory services) as well as food provision, supply of raw materials and clean drinking water (provisioning services). The wetlands within the municipality also play a pivotal role in disaster risk management as well as reducing the impacts of climate change within the region. Therefore, the SDF states that wetlands require careful consideration during the spatial planning process. It identifies threats such as inappropriate development within close proximity to the wetlands, contamination through chemical and sewage effluent, as well as alien invasive trees. But the areas proposed for development within the Kranshoek area contain wetland habitat that has not seemingly been taken into consideration in a proactive, conscientious manner. In this respect, the development is not in alignment with the SDF and the cumulative impacts of this spatial development plan have not been assessed in sufficient detail.

No alternatives regarding this proposal have as of yet been provided by the client. However, the No-Go Alternative still applies and will be assessed as 'Trajectory of Change' within the study. The No-Go Alternative assumes that the development will not occur and that the status quo of the site will continue. It is assumed during this scenario that the land owner will clear the alien invasive plants, as required by the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983), and apply Section 28 of the NEMA, "Duty of Care", that states that reasonable measures must be taken to prevent pollution or degradation from occurring, continuing or reoccurring.

1.1 Relevant Legislation

The protection of water resources is essential for sustainable development and therefore many policies and plans have been developed, and legislation promulgated, to protect these sensitive ecosystems. The proposed project must abide by the relevant legislative requirements. Table 1 below shows an outline of the environmental legislation relevant to the project.

Table 1: Relevant environmental legislation

Legislation	Relevance
South African Constitution 108 of 1996	The constitution includes the right to have the environment protected
National Environmental Management Act 107 of 1998	Outlines principles for decision-making on matters affecting the environment, institutions that will promote co-operative governance and procedures for coordinating environmental functions exercised by organs of state.
Environmental Impact Assessment (EIA) Regulations	The 2014 regulations have been promulgated in terms of Chapter 5 of NEMA and were amended on 7 April 2017 in Government Notice No. R. 326. In addition, listing notices (GN 324-327) lists activities which are subject to an environmental assessment.
The National Water Act 36 of 1998	Chapter 4 of the National Water Act addresses the use of water and stipulates the various types of licensed and unlicensed entitlements to the use of water. The water uses under Section 21 (NWA) that are associated with the proposed development are most likely section 21 (c) and (i). Also, according to the Department of Water and Sanitation (DWS), any structures within a 500 metre radius from the boundary of a wetland constitutes a Section 21(c) and (i) water use and as such requires a water use licence.

General Authorisations (GAs)	Any uses of water which do not meet the requirements of Schedule 1 or the GAs, require a license which should be obtained from the Department of Water and Sanitation (DWS). The project will require a Water Use Authorisation or General Authorisation in terms of Section 21 (c) and (i) of the National Water Act (NWA), Act 36 of 1998, as the development will impact watercourses. Government Notice R509 of 2016 was issued as a revision of the General Authorisations (No. 1191 of 1999) for section 21 (c) and (i) water uses (impeding or diverting flow or changing the bed, banks or characteristics of a watercourse) as defined under the NWA. Determining if a water use licence is required is associated with the risk of impacting on that watercourse. A low risk of impact could be authorised in terms of a General Authorisations (GA).
National Environmental Management: Biodiversity Act No. 10 of 2004	This is to provide for the management and conservation of South Africa's biodiversity through the protection of species and ecosystems; the sustainable use of indigenous biological resources; the fair and equitable sharing of benefits arising from bioprospecting involving indigenous biological resources; and the establishment of a South African National Biodiversity Institute.
Conservation of Agricultural Resources Act 43 of 1967	To provide for control over the utilization of the natural agricultural resources of the Republic in order to promote the conservation of the soil, the water sources and the vegetation and the combating of weeds and invader plants; and for matters connected therewith.

1.2 Scope of Work

The Scope of Work in accordance with the specific Terms of Reference are described below:

Phase 1 (Contextualisation of study area)

- ✓ Contextualization of the study area in terms of important biophysical characteristics and the latest available aquatic conservation planning information (including but not limited to vegetation, CBAs, Threatened ecosystems, any Red data book information, NFEPA data, broader catchment drainage and protected areas).
- ✓ Desktop delineation and illustration of all watercourses within and surrounding the site utilising available site-specific data such as aerial photography, contour data and water resource data.
- ✓ A risk/screening assessment of the identified aquatic ecosystems (as well as within the surrounding NWA regulated area) to determine which ones will be impacted upon by the proposed development and therefore require groundtruthing and detailed assessment.

Phase 2 (Delineation and classification)

- ✓ Ground truthing, infield identification, delineation and mapping of any potentially affected aquatic ecosystems in terms of the Department of Water and Sanitation (DWAF 2008) *Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas*.
- ✓ Field delineation must follow the accepted national protocol and should result in a map that includes the identified boundary and the field data collection points (which should include at

least one point outside the wetland or riparian area), and a report that explains how and when the boundary was determined.

- ✓ Classification of the identified aquatic ecosystems in accordance with the, '*National Wetland Classification System for Wetlands and other Aquatic Ecosystems in South Africa'* (Ollis *et al*. 2013) and *WET-Ecoservices* (Kotze *et al*. 2009).
- ✓ Description of the identified watercourses with photographic evidence

Phase 3 (Aquatic Assessment)

- ✓ Conduct a Present Ecological State (PES), functional importance assessment and Ecological Importance and Sensitivity (EIS) assessment of the delineated wetland habitats, utilising the latest tools, such as:
  - → Level 2 WET-Health Version 2 tool (Macfarlane *et al*., 2009) – PES
  - → WET-Ecoservices (Kotze *et al*., 2009) and/or the Wetland EIS assessment tool of Rountree and Kotze (2013). - Functional assessment
- ✓ Conduct a Present Ecological State (PES) and Present Ecological Importance and Sensitivity (EIS) assessment of the delineated river/riparian habitats, utilising:
  - → Qualitative Index of Habitat Integrity (IHI) tool adapted from (Kleynhans, 1996) – PES
  - → DWAF (DWS) River EIS tool (Kleynhans, 1999) - EIS
- ✓ Indicate the Recommended Ecological Category (REC) of the impacted aquatic ecosystems.

Phase 4 (Impact Assessment)

- ✓ Identification, prediction and description of potential impacts on aquatic habitat during the construction and operational phases of the project. Impacts are described in terms of their extent, intensity, and duration. The other aspects that must be included in the evaluation are probability, reversibility, irreplaceability, mitigation potential, and confidence in the evaluation.
- ✓ All direct, indirect, and cumulative impacts for each alternative must be rated with and without mitigation to determine the significance of the impacts.
- ✓ Complete the Department of Water and Sanitation Risk Matrix.

Phase 5 (Mitigation and monitoring)

- ✓ Recommend actions that should be taken to avoid impacts on aquatic habitat, in alignment with the mitigation hierarchy, and any measures necessary to restore disturbed areas.
- ✓ Determination and mapping of any necessary buffer zones with consideration to the *Buffer zone guidelines for rivers, wetlands and estuaries* (Macfarlane & Bredin, 2016).
- ✓ Rehabilitation guidelines for disturbed areas and monitoring.

2 STUDY AREA

2.1 Drainage Setting

The study area of the proposed project is located within the DWS Quaternary Catchment K60G and falls within the Gouritz Water Management Area (Figure 3).

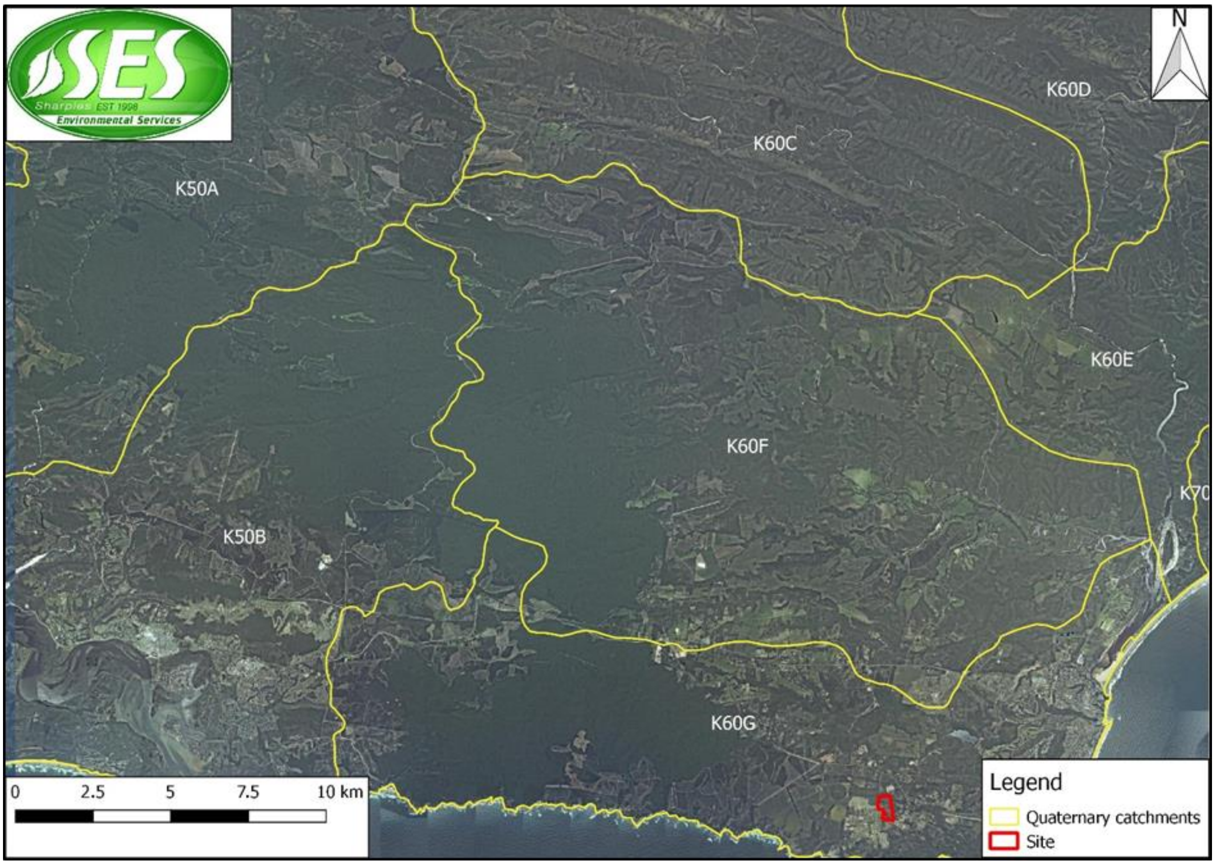

Figure 4: Map showing the site situated in quaternary catchment K60G

The area receives the lowest rainfall in June and the highest in October. Kranshoek receives rain throughout the year with most rain occurring in late Winter and Spring. Annual rainfall adds up to 1030 mm ranging between 64 mm and 92 mm per month. The mean annual temperature is 16.5˚C. Day temperatures peak at 24.1˚C in February and minimum temperatures go down to 8.7˚C in July. The site is fairly flat, sloping slightly towards the east with drainage lines. Most drainage from the site are therefore in an easterly direction.

According to the 3322 Oudtshoorn 1:250 000 geological map, the site consists of the arenite quartzitic sandstones of the Peninsula Formation from the Table Mountain Group. It is the hardest and most erosion resistant layer of the Cape Supergroup. According to Mucina and Rutherford (2006) the area consists of acidic lithosol soils that are derived from the sandstone geology. The summarised biophysical characteristics are indicated below (Table 2).

Table 2: Biophysical characteristics of the area around the proposed project site

Biophysical categories	Biophysical characteristics	Source
Approx. Elevation (a.s.l.)	85 - 230 m	Google Earth™ & Surveyor General
Mean annual precipitation	860 mm	Schultz, 1998
Rainfall seasonality	All year	DWAF, 2007
Potential Evaporation	1576 mm	Schultz, 1998
Quaternary catchment	K60G	Schultz, 1998
DWA Ecoregion	South Eastern Coastal Belt	DWA, 2005
NFEPA	No	Driver *et* al. 2011

2.2 Vegetation

Mucina and Rutherford (2006) delineated vegetation units throughout Southern Africa and updated this data in 2012. According to this data, the study site is located in a typical fynbos environment on the Southern Cape coastal plain. The main vegetation type found in the area is classified as South Outeniqua Sandstone Fynbos (Figure 5). The fynbos is described as fragmented, with ecological corridors remaining mainly along the road reserves and main watercourses. Extensive alien infestation was also noted. This vegetation group is currently categorized as Vulnerable (Figure 6). It was upgraded to this category from Least Threatened in 2014. The site-specific vegetation is further described in the Ecological Assessment Report which should be read in conjunction with this report.

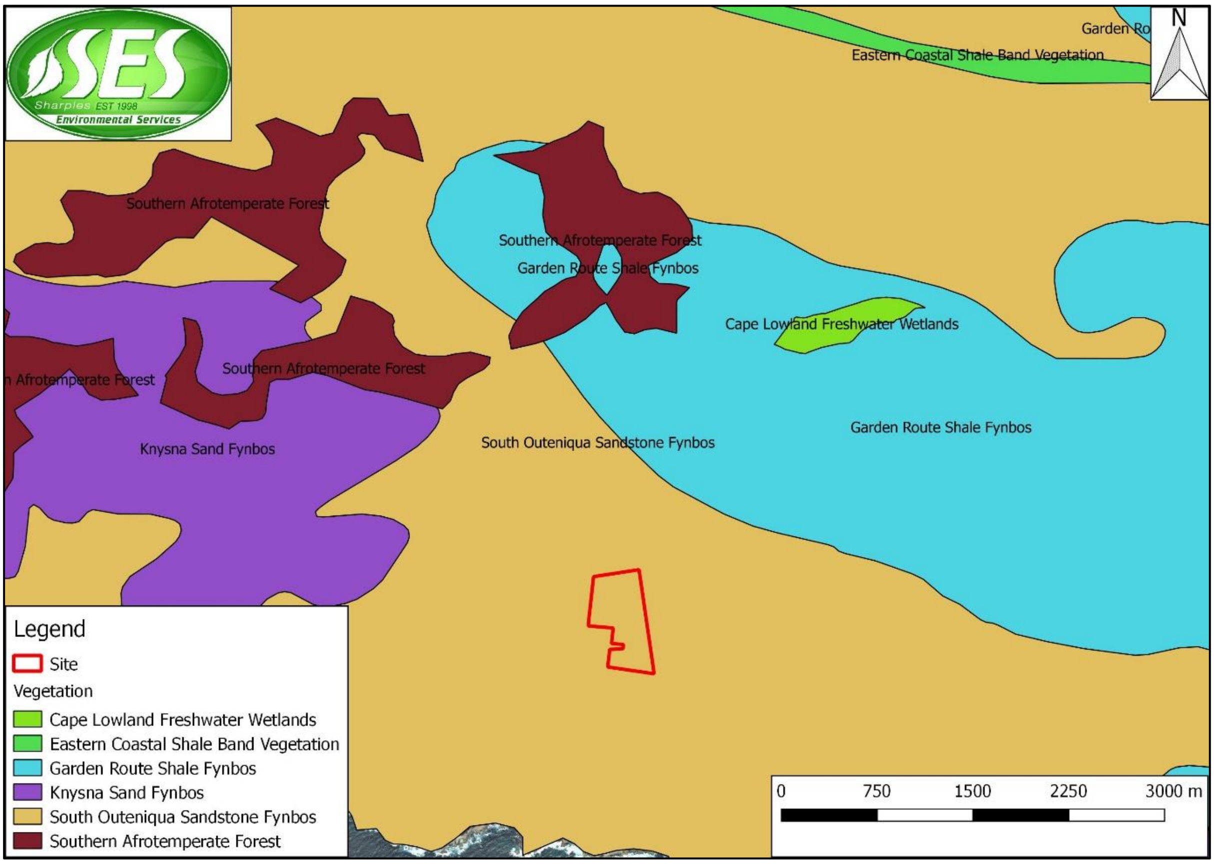

Figure 5: Vegetation types found at and around the study area

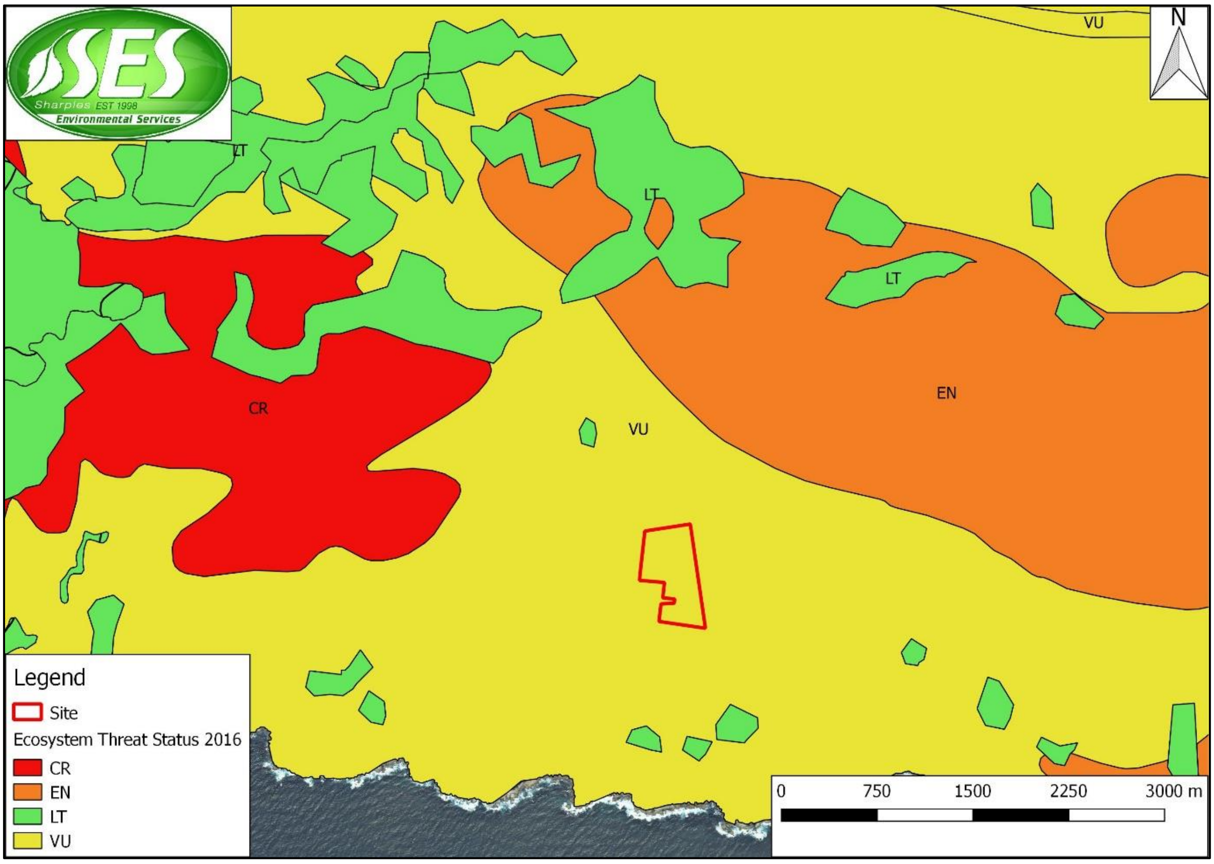

Figure 6: The Ecosystem Threat Status of areas surrounding the site.

2.3 Conservation Context

The Western Cape Biodiversity Framework (WCBF) is a spatial biodiversity plan recognized by both the Department of Environmental Affairs and South African National Biodiversity Institute. It identifies areas crucial for conserving a representative sample of biodiversity and maintaining ecosystem functioning. According to the WCBF (2017), "*ecosystem threat status tells us about the degree to which ecosystems are still intact or alternatively losing vital aspects of their structure, function and composition, on which their ability to provide ecosystem services ultimately depends".* Critical Biodiversity Areas are areas required to meet biodiversity targets for ecosystems, species and ecological processes, as identified in a systematic biodiversity plan. Ecological Support Areas are not essential for meeting biodiversity targets but play an important role in supporting the ecological functioning of Critical Biodiversity Areas and/or in delivering ecosystem services. The primary purpose of a map of Critical Biodiversity Areas and Ecological Support Areas is to guide decision-making about where best to locate development.

The site is not located near any CBA classified habitat but there is ESA 2 classified area within the north eastern corner as well as directly south of the site. The identified biodiversity areas are aligned with the drainage network of the area. Please refer to the Ecological Assessment Report for further detail.

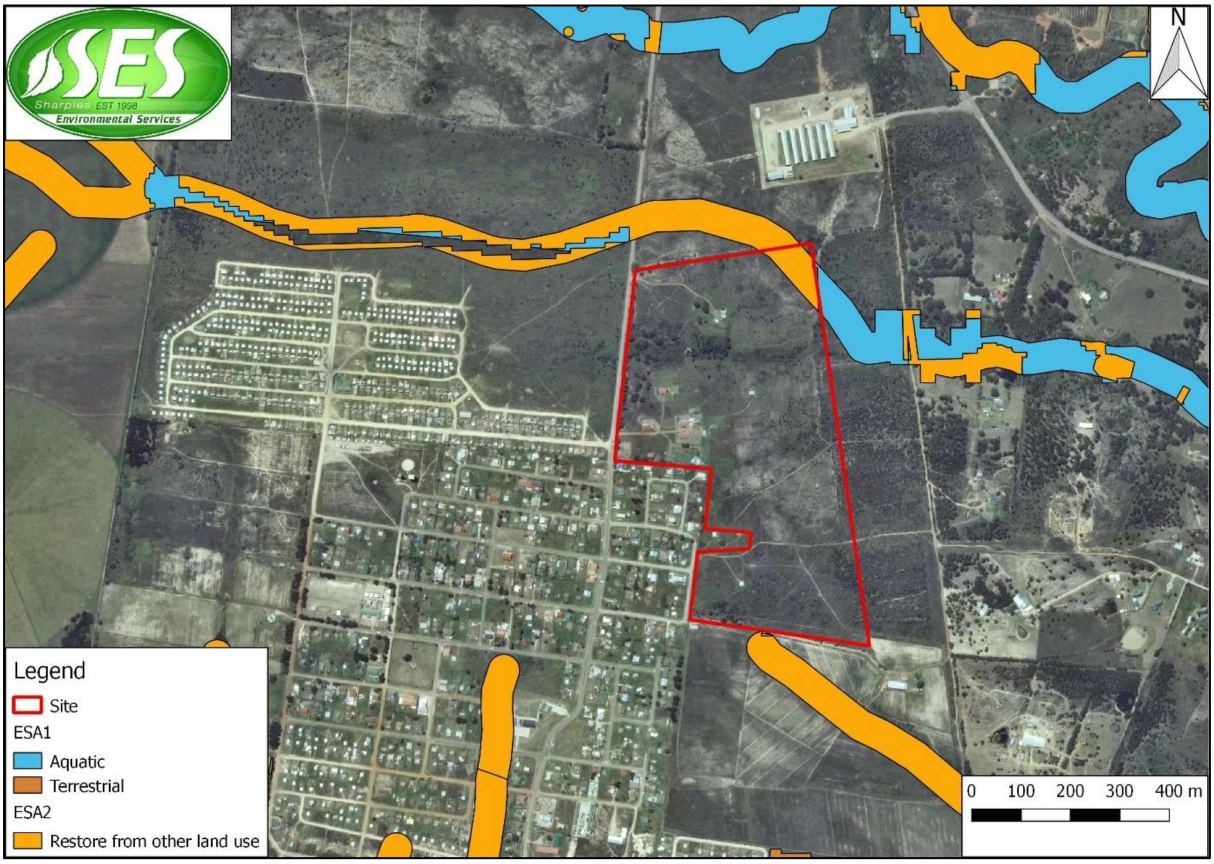

Figure 7: The site in relation to Western Cape Spatial Biodiversity Plan (Pence 2017)

The National Aquatic Ecosystem Priority Areas (NFEPA) map provides strategic spatial priorities for conserving South Africa's aquatic ecosystems and supporting sustainable use of water resources. FEPAs were identified based on a range of criteria dealing with the maintenance of key ecological processes and the conservation of ecosystem types and species associated with rivers, wetlands and estuaries (Driver *et al.* 2011). The NFEPA project did not identify any rivers or wetlands within this study area.

2.4 Existing impacts upon watercourses

Catchment and site-specific impacts are important for determining a baseline of the current status quo for the watercourses that will be impacted by any proposed developments. These characteristics are also important to note as they are used in assessing the various systems. The main changes to land cover and land use are due to housing and road infrastructure, plantations, livestock farming, dams, and the establishment of alien invasive plant species (Figure 8).

There are only scattered old dwellings on site, but the town of Kranshoek on the western boundary has presented urban threats to the wetlands through altered runoff and pollution. Refer to Figure 9 for a depiction of the impacts associated with urban development. Road culverts in the study area cause the impoundment of flows upstream, and confine flows, causing erosion downstream. The many dams within the study area also impact the watercourses in this way. Roads crossing watercourses also destroy portions of habitat, alter flows, and increase sediment and storm water inputs. Plantations in catchments have changed land cover characteristics which alter the movement and retention of flows, as well as reduce water inputs. Additionally, alien invasive species have established within the watercourses, especially in disturbed or eroded areas, and can outcompete natural vegetation. The burying of service infrastructure through watercourses was evident and causes habitat disturbance and possible loss. The cleared vegetation and disturbed soils increase sediment inputs into the systems. Additionally, disturbed soils can result in further alien plant species encroachment.

A road culvert crossing a wetland on the Kranshoek access road causing the pooling of water upslope and slight erosion downslope.

The flat topography of the site that was previously under plantation, with planation in the background. Photograph taken from a large earthen berm.

The sparsely vegetated land surface with shallow ridges and furrows indicating the past soil disturbance from ploughing.

Alien invasive plant species, such as Acacia cyclops, have established within most watercourses in the study area.

Figure 8: Photographs illustrating the existing impacts affecting watercourses within the study area

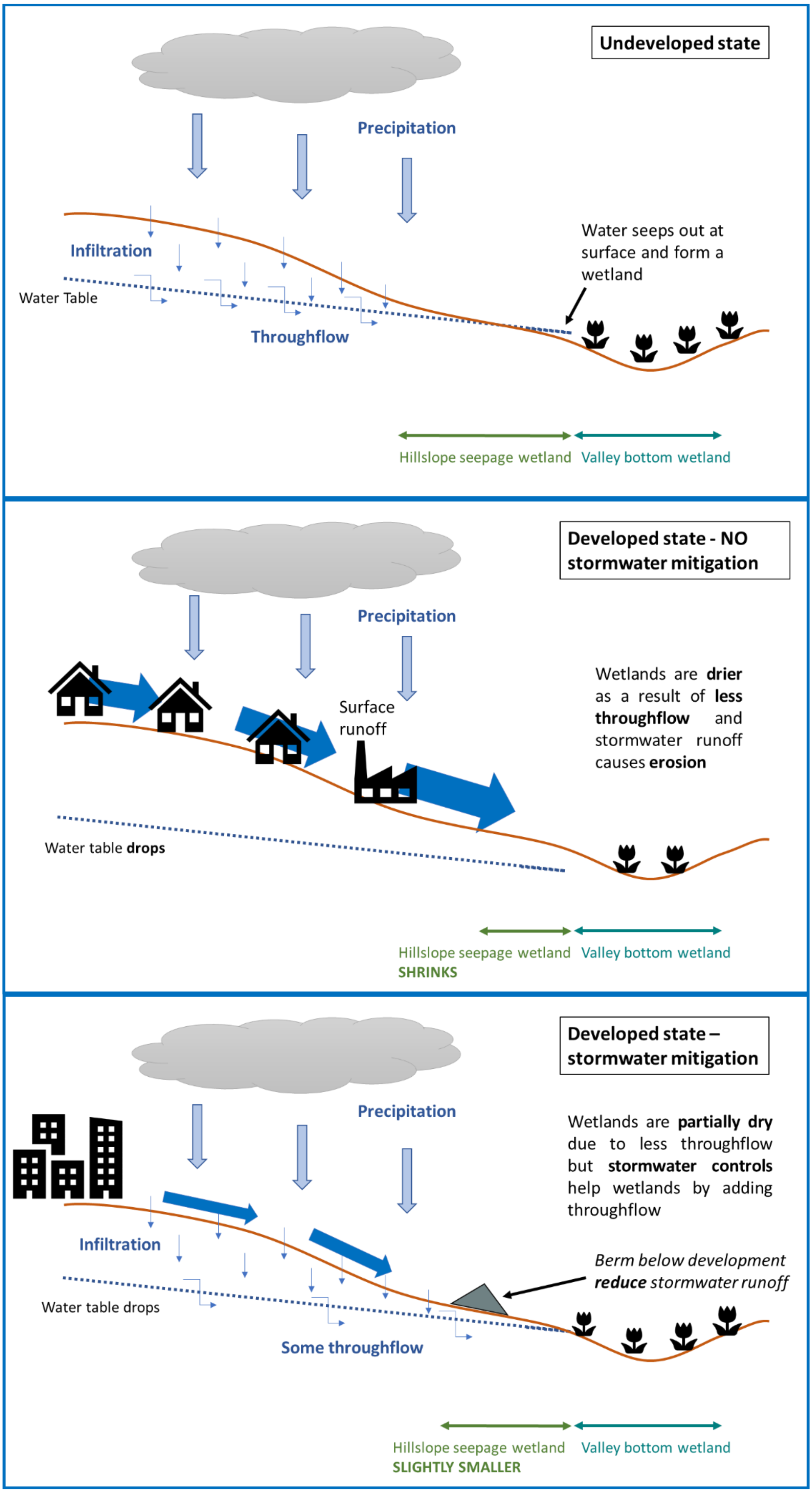

Figure 9: Diagrams indicating the characteristics influencing wetlands that are affected by development

3 APPROACH AND METHODS

3.1 Desktop Assessment Methods

- The contextualization of each study area was undertaken in terms of important biophysical characteristics and the latest available aquatic conservation planning information in a Geographical Information System (GIS). It is imperative to develop an understanding of the regional drainage setting and longitudinal dynamics of the watercourse. The conservation planning information aids in the determination of importance and sensitivity, management objectives, and the significance of potential impacts.
- Following this, desktop delineation and illustration of all watercourses within the study area was undertaken utilising available site-specific data such as aerial photography, contour data and water resource data. Digitization and mapping were undertaken using QGIS 2.18 GIS software (Table 2).
- These results, as well as professional experience, allowed for the identification of specific watercourses that could potentially be impacted by the development and therefore required groundtruthing and detailed assessment. The following data sources listed within Table 2 assisted with the assessment.

Table 3: Utilised data and associated source relevant to the proposed project

Data	Source
Google Earth Pro™ Imagery	Google Earth Pro™
DWS Eco-regions (GIS data)	DWS (2005)
South African Vegetation Map (GIS Coverage)	Mucina & Rutherford (2006)
National Biodiversity Assessment Threatened Ecosystems (GIS Coverage)	SANBI (2011)
Geology	Surveyor General
Contours (elevation) - 5m intervals	Surveyor General
NFEPA river and wetland inventories (GIS Coverage)	CSIR (2011)
NEFPA river, wetland and estuarine FEPAs (GIS Coverage)	CSIR (2011)
Western Cape Biodiversity Framework 2017: Critical Biodiversity Areas of the Western Cape.	Pence (2017)

3.2 Baseline Assessment Methods

- An infield site assessment was conducted on the 17th of October 2017 to confirm the location and extent of the systems identified as likely to be impacted by the proposed project. There are a number of factors which influence the level of impact, such as type of system, position of the system in relation to the project and position the system is located in the landscape. The identified aquatic ecosystems were classified in accordance with the, '*National Wetland Classification System for Wetlands and other Aquatic Ecosystems in South Africa'* (Ollis *et al*. 2013) and *WET-Ecoservices* (Kotze *et al*. 2009).

- Infield delineation was undertaken with a hand-held GPS, for mapping of any potentially affected aquatic ecosystems, in alignment with standard field-based procedures in terms of the Department of Water and Sanitation (DWAF 2008) *Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas*. The delineation is based upon observations of the landscape setting, topography, vegetation and soil characteristics (using a hand-held soil auger for wetland soils).
- Determination of the Present Ecological State (PES), functional importance assessment and Ecological Importance and Sensitivity (EIS) assessment of the delineated wetland habitats.
  - The health/condition or Present Ecological State (PES) of the wetland was assessed using the Level 2 WET-Health assessment tool (Macfarlane *et al.* 2008), which is based on an understanding of both catchment and on-site impacts and the impact that these aspects have on system hydrology, geomorphology and the structure and composition of wetland vegetation.
  - Wetland benefits can be classified into goods/products (directly harvested from wetlands), functions/ services (performed by wetlands), and ecosystem scale attributes. The WET-Ecoservices tool (Kotze *et al*., 2009) is utilised to assess the goods and services that the individual wetlands under assessment provide, thereby aiding informed planning and decision-making. The tool provides guidelines for scoring the importance of a wetland in delivering each of 15 different ecosystem services (including flood attenuation, sediment trapping and provision of livestock grazing).
  - The Ecological Importance and Sensitivity (EIS) of freshwater habitats is an expression of the importance of the water resource for the maintenance of biological diversity and ecological functioning on local and wider scales; whilst Ecological Sensitivity (or fragility) refers to a system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (Kleynhans & Louw, 2007). There Wetland EIS Tool was utilised to determine EIS (Kleynhans, 1999).
- The PES and EIS results then allowed for the determination of management objectives for the potentially impacted aquatic ecosystems. Refer to the Table below and Annexure 12 for a list and description of the tools utilised.

Table 4: Tools utilised for the assessment of water resources impacted upon by the proposed project.

METHOD/TOOL*	SOURCE	REFERENCE	APPENDIX (ANNEXURE)
Delineation of wetland and/or Riparian areas	*A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas.*	(DWAF 2005)	12.1
Classification of wetlands and/ or other aquatic ecosystems	*National Wetland Classification System for Wetlands and other Aquatic*	(Ollis *et al.*, 2013), Kotze *et al.*, 2009)	12.2

	Ecosystems in South Africa & WET-Ecoservices		
Present Ecological State (PES) Assessment (Wetland)	*WET-Health Assessment*	(McFarlane *et al.* 2009)	12.3
Functional Importance Assessment (Wetland)	*WET-Ecoservices Assessment*	(Kotze *et al.*, 2009)	12.4
Ecological Importance & Sensitivity (EIS) Assessment (wetland)	*DWAF Wetland EIS Tool*	(Duthie 1999)	12.5

3.3 Impact Assessment Methods

- The approach adopted is to identify and predict all potential direct and indirect impacts resulting from an activity from planning to rehabilitation. Thereafter, the impact significance for the three alternatives is determined.
- Impact significance is defined broadly as a measure of the desirability, importance and acceptability of an impact to society (Lawrence, 2007). The degree of significance depends upon three dimensions: the measurable characteristics of the impact (e.g. intensity, extent and duration), the importance societies/communities place on the impact, and the likelihood / probability of the impact occurring. A methodology for assigning scores to the respective impacts is described in Annexure 12.
- Actions are thereafter recommended to prevent and mitigate the identified impacts on aquatic habitat, in alignment with the mitigation hierarchy, as well as any measures necessary to restore disturbed areas or ecological processes.

3.4 Opportunities and Constraint Analysis

- Regarding any proposed development on the property, a buffer area from the boundary of the aquatic habitat must be determined. The specific size of the buffer zone was determined by a tool developed by Macfarlane and Bredin (2016) called *Buffer zone guidelines for rivers, wetlands and estuaries*, site-based information and professional opinion. The final buffer requirement includes the implementation of practical management considerations/ mitigation measures.
- Identify legislation and permit requirements that are relevant to the development proposal from an aquatic perspective.
- Present recommendations of the suitability of the site based on sensitivity analysis.

4 ASSUMPTIONS AND LIMITATIONS

The following assumptions and limitations are relevant:

- The location of the proposed infrastructure was extrapolated from data provided by the client.

- No alternatives were provided for assessment.
- A layout plan was provided but no stormwater plan was provided by the client.
- Aquatic ecosystems vary both temporally and spatially. Once-off surveys such as this are therefore likely to miss certain ecological information due to seasonality, thus limiting accuracy and confidence.
- Infield soil and vegetation sampling was only undertaken within a specific focal area around the proposed development, while the remaining watercourses were delineated at a desktop level with limited accuracy.
- No detailed assessment of aquatic fauna/biota was undertaken. Refer to Ecological Assessment report.
- The vegetation information provided is based on observation not formal vegetation plots. As such species documented in this report should be considered as a list of dominant and/or indicator wetland/riparian species and only provide a very general indication of the composition of the riverine vegetation communities. Refer to Ecological Assessment report.
- The assessment of impacts and recommendation of mitigation measures was informed by the site-specific ecological concerns arising from the field survey and based on the assessor's working knowledge and experience with similar development projects. The degree of confidence is considered high.
- The study does not include flood line determination or offset calculations.

5 RESULTS

A screening assessment identified seven wetland systems within a 500 m radius of the site. The watercourses that may potentially be impacted upon by the proposed project were verified through infield soil samples and documentation of vegetation communities and species and key features within the landscape. The two wetlands that traverse the site, named WET/3 and WET/4 for the purposes of this study, will be directly impacted upon by the proposed development (Figure 10). WET/7 located near the southern boundary of the site is likely to be indirectly impacted upon. Any development within the site is likely to impact the habitat, biota, and water quality of these three wetlands and they were therefore studied further. The other freshwater habitat identified within the regulated study area will not be impacted and was therefore not assessed further.

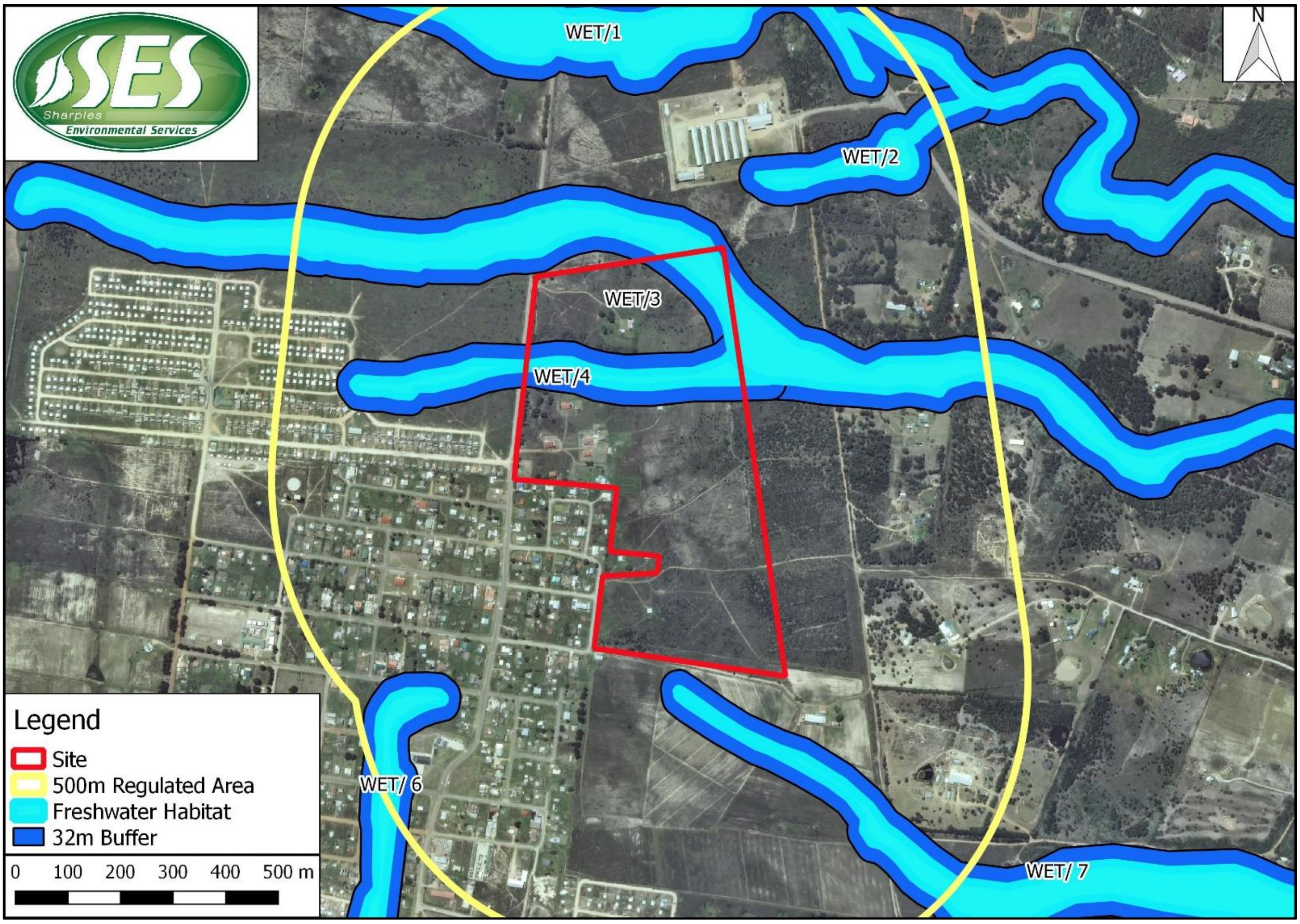

Figure 10: Freshwater ecosystems in relation to the proposed site and the DWS 500 m radius regulated area.

5.1 Description of impacted wetlands

The WET/3 system is an unchannelled valley bottom wetland, with a large seasonal zone, situated in a shallow valley with a gentle slope (Figure 11). Although the system is in close proximity to the town of Kranshoek, and intersected by two roads, it is dominated by diffuse flows and little erosion is evident. However, in the lower reaches of the system farming activities intensify, including dams, and cause significant erosion. The soil disturbance has allowed for the encroachment of alien plant species, but the vegetation of the upper reaches remains largely natural. The dominant plant species identified in the system were *Cyperus congestus, Carpha glomerata, Leucadendron eucalyptifolium, Chrysanthemoides monilifera, Acacia cyclops, Acacia mearnsii,* and *Pinus pinaster.*

The WET/3 wetland looking upstream from the Kranshoek access road culvert

The WET/3 wetland looking downstream from the Kranshoek access road culvert

Figure 11: Photographs of WET/3

The WET/4 system is a relatively small, unchannelled valley bottom wetland with a gentle gradient (Figure 12). The wetland is surrounded and intersected by housing and road infrastructure which has resulted in extensive habitat loss. The town has caused hardened surfaces in the catchment, increased water inputs from grey water and stormwater, as well as solid domestic waste. The road has impeded flows upslope and confined flows downslope through culverts. However, the low gradient and well vegetated state of the system limits the incision and diffuse flows still dominate. The vegetation of the system consists largely of alien invasive plant species. The dominant species identified where *Eleocharis limosa, Cyperus congestus, Paspalum urvillei, Commelina benghalensis, Pennisetum clandestinum, Cortaderia selloana, Eucaluptus grandis, Pinus pinaster, Acacia mearnsii,* and *Acacia cyclops.*

The *Pennisetum clandestimum* dominated *W/04 wetland downslope of the Kranshoek access road.*

Mottling within the W/04 system providing evidence of hydric soils.

Figure 12: Photographs of WET/4

The WET/7 system is a seasonal seep wetland to the south of the development proposal. It has incurred significant habitat loss and disturbance due to agriculture (forestry and more recently ploughed lands). In the area assessed at the head of the system, the wetland has almost completely lost ecological functioning. It is currently covered by grass species and no obligate wetland plants were observed. However, despite the extensive soil disturbance, due to the soil characteristics and its position in the landscape it was delineated as wetland habitat.

Figure 13: Photographs of WET/7

5.2 Present Ecological State (PES):

The health/condition or Present Ecological State (PES) of the wetlands was assessed using the WET-Health assessment tool (Macfarlane *et al.* 2008, 2018), which is based on an understanding of both catchment and on-site impacts and the impact that these aspects have on system hydrology, geomorphology and the structure and composition of wetland vegetation. It is based on the determination of the level of deviation from the perceived reference state of the system. The assessment was aided by an aerial photograph indicating the already disturbed state of the site in by 1974 (Figure 14).

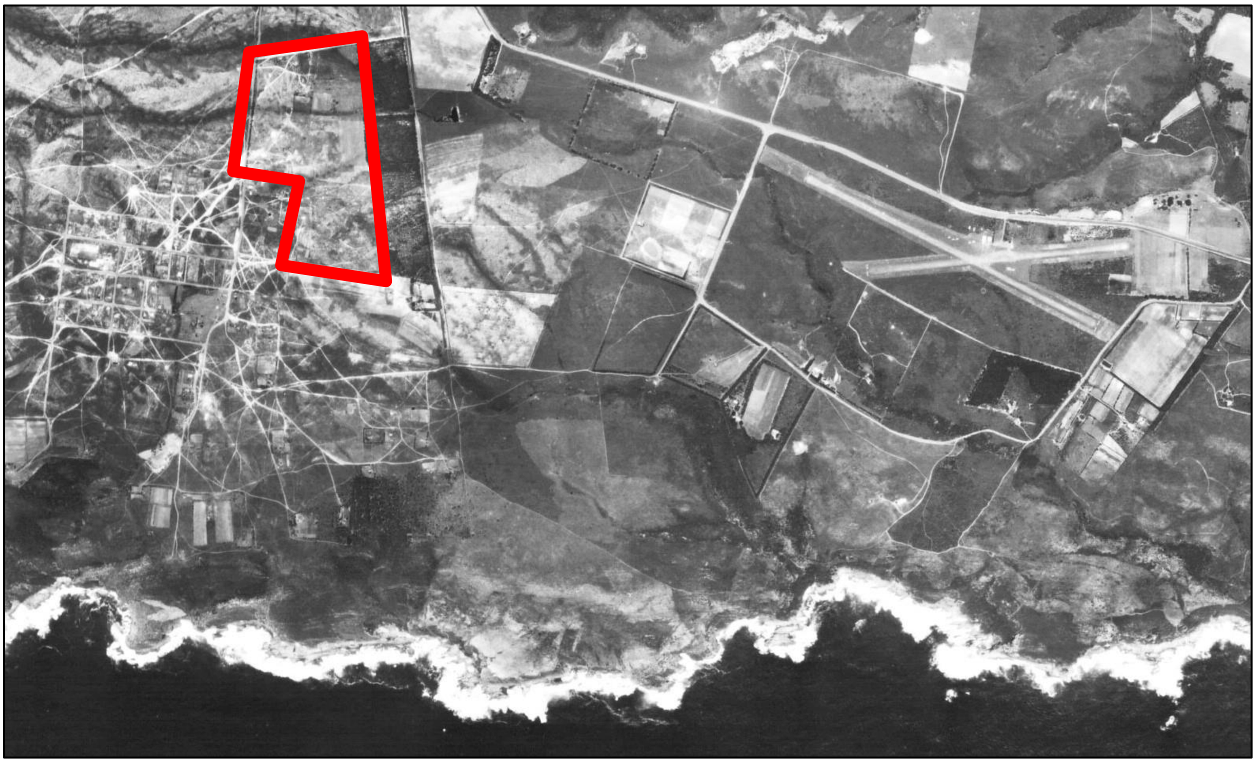

Figure 14: A 1974 aerial photograph of the study area (red polygon) indicating the historic land use impacts

A summary of the wetland PES scores is presented in Table 5. The WET/3 system has been subjected to a large amount of habitat loss as it borders the Kranshoek town and there are more intense cultivation and farming activities in its lower reaches. These activities have significantly altered water inputs, flow patterns and the vegetation of the system. The geomorphology is moderately modified due to relatively extensive erosion in the lower reaches of the wetland. The overall PES of the wetland WET/3 can be regarded as being Good "C" Category (Table 5). This category is indicative of a system where a moderate change in ecosystem processes and loss of natural habitat and biota and has occurred.

The WET/4 wetland is a small system that flows through the Kranshoek town and its associated urban infrastructure. It is crossed by roads and pipelines, has raw sewage inputs, and litter in this area. The resultant land use and land cover changes have caused extensive habitat loss in this reach to the west of the proposed site. The water inputs and flow patterns are altered by domestic grey water inputs, sewage spills, increased stormwater inputs and the confinement of flows. The geomorphology is largely modified due to infilling, excavations, and erosion. Additionally, there is a moderate level of alien plant species infestation. The overall PES of the wetland (WET/4) can be regarded as being Fair 'D" Category (Table 5). This category is indicative of a system where the change in ecosystem processes and loss of natural habitat and biota is large but some remaining natural habitat features are functional.

The WET/7 seep has incurred the largest modifications from the natural condition and basic functioning has been critically compromised. Due to groundwater dominated water inputs there is some remaining habitat, however, the soils and vegetation are almost completely transformed from the reference state. The overall PES of the wetland W/04 can be regarded as being Poor ‘E” Category (Table 5). This category is indicative of a system where the change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.

Table 5: The PES Scores for the potentially impacted wetlands

Wetland	Result	Hydrology	Geomorphology	Vegetation	Overall PES	
WET/3	Score	3.5	1.9	5.75	3.7	**Good**
	Category	C	B	D	**C**	
WET/4	Score	4	3.025	5.6	4.2	**Fair**
	Category	D	C	D	**D**	
WET/7	Score	4.6	6.5	6.95	6.1	**Poor**
	Category	D	E	E	**E**	

5.3 Functional Importance

Wetland benefits can be classified into goods/products (directly harvested from wetlands), functions/ services (performed by wetlands), and ecosystem scale attributes. The WET-EcoServices assessment highlights these benefits and the extent of each benefit for the wetlands. The assessment indicates that the wetlands to be impacted by the proposed project have a Low- Moderate functional importance. WET/3 and WET/4 combine near the eastern site boundary, and within a relatively short distance, become a riparian system and flow into the Indian Ocean. They pass over various small holdings and supplement small dams. Therefore, the wetlands provide direct services to the landowners through water for domestic and agricultural use (crop irrigation and livestock grazing). The seep wetland has similar characteristics but provides slightly less direct products. Indirectly, the remaining functional wetland habitat provides services such as habitat for biota, corridors, water recharge, erosion control, pollution management, amongst other benefits. These services will only become more important and valuable following development in the area.

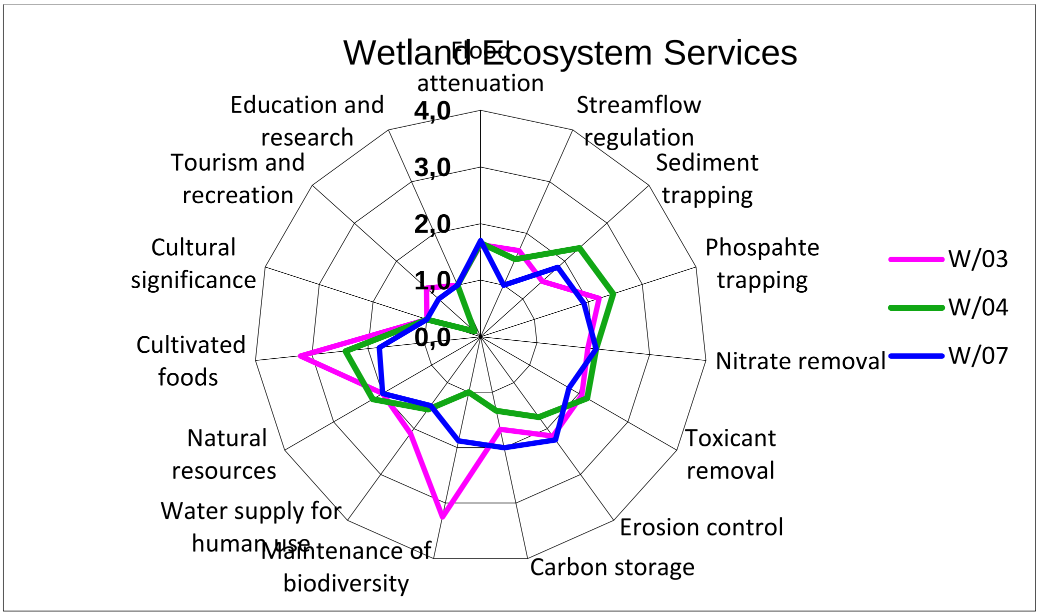

Figure 15: Functional importance results for the potentially impacted wetlands

5.4 Wetland EIS

The WET/3 and WET/4 wetland systems assessed obtained a Moderate EIS score and the WET/7 wetland was determined to have Low EIS. The wetland systems of the study area provide limited direct human benefits yet have moderate significance regarding indirect services. Ecologically, the systems are not conserved in any way and no red data species or populations of unique species were identified in any of the wetlands. However, many of the wetlands assessed are sensitive to changes to flow regimes and periods of low flows.

Table 6: Wetland EIS Assessment Results

HGM Unit	**Ecological Importance and Sensitivity Categories**							
	Ecological Importance		*Functional/Hydrological Importance*		*Direct Benefits to Society*		***Overall Importance***	
	Score (0-4)	Rating	Score (0-4)	Rating	Score (0-4)	Rating	**Score (0-4)**	**Rating**
W/03	2.8	Moderate	2.75	Moderate	2.33	Moderate	**2.8**	Moderate
W/04	2.33	Moderate	2.38	Moderate	1.67	Low	**2.38**	Moderate
W/07	1.8	Low	1.67	Low	1.8	Low	1.8	Low

5.5 Recommended ecological category and management objectives

The recommended ecological category (REC) is used to inform future management objective for an aquatic ecosystem. The REC can be determined by using the PES (Present Ecological State) and EIS (Ecological Importance and Sensitivity) scores of the system (DWAF 2007). The wetlands fall within the REC category which advocates that the management objective be to maintain the wetlands within their PES.

6 POTENTIAL IMPACTS

Aquatic ecosystems are particularly vulnerable to human activities and these activities can often result in irreversible damage or longer term, cumulative changes. The significance of an impact to the environment or ecosystem can only be assessed in terms of the change to ecosystem services, resources and biodiversity value associated with that system or component being assessed. The approach adopted is to identify and predict all potential direct and indirect impacts resulting from an activity from planning to rehabilitation. Thereafter, the impact significance is determined. Impact significance is defined broadly as a measure of the desirability, importance and acceptability of an impact to society (Lawrence, 2007). The degree of significance depends upon three dimensions: the measurable characteristics of the impact (e.g. intensity, extent and duration), the importance societies/communities place on the impact, and the likelihood / probability of the impact occurring.

The direct and indirect impacts associated with the project are grouped into four encapsulating impact categories where associated or interlinked impacts are grouped. Impacts have been separated into construction and operational phases of the project within these categories.

6.1 Disturbance/loss of aquatic vegetation and habitat

The disturbance or loss of aquatic vegetation and habitat refers to the direct physical destruction or disturbance of aquatic habitat caused by vegetation clearing, disturbance of riparian habitat, encroachment and colonisation of habitat by invasive alien plants.

6.1.1 Construction Phase

The layout indicates a road and associated infrastructure where wetland habitat is located. In order to construct this, wetland habitat will be completely lost as a result of clearing, excavations and infilling. There is potential for loss or disturbance of riparian zone vegetation during construction from machinery, vehicles and workers. The movement of topsoil and incorrectly placed stockpiles could bury aquatic habitat. Due to construction, alien invasive species may encroach further into any disturbed areas and outcompete indigenous vegetation thereby reducing aquatic biodiversity.

6.1.2 Operational Phase

There is less direct risk to aquatic habitat during the operational phase as it will have been transformed already during construction. However, any remaining habitat is at threat due to the possibility of urban sprawl encroaching into wetland habitat or increase pressure from livestock. The project may promote the establishment of disturbance-tolerant biota, including colonization by invasive alien species, weeds and pioneer plants if there is any ongoing disturbance near the riparian zone. Although this impact is initiated during the construction phase it is likely to persist into the operational phase.

Additionally, the stormwater infrastructure of the housing and associated road network will increase and concentrate flows into the systems. This may indirectly lead to erosion in the remaining wetland habitat that compromises the remaining vegetated habitat.

6.2 Sedimentation and erosion

Sedimentation and erosion refers to the alteration in the physical characteristics of the river as a result of increased turbidity and sediment deposition, caused by soil erosion and earthworks that are associated with construction activities, as well as instability and collapse of unstable soils during project operation. These impacts can result in the deterioration of aquatic ecosystem integrity and a reduction/loss of habitat for aquatic dependent flora & fauna.

6.2.1 Construction Phase

Vegetation clearing and exposure of bare soils directly within and adjacent to the wetland habitat during construction will decrease the soil binding capacity and cohesion of the upslope soils and thus increase the risk of erosion and sedimentation downslope. The gentle slope of the study area does limit the magnitude of this impact to a degree, but it is highly likely to affect all of the identified wetlands. This activity may cause the burying of aquatic habitat. Ineffective site stormwater management, particularly in periods of high runoff, can lead to soil erosion from confined flows. Formation of rills and gullies from increased concentrated runoff. This increase in volume and velocity of runoff increases the particle carrying capacity of the water flowing over the surface. Soil compaction resulting in reduced infiltration and increased surface runoff together with the artificial creation of preferential flow paths due to construction activities, will result in increased quantities of flow entering the systems.

6.2.2 Operational Phase

Where soil erosion problems and bank stability concerns initiated during the construction phase are not timeously and adequately addressed, these can persist into the operational phase of the development project and continue to have a negative impact downstream. The increase in hardened surface by development, and the impact of road and pipe crossings will be considerable and, if not mitigated against, will result in further erosion. Surface runoff and velocities will be increased, and flows will be concentrated by stormwater infrastructure.

6.3 Water Pollution

Water and/or soil pollution cause negative changes in the physical, chemical and biological characteristics of water resources (i.e. water quality). This can result in possible deterioration in aquatic ecosystem integrity and a reduction in, or loss of, species of conservation concern (i.e. rare, threatened/endangered species). Additionally, litter indirectly decreases the aesthetic value of the wetlands.

6.3.1 Construction Phase

During construction there are a number of potential pollution inputs into the wetlands (such as hydrocarbons and raw cement). The likelihood of these entering the WET/4 wetland is larger there will be direct construction works within the system. These pollutants alter the water quality parameters such as turbidity, nutrient levels, chemical oxygen demand and pH. These alternations impact the species composition of the systems, especially species sensitive to minor changes in these parameters. Sudden drastic changes in water quality can also have chronic effects on aquatic biota in general and result in localised extinctions. Hydrocarbons including petrol/diesel and oils/grease/lubricants associated with construction activities (machinery, maintenance, storage, handling) may potentially enter the system by means of surface runoff or through dumping by construction workers. Raw cement entering the systems through incorrect batching procedure and/or direct disposal. The incorrect positioning and maintenance of the portable chemical toilets and use of the surrounding environment as ablution facilities may result in sewage and chemicals entering the systems.

6.3.2 Operational Phase

If not prevented, litter, and contaminants, including sand, silt, and dirt particles, will enter storm water runoff and pollute the wetlands. Micro-litter such as cigarette butts may travel through certain stormwater grids and grids may not be regularly cleared. The number of vehicles on the property due to the development increases the potential for pollutants to enter the system. During maintenance of the development there could be water pollution impacts similar to those encountered in the construction phase. The establishment of sewer pipes within and/or in close proximity to watercourse always poses a long term threat to the water quality and ecological health of freshwater ecosystems due to the relatively high likelihood that surcharge events will occur at some point in the future. A complete shift in the structure and composition of aquatic biotic communities is the result, as well as a general degradation in water resource quality that could have negative impacts to downstream human users e.g. dams used for domestic water and agriculture. Over the lifetime of the development, surcharge events and/or pipe leakages will likely occur and as a result some pollution as a result of sewerage infrastructure is inevitable. However, the proposed mitigation measures will go a long way to reducing the intensity of pollution events and ultimately reduce pollutant loads.

6.4 Flow Modification

The changes in the quantity, timing and distribution of water inputs and flows within the watercourses. Possible ecological consequences associated with this impact may include: deterioration in freshwater ecosystem integrity, reduction/loss of habitat for aquatic dependent flora & fauna, and a reduction in the supply of ecosystem goods & services.

6.4.1 Construction Phase

Land clearing and earth works in and adjacent to the wetlands will reduce infiltration rates and increase the surface runoff volume and velocity. Such changes in surface roughness and runoff rates may lead to some rill and gully erosion. Altered water inputs from upslope disturbances as well as modified water distribution and retention patterns will ultimately affect the hydrological integrity of water resources. In WET/4 there will be direct flow modification within the wetland due to the altering of the morphology via road and pipeline crossings and the impacts are therefore far greater in this scenario.

6.4.2 Operational Phase

One has to ensure that surface flows are slowed and enter the river in a diffuse pattern. This is likely to be more difficult to accomplish with the current proposed layout. Ultimately, the operational surface will alter the natural processes of rain water infiltration and surface runoff, promoting increased volumes and velocities of storm water runoff, which can be detrimental to the wetlands receiving concentrated flows off of the area. According to the SANRAL (2006), urbanisation typically increases the runoff rate by 20 -50%, compared with natural conditions. Increased volumes and velocities of storm water draining from the area and discharging into the wetlands will alter the natural ecology, increasing the risk of erosion and channel incision/scouring.

7 IMPACT SIGNIFICANCE ASSESSMENT

The impact significance of the proposed development was determined for each potential impact of the project. The current proposed layout, even if some form of mitigation is implemented, will potentially result in unacceptably high impacts and irreversible resource loss (Table 7). The proposed development could result in complete destruction of patterns and permanent cessation of wetland processes and thus the impact must have an influence on the decision process to develop the area.

Table 7: Evaluation of potential impacts of the proposed development on freshwater habitat

	Impact	Mitigation	Extent	Duration	Magnitude	Probability	Significance	Reversibility	Mitigation Potential	Irreplaceable Resource Loss
Construction Phase	Loss and disturbance of aquatic vegetation & habitat	Without Mitigation	Local (2)	Permanent (5)	High (8)	Definite (5)	**High (75)**	Irreversible	Low	Yes
		With Mitigation	Local (2)	Permanent (5)	Moderate (6)	Definite (5)	**High (65)**	Barely	None	Yes
	Erosion & sedimentation	Without Mitigation	Local (2)	Medium (3)	Moderate (6)	Definite (5)	**Medium (55)**	Partly	Medium	Yes
		With Mitigation	Site only (1)	Short (2)	Low (4)	Highly Likely (4)	**Low (28)**	Barely	Low	No
	Water Pollution	Without Mitigation	Regional (3)	Medium (3)	Moderate (6)	Probable (3)	**Medium (36)**	Partly	High	No
		With Mitigation	Local (2)	Very short (1)	Minor (2)	Improbable (2)	**Low (10)**	Barely	Low	No
	Flow modification	Without Mitigation	Local (2)	Permanent (5)	High (8)	Definite (5)	**High (75)**	Partly	Medium	Yes
		With Mitigation	Site only (1)	Permanent (5)	Moderate (6)	Definite (5)	**High (60)**	Barely	Low	Yes

	Impact	Mitigation	Extent	Duration	Magnitude	Probability	Significance	Reversibility	Mitigation Potential	Irreplaceable Resource Loss
Operational Phase	Loss and disturbance of aquatic vegetation & habitat	Without Mitigation	Local (2)	Permanent (5)	Very High (10)	Definite (5)	**High (85)**	Irreversible	Low	Yes
		With Mitigation	Site only (1)	Permanent (5)	Moderate (6)	Definite (5)	**High(60)**	Barely	None	Yes
	Erosion & sedimentation	Without Mitigation	Local (2)	Permanent (5)	High (8)	Highly Likely (4)	**High(60)**	Partly	Medium	Yes
		With Mitigation	Site only (1)	Permanent (5)	Moderate (6)	Probable (3)	**Medium (36)**	Barely	Low	No
	Water Pollution	Without Mitigation	Regional (3)	Permanent (5)	Moderate (6)	Highly Likely (4)	**Medium (56)**	Partly	High	Yes
		With Mitigation	Local (2)	Permanent (5)	Small (4)	Probable (3)	**Medium (33)**	Barely	Low	No
	Flow modification	Without Mitigation	Local (2)	Permanent (5)	Very High (10)	Definite (5)	**High (85)**	Irreversible	Low	Yes
		With Mitigation	Local (2)	Permanent (5)	Moderate (6)	Definite (5)	**High(60)**	Barely	None	Yes

8 CUMULATIVE IMPACTS

Cumulative impacts on the environment can result from broader, long term changes and not only as a result of a single activity or development. They are rather from the combined effects of many activities overtime. Rivers and wetlands are longitudinal systems where different reaches interact in a continuum along the length of the watercourse. This is vitally important to understand in the context of cumulative impacts from developments. Activities in the upper reaches influence the processes of the lower reaches and it must therefore be viewed as a whole.

As stated previously in this report, the SDF identifies threats such as inappropriate development within close proximity to the wetlands but has not groundtruthed and mapped this during spatial planning. In this respect, the development is not in alignment with the SDF and the cumulative impacts of this spatial development plan have not been assessed in sufficient detail.

The impacts of the proposed development, even when assessed on their own, are found to range between Medium to High significance (after mitigation). Therefore, this development, compounded with the impacts from the other development plans within the area, will result in unacceptable cumulative impacts. Due to increasing urban development of the area, the combination of development impacts becomes cumulatively even more significant and will result in wetland lost. The only sustainable way to manage the wetlands is to consider them complete No-Go Areas during design, adopt buffers around them, and apply this to all proposed development within the area, and then actively manage these areas. Approving increased development plans within the watercourses without broader freshwater studies and associated spatial planning is highly risky and resulted now in conflicting land use proposals.

Figure 16 below shows the impacted state of the wetland west of the study site, under developed conditions, similar to the proposed urban conditions of this proposal, and is a clear example of what will happen to the wetland on the proposed site. It is unacceptable, a loss, and unnecessary. The wetland currently filters effluent and sediment, attenuated storm flows, provides habitat for biota etc. and its loss would be a loss to greater society.

Figure 16: Photographs of the WET/4 wetland as it flows onto the site from the urban area. This indicates the impact development will have on the remaining habitat if the proposal is not adapted to be more acceptable.

9 MITIGATION MEASURES

The mitigation of negative impacts on biodiversity and ecosystem goods and services is a legal requirement for authorisation purposes and must take on different forms depending on the significance of the impact and the specific area being affected. Mitigation requires the adoption of the precautionary principle and proactive planning that is enabled through a mitigation hierarchy. Its application is intended to strive to first avoid disturbance of ecosystems and loss of biodiversity, and where this cannot be avoided altogether, to minimise, rehabilitate, and then finally offset any remaining significant residual negative impacts on biodiversity (DEA 2013).

The development layout proposed for this area, from the perspective of aquatic ecosystems, is not a compatible land use, in that it would be associated with a high density of residents and extensive catchment hardening, all likely to increase pressures on receiving wetlands in terms of nutrients, sediments and runoff velocities. These issues can however be managed in development design and layout change, and the proposed project, including mitigation measures, must aim to reduce such risks as far as possible.

However, the proposed development layout allows for the infilling and modification of a substantial portion of wetland and this will have significant negative impacts. Therefore, in recognition of the fact that a net loss of wetland extent would result from this approach, it is recommended that either the layout be amended, or wetland offsets be investigated.

According to the best practice guideline for wetland offsets in South Africa (Macfarlane *et al.* 2014), wetland offsets address residual impacts to both the intrinsic value of wetlands as well as their value in terms of water resources, hydrological functioning and ecosystem services, arising from project development after appropriate prevention and mitigation measures have been taken. The goal of wetland offsets is to achieve no net loss and preferably a net gain on the ground with respect to water resources (focusing on the importance of wetlands for supporting water resource management objectives, as well as people's use and cultural values associated with wetlands), ecosystem and habitat objectives (especially in terms of meeting national and local objectives for habitat protection and avoiding worsening of ecosystem threat status), and species of special concern (particular threatened, rare or keystone wetland species). Application of the offset calculator (as developed by McFarlane *et al.* (2014) and included in the 2017 Draft National Offset Guidelines (GN 276 of March 2017)) would also be required as part of the WULA. **Ideally, however, the development of the area should keep infrastructure out of wetlands and buffer areas can be implemented to avoid the need to offset any wetland habitat.**

The mitigation measures detailed within this report must be taken into consideration during financial planning of the construction phase of the development. This to ensure that sufficient funds are available to implement all the measures required to maintain the current PES score of the watercourses impacted upon. Any potential risks must be managed and mitigated to ensure that no deterioration to the water resource takes place. Standard management measures should be implemented to ensure that any on-going activities do not result in a decline in water resource quality. Consideration should also be given to the rehabilitation of the watercourse where feasible. Mitigation measures related to the impacts associated with the construction activities are intended to augment standard/generic mitigation measures included in the project-specific Environmental Management Programme (EMPr).

The monitoring of the development activities is essential to ensure the mitigation measures are implemented. Therefore, compliance with the mitigation recommendations must be audited by a suitably qualified independent Environmental Control Officer with an appropriately timed audit report. In the case where there is extensive damage to any aquatic system, where rehabilitation is required, a suitably qualified aquatic specialist must audit the site. Monitoring for non-compliance must be done on a daily basis by the contractors. Photographic records of all incidents and non-compliances must be retained. This is to ensure that the impacts on the aquatic habitat are adequately managed and mitigated against and the successful rehabilitation of any disturbed areas within any system occurs. Monitoring should especially focus on preventing water pollution, avoiding wetland habitat, and determining the success of the stormwater management plan for adaptive management. The following mitigation measures must be adhered to and monitored:

9.1 Design Phase: No-Go Zones

Aquatic buffer zones which are designed to act as barriers between human activities and sensitive water resources in order to protect them from adverse negative impacts. Buffer zones associated with water resources have been shown to perform a wide range of functions and have therefore been adopted as a standard measure to protect water resources and associated biodiversity. An aquatic impact buffer zone is defined as a zone of vegetated land designed and managed so that sediment and pollutant transport carried from source areas via diffuse surface runoff is reduced to acceptable levels (Macfarlane and Bredin 2016). Typical threats to buffer zone areas in this area include transformation (e.g. new infrastructure) and alien plant encroachment.

Regarding the proposed development, the layout design does not provide any significant buffer and there is infrastructure proposed within the wetland. However, should a 42 m No-Go zone, as well as the other mitigation measures be effectively implemented, the proposal will not have high aquatic impacts (Figure 15). Therefore, the No-Go boundary must be demarcated during works, and no disturbance may occur past this point during any stage. An important component of these buffers is that they represent minimum setbacks from the wetlands. Functions such as stormwater attenuation, sewage lines, water lines, roads and pathways must lie outside of this setback area. No sewage pump stations must be located within 42 m of a watercourse.

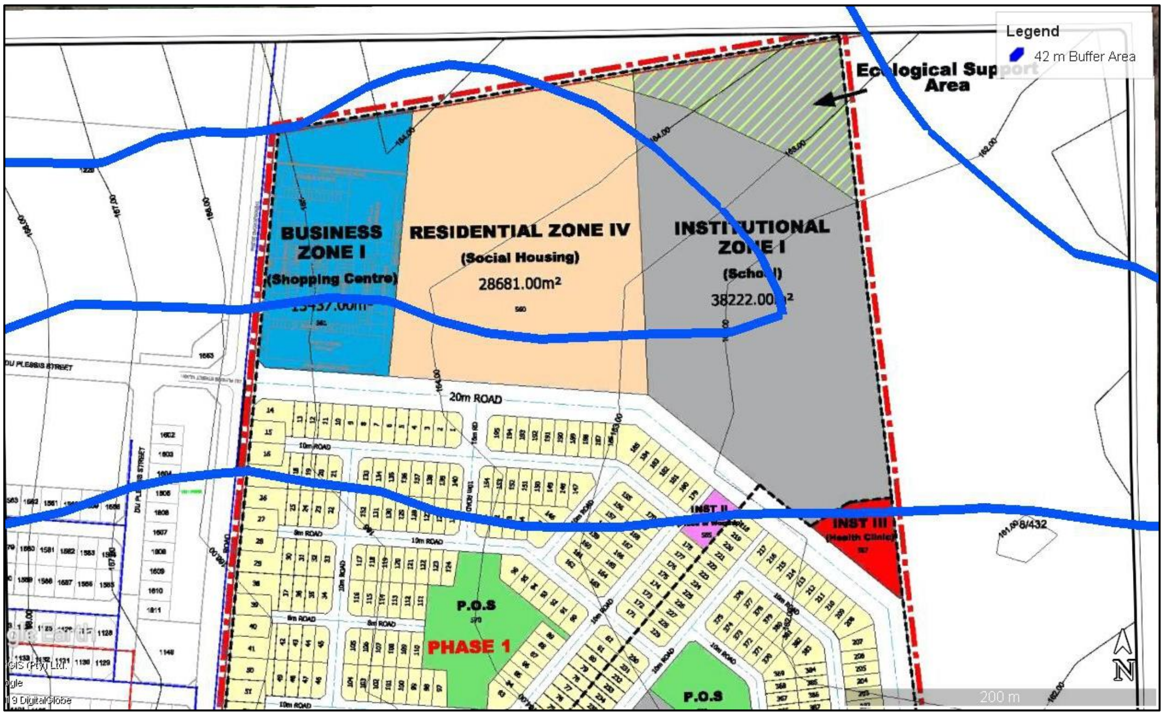

Figure 17: A recommended 42 m buffer zone between any construction and the boundary of the wetlands

9.2 Construction Phase

The mitigation of impacts should focus on managing the runoff generated by the development and introducing it responsibly into the receiving environment. The stormwater flows must enter the wetland areas in a diffuse flow pattern without pollutants. It must be noted that a formal stormwater management plan has not been undertaken. When developing a stormwater management plan for the site, it will be critical that due consideration is given to the collection and treatment of stormwater prior to discharge into the natural environment. It is therefore recommended that the stormwater management plan be developed with appropriate ecological input and be developed based on Sustainable Drainage Systems (SUDS).

Soft infrastructure must be considered where practical. For example, permeable surfaces can be done via permeable concrete block pavers (such as Amorflex), brick pavers, stone chip, and gravel and may contribute to slowing surface flows (especially if maintained). Stormwater managed by the development could be discharged into porous channels / swales (‘infiltration channels or basins’) running near parallel or parallel to contours within and along the edge of the development (Figure 18). This will provide for some filtration and removal of urban pollutants (e.g. oils and hydrocarbons), provide some attenuation by increasing the time runoff takes to reach low points, and reduce the energy of storm water flows within the stormwater system through increased roughness when compared with pipes and concrete V-drains.

Figure 18: Examples of soft infrastructure incorporated into the stormwater management design

Frequent stormwater outlets must be designed to prevent erosion at discharge points. All erosion protection measures (e.g. Reno-mattresses) must be established to reflect the natural slope of the surface and located at the natural ground level.

Stormwater exit points must include a best management practice approach to trap any additional suspended solids and pollutants originating from the proposed development. Also include the placement of stormwater grates (or similar). The use of grease traps/oil separators to prevent pollutants from entering the environment from stormwater is recommended. To ensure the efficiency of these, they must be regularly maintained. Key maintenance will include litter and sediment clearing and the servicing and maintenance of key collection points like catch pits, detention tanks etc. Such maintenance should be the responsibility of either the local municipality or, where possible, the relevant owners/estate associations, and budgeted for.

Stockpiles must not be located within 50 metres of the wetlands. The furthest threshold must be adhered to. They should not be placed in vegetated areas that will not be cleared. Erosion control measures including silt fences, low soil berms and/or shutter boards must be put in place around the stockpiles to limit sediment runoff from stockpiles. Alternatively, the exposed slopes must drain into small temporary stormwater and silt traps/ponds.

Regular inspections during the operational phase should also be undertaken to ensure that functions are not undermined by inappropriate activities.

9.3 Post-construction/ Rehabilitation Phase

Although it is recommended that no construction should be allowed to occur within or impact upon watercourses under the current proposal, there is always potential for accidental disturbance therefore guidelines for rehabilitation of aquatic habitats are provided. The aim of the rehabilitation is to ensure the necessary procedures are appropriately implemented in the natural environment that may be negatively affected by the development. The plan will promote the re-establishment of the ecological functioning of any area disturbed by construction activities. Also consult WET-RehabEvaluate, WET-RehabMethods (Cowden and Kotze, 2009), and the river rehabilitation manual developed by Day *et al.* 2016, for further information.

Important guidelines for rehabilitation are:

- The area must be maintained through alien invasive plant species removal (which is the landowner's responsibility regardless of mitigation associated with this project) and the establishment of indigenous vegetation cover to filter run-off before it enters the freshwater habitat. Please see the Annexure for control options for likely alien invasive plants species.
- The solid domestic waste must be removed and disposed of offsite. All post-construction building material and waste must be cleared in accordance with the EMPr.
- Removal of vegetation must only be when essential for the continuation of the project. Do not allow any disturbance to the adjoining natural vegetation cover or soils.
- Erosion features that have developed due to construction within the aquatic habitat due to the project are required to be stabilised. This may also include the need to deactivate any erosion headcuts/rills/gullies that may have developed.
- It is the contractor's responsibility to continuously monitor the area for newly established alien species during the contract and establishment period, which if present must be removed. Removal of these species shall be undertaken in a way which prevents any damage to the remaining indigenous species and inhibits the re-infestation of the cleaned areas.
- Alien/ invasive species shall not be stockpiled, they should be removed from site and dumped at an approved site.
- Any use of herbicides in removing alien plant species is required to be investigated by the ECO before use, for the necessity, type proposed to be used, effectiveness and impacts of the product on aquatic biota.
- A monitoring programme shall be in place, not only to ensure compliance with the EMPr throughout the construction phase, but also to monitor any post-construction environmental issues and impacts such as increased surface runoff. The monitoring should be regular and additional visits must be taken when there is potential risk to watercourses.

9.4 Operational Phase

- The stormwater management infrastructure must be designed to ensure the runoff from the development is not highly concentrated before entering the buffer area. The volume and velocity of water must be reduced through discharging the surface flow at multiple locations surrounding the development, preventing erosion.
- Any evidence of erosion from this stormwater system must be rehabilitated and the volume/velocity of the water reduced through further structures and/or energy dissipaters. These structures must be incorporated within the layout area.
- The recommended use and maintenance of grease traps/oil separators to prevent pollutants from entering the environment from stormwater.
- Appropriate waste water infrastructure must be designed to prevent any such water from entering the surrounding environment.
- Maintenance of the wetland habitat and buffer area must be implemented for it to remain effective. Apart from erosion control and alien invasive plant eradication, the encroachment of any further infrastructure or vehicles must be prevented.
- The local authority should prevent illegal dumping in this area by providing suitable waste disposal facilities where waste can be recycled and disposed of in a controlled manner.
- Engage with the community to explain the reasons why the buffer and the water resources are protected and what human activities are allowed. This could be targeted at learners to prevent the dumping of solid waste and other activities that threaten the watercourses and buffer zones.
- The community could be involved in the monitoring.
- Placement of signage near the boundary of the buffer zone should also be considered to help mark the boundary and educate the community about the purpose and value of protecting buffer zones. Information can include a description and visual of alien invasive plant species.

10 CONCLUSION

The assessment identified three freshwater ecosystems within the 500 m regulated area that are likely to be impacted by the proposed development. There are two small wetlands that flow from west to east across the study area, and a very degraded seep wetland located directly south of the site boundary. According to the current layout, there will be loss of wetland habitat associated with the project and it was found that the impact of this is of high negative significance. It is highly recommended that the layout be amended ideally to avoid wetland habitat completely and adopt a 42 m buffer area. It is advisable that an alternative such as this be presented for assessments before offsets are considered. At present, the project will not qualify for GA and will need to go through the water use licence application process with the BGCMA for authorisation.

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12 ANNEXURE (METHODOLOGIES)

12.1 Wetland delineation and HGM type identification

Wetland delineation includes the confirmation of the occurrence of wetland and a determination of the outermost edge of the wetland. The outer boundary of wetlands was identified and delineated according to the Department of Water Affairs wetland delineation manual 'A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas' (DWAF, 2005a). Wetland indicators were used in the field delineation of the wetlands: position in landscape, vegetation and soil wetness (determined through soil sampling with a soil auger and the examining the degree of mottling).

Four specific wetland indicators were used in the detailed field delineation of wetlands, which include:

- The Terrain Unit Indicator helps to identify those parts of the landscape where wetlands are more likely to occur.
- The Soil Form Indicator identifies the soil forms, as defined by the Soil Classification Working Group (1991), which are associated with prolonged and frequent saturation.
- The Soil Wetness Indicator identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation.
- The Vegetation Indicator identifies hydrophilic vegetation associated with frequently saturated soils.

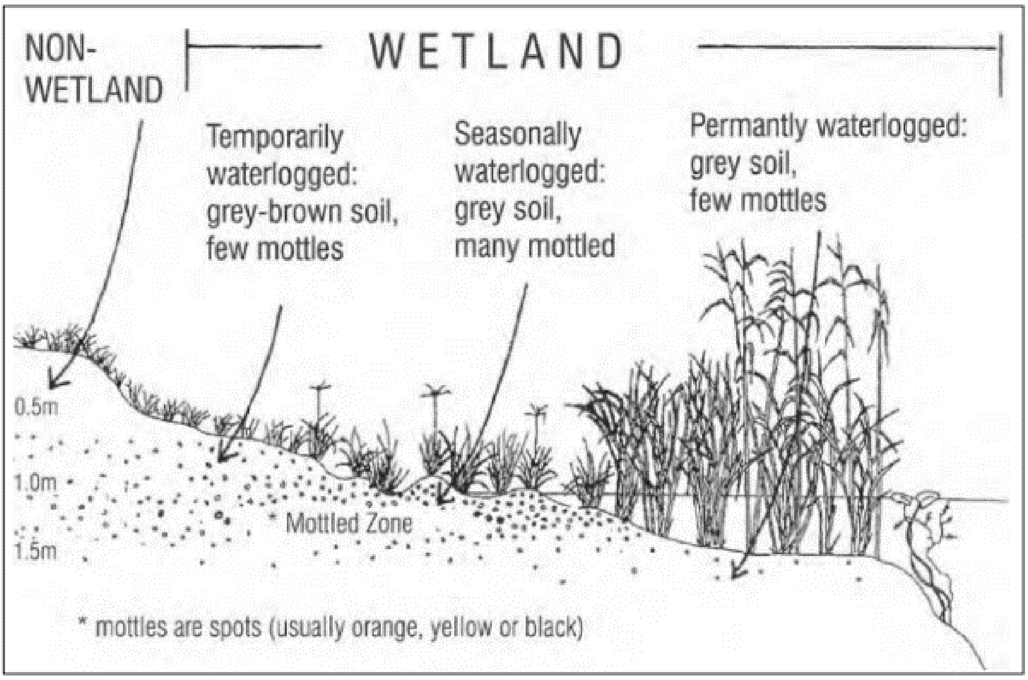

Figure A11.1a: Cross section through a wetland, indicating how the soil wetness and vegetation indicators change as one moves along a gradient of decreasing wetness, from the middle to the edge of the wetland. Source: Donovan Kotze, University of KwaZulu-Natal.

According to the wetland definition used in the National Water Act, vegetation is the primary indicator, which must be present under normal circumstances. However, in practise the soil wetness indicator tends to be the most important, and the other three indicators are used in a confirmatory role. The reason is that vegetation responds relatively quickly to changes in soil moisture regime or management and may be transformed; whereas the morphological indicators in the soil are far more permanent and will hold the signs of frequent saturation long after a wetland has been drained (perhaps for several centuries).

The permanent, seasonal and temporary wetness zones can be characterised to some extent by the soil wetness indicators that they display (Table A11.1a)

A11.1a: Soil Wetness Indicators in the various wetland zones

TEMPORARY ZONE	SEASONAL ZONE	PERMANENT ZONE
Minimal grey matrix (<10%)	Grey matrix (<10%)	Prominent grey matrix
Few high chroma mottles	Many low chroma mottles present	Few to no high chroma mottles
Short periods of saturation (less than three months per annum)	Significant periods of wetness (at least three months per annum)	Wetness all year round (possible sulphuric odour)

Table A11.1b: Relationship between wetness zones and vegetation types and classification of plants according to occurrence in wetlands

VEGETATION	TEMPORARY WETNESS ZONE	SEASONAL WETNESS ZONE	PERMANENT WETNESS ZONE
Herbaceous	Predominantly grass species; mixture of species which occur extensively in non-wetland areas, and hydrophilic plant species which are restricted largely to wetland areas	Hydrophilic sedges and grasses restricted to wetland areas	Dominated by: (1) emergent plants, including reeds (*Phragmites australis*), a mixture of sedges and bulrushes (Typha capensis), usually >1m tall; or (2) floating or submerged aquatic plants.
Woody	Mixture of woody species which occur extensively in non-wetland areas, and hydrophilic plant species which are restricted largely to wetland areas.	Hydrophilic woody species restricted to wetland areas	Hydrophilic woody species, which are restricted to wetland areas. Morphological adaptations to prolonged wetness (e.g. prop roots).
SYMBOL	**HYDRIC STATUS**	**DESCRIPTION/OCCURRENCE**	
Ow	Obligate wetland species	Almost always grow in wetlands (>90% occurrence)	

Fw/F+	Facultative wetland species	Usually grow in wetlands (67-99% occurrence) but occasionally found in non-wetland areas
F	Facultative species	Equally likely to grow in wetlands (34-66% occurrence) and non-wetland areas
Fd/F-	Facultative dryland species	Usually grow in non-wetland areas but sometimes grow in wetlands (1-34% occurrence)
D	Dryland species	Almost always grow in drylands

In order to identify the wetland types, using Kotze *et al.* (2009) and Ollie *et al*. (2013), a characterisation of hydrogeomorphic (HGM) types was conducted. These have been defined based on the geomorphic setting of the wetland in the landscape (e.g. hillslope or valley bottom, whether drainage is open or closed), water source (surface water dominated or sub-surface water dominated), how water flows through the wetland (diffusely or channelled) and how water exits the wetland (Figure A11.1b).

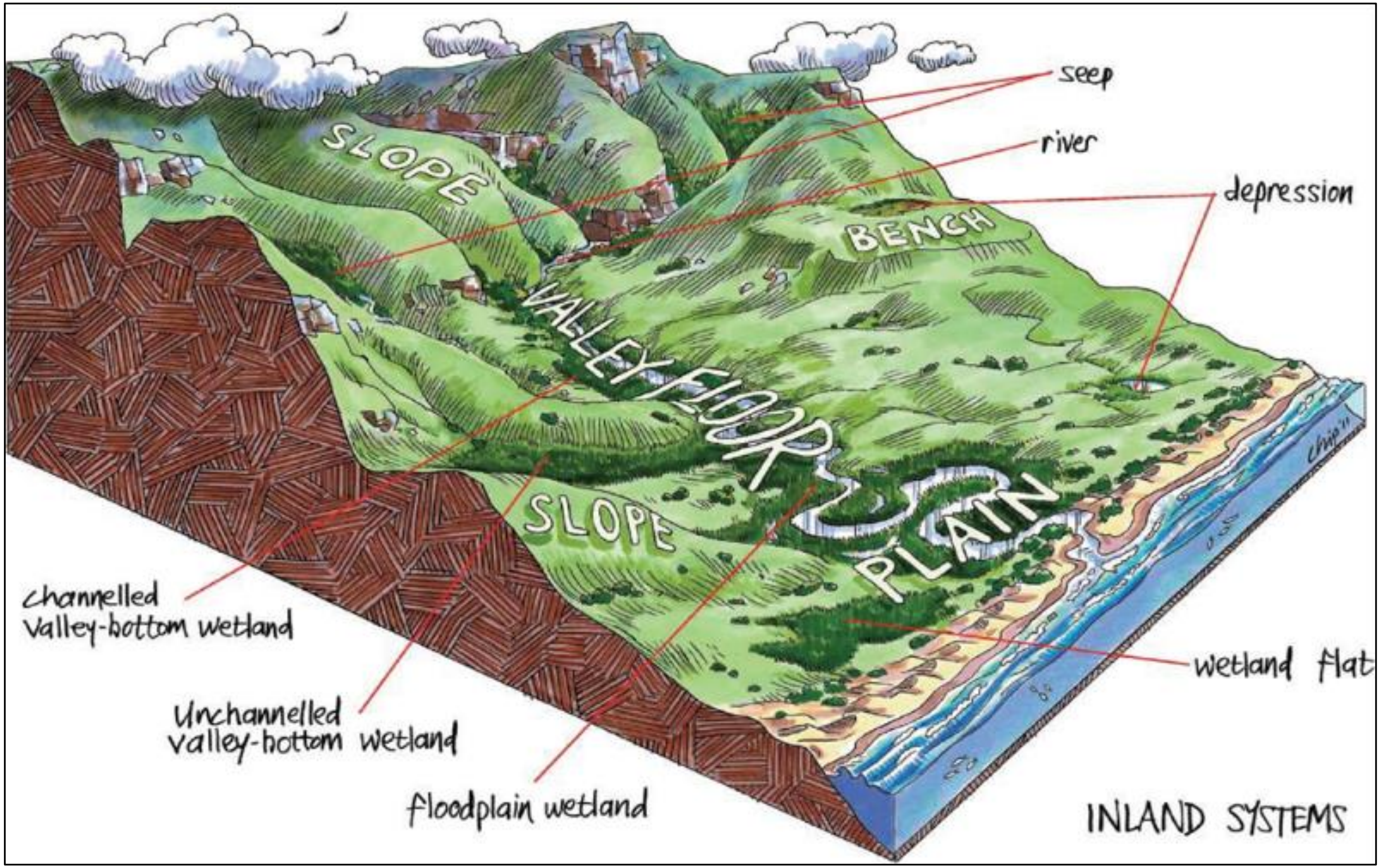

Figure A11.1b: Illustration of wetland types and their typical landscape setting (From Ollie et al. 2013)

12.2 Delineation of Riparian Areas

Riparian zones are described as “the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent areas” i , Riparian zones can be thus be distinguished from adjacent terrestrial areas through their association with the physical structure (banks) of the river or stream, as well as the distinctive structural and compositional vegetation zones between the riparian and upland terrestrial areas (Figure 8). Unlike wetland areas, riparian zones are usually not saturated for a long enough duration for redoxymorphic features to develop. Riparian zones instead develop in response to (and are adapted to) the physical disturbances caused by frequent overbank flooding from the associated river or stream channel.

Like wetlands, riparian areas can be identified using a set of indicators. The indicators for riparian areas are: - **Landscape position**; - Alluvial soils and recently deposited material; - **Topography** associated with riparian areas; and - **Vegetation** associated with riparian areas. Landscape Position As discussed above, a typical landscape can be divided into 5 main units (Figure 2), namely the: - Crest (hilltop); - Scarp (cliff); - Midslope (often a convex slope); - Footslope (often a concave slope); and - Valley bottom. Amongst these landscape units, riparian areas are only likely to develop on the valley bottom landscape units (i.e. adjacent to the river or stream channels; along the banks comprised of the sediment deposited by the channel). Alluvial soils are soils derived from material deposited by flowing water, especially in the valleys of large rivers. Riparian areas often, but not always, have alluvial soils. Whilst the presence of alluvial soils cannot always be used as a primary indicator to accurately delineate riparian areas, it can be used to confirm the topographical and vegetative indicators. Quaternary alluvial soil deposits are often indicated on geological maps, and whilst the extent of these quaternary alluvial deposits usually far exceeds the extent of the contemporary riparian zone; such indicators are useful in identifying areas of the landscape where wider riparian zones may be expected to occur.

Topography and recently deposited material associated with riparian areas The National Water Act definition of riparian zones refers to the structure of the banks and likely presence of alluvium. A good indicator of the presence of riparian zones is the presence of alluvial deposited material adjacent to the active channel (such as benches and terraces), as well as the wider incised “macro-channels” which are typical of many of southern Africa’s eastern seaboard rivers. Recently deposited alluvial material outside of the main active channel banks can indicate a currently active flooding area; and thus the likely presence of wetlands. Vegetation associated with riparian areas unlike the delineation of wetland areas, where redoxymorphic features in the soil are the primary indicator, the identification of riparian areas relies heavily on vegetative indicators. Using vegetation, the outer boundary of a riparian area can be defined as the point where a distinctive change occurs: - in species composition relative to the adjacent terrestrial area; and - in the physical structure, such as vigour or robustness of growth forms of species similar to that of adjacent terrestrial areas. Growth form refers to the health, compactness, crowding, size, structure and/or numbers of individual plants. As with the delineation approach for wetlands, the field delineation method for riparian areas focuses on two main indicators of riparian zones: - **Vegetation Indicators**, and - **Topography** of the banks of the river or stream.

Additional verification can be obtained by examining for any recently alluvial deposited material to indicate the extent of flooding and thus obtain at least a minimum riparian zone width. The following procedure should be used for delineation of riparian zones: A good rough indicator of the outer edge of the riparian areas is the edge of the macro channel bank. This is defined as the outer bank of a compound channel, and should not be confused with the active river or stream channel bank. The macro-channel is an incised feature, created by uplift of the subcontinent which caused many rivers to cut down to the underlying geology and creating a sort of "restrictive floodplain" within which one or more active channels flow. Floods seldom have any known influence outside of this incised feature. Within the macro-channel, flood benches may exist between the active channel and the top of the macro channel bank. These depositional features are often covered by alluvial deposits and may have riparian vegetation on them. Going (vertically) up the macro channel bank often represents a dramatic decrease in the frequency, duration and depth of flooding experienced, leading to a corresponding change in vegetation structure and composition.

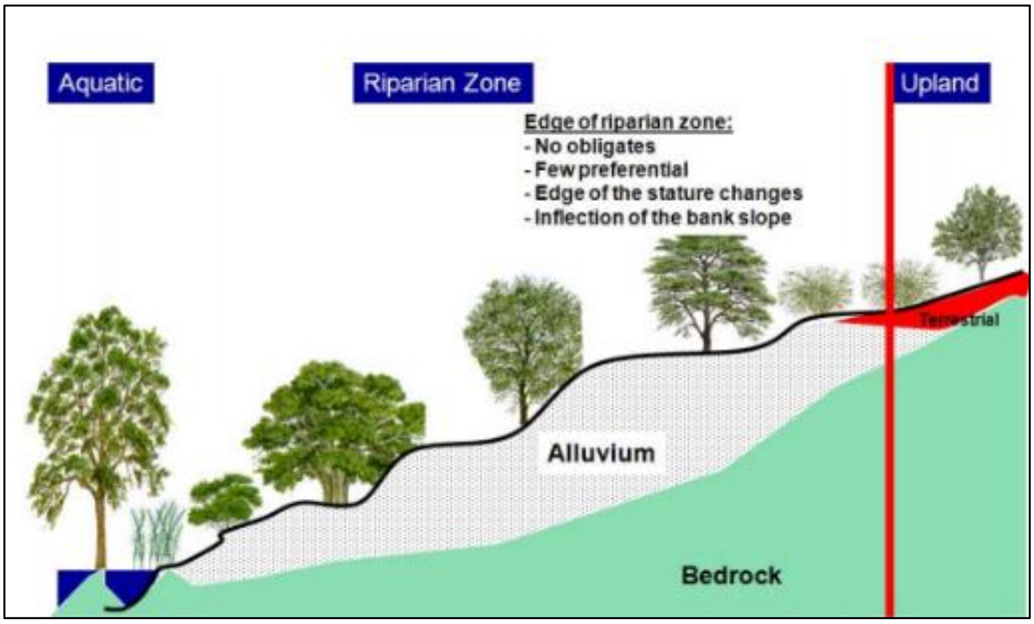

Figure A11: A schematic diagram illustrating the edge of the riparian zone on one bank of a large river (DWAF 2008).

12.3 Present Ecological State (PES) – Wetlands

WET-Health assists in assessing the health of wetlands using indicators based on geomorphology, hydrology and vegetation. For the purposes of rehabilitation planning and assessment, WET-Health helps users understand the condition of the wetland in order to determine whether it is beyond repair, whether it requires rehabilitation intervention, or whether, despite damage, it is perhaps healthy enough not to require intervention. It also helps diagnose the cause of wetland degradation so that rehabilitation workers can design appropriate interventions that treat both the symptoms and causes of degradation. WET-Health is tailored specifically for South African conditions and has wide application, including assessing the Present Ecological State of a wetland. There are two levels of complexity: Level 1 is used for assessment at a broad catchment level and Level 2 provides detail and confidence for individual wetlands based on field assessment of indicators of degradation (e.g. presence of alien plants). A basic tertiary education in agriculture and/or environmental sciences is required to use it effectively. Level 1 was utilised for the assessment.

WET-Health is a tool designed to assess the health or integrity of a wetland. Wetland health is defined as a measure of the deviation of wetland structure and function from the wetland's natural reference condition. This technique attempts to assess hydrological, geomorphological and vegetation health in three separate modules.

Hydrology is defined in this context as the distribution and movement of water through a wetland and its soils. This module focuses on changes in water inputs as a result of changes in catchment activities and characteristics that affect water supply and its timing, as well as on modifications within the wetland that alter the water distribution and retention patterns within the wetland.

Geomorphology is defined in this context as the distribution and retention patterns of sediment within the wetland. This module focuses on evaluating current geomorphic health through the presence of indicators of excessive sediment inputs and/or losses for clastic (minerogenic) and organic sediment (peat).

Vegetation is defined in this context as the vegetation structural and compositional state. This module evaluates changes in vegetation composition and structure as a consequence of current and historic onsite transformation and/or disturbance.

The overall approach is to quantify the impacts of human activity or clearly visible impacts on wetland health, and then to convert the impact scores to a Present State score. The tool attempts to standardise the way that impacts are calculated and presented across each of the modules. This takes the form of assessing the spatial extent of impact of individual activities and then separately assessing the intensity of impact of each activity in the affected area. The extent and intensity are then combined to determine an overall magnitude of impact (Table A11.2a).

Table A11.2a: Guideline for interpreting the magnitude of impacts on integrity (Macfarlane et al., 2008).

IMPACT CATEGORY	DESCRIPTION	SCORE
None	No discernible modification or the modification is such that it has no impact on this component of wetland integrity.	0 – 0.9
Small	Although identifiable, the impact of this modification on this component of wetland integrity is small.	1 – 1.9
Moderate	The impact of this modification on this component of wetland integrity is clearly identifiable, but limited.	2 – 3.9
Large	The modification has a clearly detrimental impact on this component of wetland integrity. Approximately 50% of wetland integrity has been lost.	4 – 5.9
Serious	The modification has a highly detrimental effect on this component of wetland integrity. Much of the wetland integrity has been lost but remaining integrity is still clearly identifiable.	6 – 7.9
Critical	The modification is so great that the ecosystem processes of this component of wetland integrity are almost totally destroyed, and 80% or more of the integrity has been lost.	8 – 10

Impact scores obtained for each of the modules reflect the degree of change from natural reference conditions. Resultant health scores fall into one of six health categories (A-F) on a gradient from "unmodified/natural" (Category A) to "severe/complete deviation from natural" (Category F) as depicted in Table A11.2b, below. This classification is consistent with DWAF categories used to evaluate the present ecological state of aquatic systems.

Table A11.2b. Health categories used by WET-Health for describing the integrity of wetlands (after Macfarlane et al., 2008).

IMPACT CATEGORY	DESCRIPTION	RANGE	PES CATEGORY
None	Unmodified, natural.	0 – 0.9	**A**
Small	Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1 – 1.9	**B**
Moderat e	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact	2 – 3.9	**C**
Large	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4 – 5.9	**D**
Serious	The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still	6 – 7.9	**E**
Critical	Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8 – 10	**F**

An overall wetland health score was calculated by weighting the scores obtained for each module and combining them to give an overall combined score using the following formula:

Overall health rating = [(Hydrology*3) + (Geomorphology*2) + (Vegetation*2)] / 7

This overall score assists in providing an overall indication of wetland health/functionality which can in turn be used for recommending appropriate management measures.

12.4 Wetland Functional Importance (Goods and Services)

WET-EcoServices is used to assess the goods and services that individual wetlands provide, thereby aiding informed planning and decision making. It is designed for a class of wetlands known as palustrine wetlands (i.e. marshes, floodplains, vleis or seeps). The tool provides guidelines for scoring the importance of a wetland in delivering each of 15 different ecosystem services (including flood attenuation, sediment trapping and provision of livestock grazing). The first step is to characterise wetlands according to their hydro-geomorphic setting (e.g. floodplain). Ecosystem service delivery is then assessed either at Level 1, based on existing knowledge or at Level 2, based on a field assessment of key descriptors (e.g. flow pattern through the wetland).

The overall goal of WET-EcoServices is to assist decision makers, government officials, planners, consultants and educators in undertaking quick assessments of wetlands, specifically in order to reveal the ecosystem services that they supply. This allows for more informed planning and decision making. WET-EcoServices includes the assessment of several ecosystem services - that is, the benefits provided to people by the ecosystem.

The steps involved in applying WET-EcoServices can be summarised as follows.

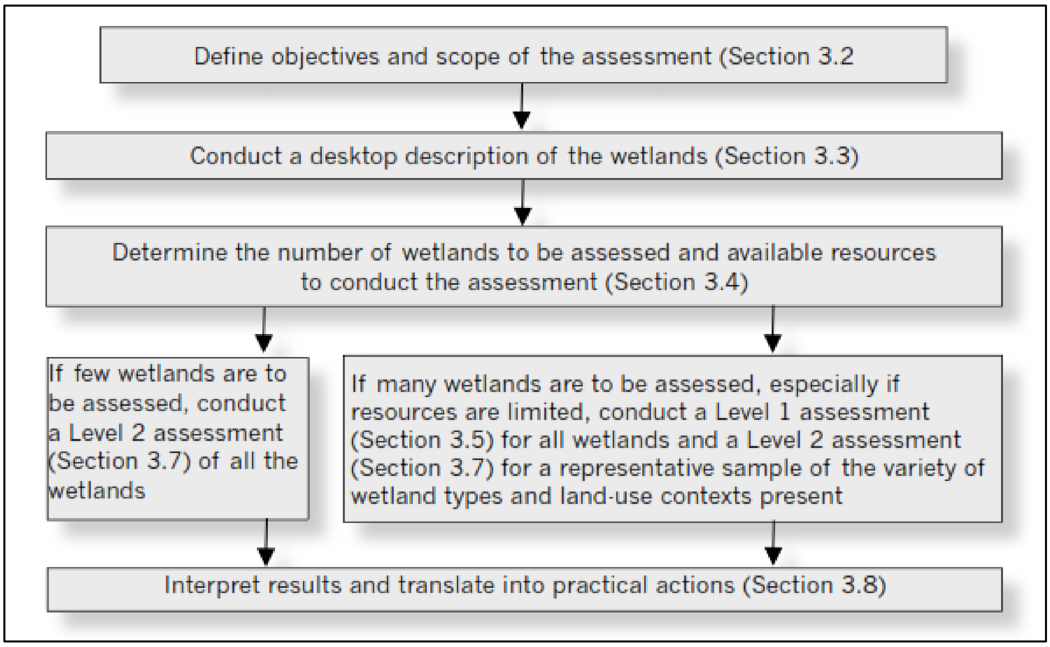

Figure A11.4a: Steps required for Wet-EcoServices. The sections referred to within this figure relate back to the Wetland Management Series: Wet-Ecoservices. WRC Report TT 339/08

12.5 Ecological Importance & Sensitivity (EIS) - Wetlands

The Ecological Importance and Sensitivity was determined by utilising a rapid scoring system. The system has been developed to provide a scoring approach for assessing the Ecological, Hydrological Functions; and Direct Human Benefits of importance and sensitivity of wetlands. These scoring assessments for these three aspects of wetland importance and sensitivity have been based on the requirements of the NWA, the original Ecological Importance and Sensitivity assessments developed for riverine assessments (DWAF, 1999), and the work conducted by Kotze et al (2008) on the assessment of wetland ecological goods and services from the WET-EcoServices tool (Rountree, 2010). An example of the scoring sheet is attached as Table A11.5a. The scores are then placed into a category of very low, low, moderate, high and very high as shown in Table 14.5b.

Table A11.5a: Example of scoring sheet for Ecological Importance and sensitivity

ECOLOGICAL IMPORTANCE AND SENSITIVITY:			
Ecological Importance	Score (0-4)	*Confidence (1-5)*	**Motivation for site**
Biodiversity support			
Presence of Red Data species			
Populations of unique species			
Migration/breeding/feeding sites			
Landscape scale			
Protection status of the wetland			
Protection status of the vegetation type			
Regional context of the ecological integrity			
Size and rarity of the wetland type/s present			
Diversity of habitat types			
Sensitivity of the wetland			
Sensitivity to changes in floods			
Sensitivity to changes in low flows/dry season			
Sensitivity to changes in water quality			
ECOLOGICAL IMPORTANCE & SENSITIVITY			
HYDROLOGICAL/FUNCTIONAL IMPORTANCE			
IMPORTANCE OF DIRECT HUMAN BENEFITS			
OVERALL IMPORTANCE			

Table A11.5b: Category of score for the Ecological Importance and Sensitivity

RATING	EXPLANATION
None, Rating = 0	Rarely sensitive to changes in water quality/hydrological regime
Low, Rating =1	One or a few elements sensitive to changes in water quality/hydrological regime

Moderate, Rating =2	Some elements sensitive to changes in water quality/hydrological regime
High, Rating =3	Many elements sensitive to changes in water quality/ hydrological regime
Very high, Rating =4	Very many elements sensitive to changes in water quality/ hydrological regime

12.6 Direct, Indirect and Cumulative Impacts Methodology

Direct, indirect and cumulative impacts should be assessed in terms of the following criteria:

- The **nature**, which shall include a description of what causes the effect, what will be affected and how it will be affected.
- The **extent**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high).
- The **duration**, wherein it will be indicated whether:
    - The lifetime of the impact will be of a very short duration (0-1 years) – assigned a score of 1.
    - The lifetime of the impact will be of short duration (2-5 years) – assigned a score of 2;
    - Medium term (5-15 years) – assigned a score of 3;
    - Long-term (> 15 years) – assigned a score of 4; or
    - Permanent – assigned a score of 5.

- The **magnitude**, quantified on a scale of 0-10, where:
    - 0 is small and will have no effect on the environment,
    - 2 is minor and will not result in an impact on processes,
    - 4 is low and will cause a slight impact on processes,
    - 6 is moderate and will result in processes continuing but in a modified way,
    - 8 is high (processes are altered to the extent that they temporarily cease), and
    - 10 is very high and results in complete destruction of patterns and permanent cessation of processes.

- The **probability** of occurrence, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale of 1-5, where:
    - 1 is very improbable (probably will not happen),
    - 2 is improbable (some possibility, but low likelihood),

- 3 is probable (distinct possibility),
- 4 is highly likely (most likely) and;
- 5 is definite (impact will occur regardless of any prevention measures).

- The **significance**, which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high;
- The degree to which the impact can be reversed.
- The degree to which the impact may cause irreplaceable loss of resources; and
- The degree to which the impact can be mitigated.
- The significance is calculated by combining the criteria in the following formula, **S = (E+D+M) P**, where:
  - S = significance weighting
  - E = extent
  - D = duration
  - M = magnitude
  - P = probability

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

13 ANNEXURE: ALIEN INVASIVE PLANT CONTROL

Table showing control options for likely alien invasive plants species (Adapted from Day et al. 2016)

Acacia cyclops (Rooikrans)		**Manual:** Hand pulling or hoeing of seedlings or saplings. Grubbing, hoeing and digging out of immature stage up to 2 m. Felling and cutting of stump to the ground for larger mature trees. **Bio-Control:** Indigenous field mice eat the seeds. Rooikrans seed weevil. Flower galler (*Dasineura dielsi* Rubsaamen). Seed feeder (*Melanterius servulus*).
Acacia mearnsii *(Black Wattle)*		**Manual:** Hand pulling of seedlings or saplings <40 cm. Grubbing. Hoeing. Digging of immature trees up to 2 m. Felling used for large mature trees. Ringing, ring of 10 cm width in large plants. **Chemical:** Seedlings – Mamba, Garlon 4, Viroaxe. Tree stumps – Timbrel 3A. **Bio Control:** Stump fungus *(Cylindrobasidium laeve)* applied to freshly cut stumps. Seed weevil (*Melanterius maculates*).

Arundo donax (Spanish Reed)		**Manual:** Repeated removal. Cutting of stalks. However, cut stalks can re-root and manual methods generally unsustainable. **Chemical:** 3Apply MAMBA or Nexus GLYPHOSATE 360 Reg. NO L7113: Act /Wet no 36/ 1947. This is a broad spectrum herbicide so applicable in dense monospecific stands. Ideally use as foliar spray, just before winter (as this is the time that translocation in plant nutrients to the root-mass takes place in preparation for winter dormancy and toxin transfer to roots is most effective. If stands too dense for good foliar application, cut stems and then apply as foliar to resprouting material – but note that cut material may resprout and transfer to roots less effective as cutting stimulates stem growth. If mixed stands, use GLYPHOSATE 360, on cut stems, but note less effective.
Lantana camara		**Manual:** Hand pulling of seedlings or saplings. Grubbing or hoeing of small patches. Cutting is ineffective as plant coppices use of herbicides needed. Large infestation should be crushed or rolled with brush cutters then stumps treated with herbicides. **Chemical:** Seedlings/ saplings – Mamba/Kilo Touchdown / Access. Mature tree stumps – Chopper / Access/ Timbrel 3A. **Bio Control:** Flower galler (Aceria *lantanae* Cook). Leaf miner (*Calycomyza lantanae*). Leaf sucker (Falconia intermedia). Leaf feeder (*Hypena laceratalis* Walker). Leaf miner (*Octotoma scabripennis* Guerin-Meneville). Leaf miner (*Ophiomyia camarae* Spencer). Seed miner (*Ophiomyia lantanae*). Leaf & flower sucker (*Teleonemia scrupulosa* Stal). Leaf miner (*Uroplata girardi* Pic).
Pennisetum Clandestinum (Kikuyu grass)		**Manual:** hand pull by roots; kikuyu often associated with raised fill / disturbed areas – removal will reduce invasion opportunities; Inclusion of hard paths on upland edge of river, buffer or wetland provides hard management edge from which to manage invasion and also reduces to some extent root spread **Chemical:** Spray with Roundup ® while grass is actively growing (not when dormant) and follow up spray any regrowth after 4 months.

Rubus spp (Bramble)		**Chemical:** Mamba max – most effective in autumn when downward sap movement.
Cirsium vulgare (Scottish Thistle)		**Manual:** hand pull
Hedychium gardnerianum (Kahili ginger lily)		**Manual:** hand pull

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Attention: Mr Lance Del Monte
Metroplan Town and Regional Planners

22 July 2019

RE: FRESHWATER STATEMENT ON REVISED LAYOUT FOR THE PROPOSED MIXED-USE DEVELOPMENT OF PORTION 9 OF FARM 432, KRANSHOEK

Subsequent to the layout assessed in the freshwater impact assessment report (dated 12 March 2019), a revised layout has been developed to accommodate reports by Specialists and comments raised by CapeNature (refer to letter dated 12 June 2019).

The revised layout has been designed with consideration to the identified freshwater habitat, as well as the recommended buffer area, of the freshwater report. However, the area classified as ESA in the north eastern corner of the property also contains wetland habitat and this must be reflected in future layout plans. It is recommended that a buffer area is also applied to this system, as recommended in the freshwater habitat assessment report.

Overall, the new layout substantially decreases the potential risk to freshwater habitat associated with the activities and avoids complete wetland loss. Therefore, from a freshwater perspective, the impacts can likely be managed to an acceptable level after mitigation is applied.

However, the revised layout must undergo a full assessment by a freshwater specialist to confirm the above statement. Additionally, there are currently significant assumptions and limitations relating to the freshwater assessment, as further details of the development are required. The development of a robust stormwater management plan, with structural designs, to reduce the velocity and volumes of runoff from stormwater outlets into the buffer areas, and prevent pollutants from entering the environment, will substantially decrease the potential impacts upon the wetlands. The water and sewer networks must be detailed and assessed once such layouts have been developed. Incorrectly placed service pipelines or culverts can increase the risk of impacts upon the wetlands. Furthermore, the location of such infrastructure affects the water use authorisation process to be followed. It is however expected that a full water use licence application process will be required (to be determined by Risk Matrix) and BGCMA.

Therefore, whilst further assessment is recommended, the revised layout is a largely supported from a freshwater habitat perspective. Although deemed a necessity from a wetland conservation context, the incorporation of such important wetland habitat and buffer areas into the development layout must be commended.

Kind regards

Debbie Fordham
Freshwater Ecologist