GEORGE
TEL: +27 (0) 44 873 4923 **FAX:** +27 (0) 44 874 5953
EMAIL: info@sescc.net **WEBSITE:** www.sescc.net
ADDRESS: 102 Merriman Street, George 6530
PO BOX: 9087, George , 6530

CAPE TOWN
TEL: +27 (0) 21 554 5195 **FAX:** +27 (0) 86 575 2869
EMAIL: betsy@sescc.net **WEBSITE:** www.sescc.net
ADDRESS: Tableview, Cape Town, 7441
PO BOX: 443, Milnerton, 7435

FRESHWATER HABITAT RISK ASSESSMENT

FOR THE PROPOSED

DANA BAY ACCESS ROAD, WESTERN CAPE

PREPARED FOR: Mossel Bay Municipality

PREPARED BY: Sharples Environmental Services

Debbie Fordham
Tel: 044 873 4923
debbie@sescc.net

DATE: 11/03/2020

EXECUTIVE SUMMARY

Sharples Environmental Services cc (SES) has been appointed by the Mossel Bay Municipality to compile a Freshwater Habitat Assessment for the proposed Dana Bay Access Road. The new road will provide direct access to Dana Bay, a coastal town east of Mossel Bay in the Garden Route, from the N2 national road.

The site is located within the DWS Quaternary catchment K10A and falls within the Breede Gouritz Water Management Area. The aquatic habitats within the 500m regulated area of the proposed activity were identified and mapped on a desktop level utilising available data, following which, the infield site assessment confirmed the location and extent of these systems. A depression wetland is situated within the proposed road route and therefore would be infilled and lost. The other non perennial riparian systems were determined to have a low risk of being impacted upon by the project.

The wetland identified is not connected to the river network and the water source is likely to be rainfall dominated and prolonged flooding from restricted infiltration by a sub-surface clay layer. There is only temporary wetness and thus it is dominated by grass species. Soil augering within the depression showed evidence of periods of soil saturation with the presence of mottles within 50cm of the surface. The wetland can be classified as a geochemical depression (Grenfell et al. 2009). It is located in a highly disturbed area and there is a possibility that it is artificial and has formed as a result of some agricultural activity. However, if the depression wetland is a naturally occurring feature, then it has not have deviated significantly from the estimated reference condition. The PES was determined to be within the 'B' ecological category indicating that the wetland is in a near natural state. It has a low to moderate level of ecological importance and sensitivity as, although it seems to provide refuge for the Cape Gerbil, it has limited habitat diversity and is in a disturbed landscape with little research potential. It lacks functional importance in the form of direct services to society and provides limited indirect ecological benefits. It is recommended that the wetland be avoided by the road to prevent any habitat loss and to maintain the system in its current state. However, the loss of this habitat will not result in the loss of any irreplaceable ecosystem functions or compromise overall water resource protection targets.

The construction of the road will require land clearance, excavations, land re-surfacing, and infilling along the proposed route and the proposed road reserve. The depression wetland is within the road route and will thus be cleared of vegetation, infilled and compacted for road construction. This will result in direct habitat loss. The DWS Risk Assessment Matrix (2016) was applied to ascertain the significance of perceived impacts of the proposal on the key drivers and response processes (hydrology, water quality, geomorphology, habitat and biota) of the aquatic habitat. The identified impacts during

construction of the road were determined to be of Moderate Risk significance (score of 63). This potential impact significance should influence the decision in infill the wetland and requires a clear and substantiated need and desirability for the project to justify the risks. In the operational phase, the stormwater infrastructure of the road will increase and concentrate flows into the downslope watercourses. This may lead to erosion in the systems near the site. Stormwater management during operation will be critical in ensuring that runoff characteristics mimic the natural scenario and do not lead to increased floodpeaks and flow velocities which could lead to increased erosion and sedimentation risks that could potentially affect the downstream watercourses. If operational phase mitigation is adopted, then the significance of this risk was determined to be Low.

A wetland offset investigation was undertaken to determine if such an approach is required to mitigate the residual impacts of loss of the depression. It determined that due to the negligible size and low importance of the depression there would not be any remaining significant residual negative impacts on biodiversity. The loss of the depression wetland will not influence any biodiversity conservation targets or compromise water resource protection in any way, or on any scale. There is no need for wetland offsets to be implemented. The cumulative impact can be considered as low, especially if the protection and management of the downslope watercourses through sustainable road drainage systems could be seen as appropriate mitigation. Therefore, the change to aquatic habitat due to the proposed road is deemed as acceptable after the adoption of mitigation.

The findings of the Risk Matrix undertaken show that due to road construction over the wetland resulting in a 'Moderate' risk (after mitigation) the activity cannot be authorised in terms of the GA (General Authorisation) for Section 21 (c) and (i) water use under this scenario. The Breede Gouritz Catchment Management Agency (BGCMA) should be consulted regarding the requirements of a full water use license application.

DECLARATION OF INDEPENDENCE

Independent Specialist Consultant

I, Debbie Fordham, declare that I:

- Act as an independent specialist consultant, in this application, in the field of wetland and riparian 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 Environmental Impact Assessment Regulations, 2014 (as 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 Environmental Impact Assessment Regulations, 2017; 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. Provided I have been suitably remunerated for the work.

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 326 - Environmental Impact Assessment 2017 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.

Report citation:

Sharples Environmental Services cc, 2020. Aquatic Habitat Impact Assessment: *Proposed construction of a new access road to Dana Bay*.

Author & Co-author

Specialist	Qualifications	Details
Debbie Fordham	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.
Marita Burger	BA (Hons) - Environmental Science	Marita is a junior aquatic scientist who specialises in water use licencing and spatial mapping using GIS software.

Indemnity and Copyright

The project deliverables, including the reported results, comments, recommendations and conclusions, are based on the author's professional knowledge as well as available information. The study is based on assessment techniques and investigations that are limited by time and budgetary constraints applicable to the type and level of survey undertaken. The author reserves the right to modify aspects of the report including the recommendations if and when new information may become available from on-going research or further work in this field, or pertaining to this investigation. The author has exercised reasonable skill, care and diligence in the provision of services, however, accepts no liability or consequential liability for the use of the supplied project deliverables and any information or material contained therein. The client, including their agents, by receiving these deliverables indemnifies Sharples Environmental Services cc (including its members, employees and sub-consultants) against any actions, claims, demands, losses, liabilities, costs, damages and expenses arising directly or indirectly from or in connection with services rendered, directly or indirectly by Sharples Environmental Services cc.

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1 INTRODUCTION

Sharples Environmental Services cc (SES) has been appointed by the Mossel Bay Municipality to compile a Freshwater Habitat Assessment for the proposed new Dana Bay Access Road.

1.1 Location

The new road will provide direct access to Dana Bay, a coastal town east of Mossel Bay in the Garden Route, from the N2 national road. The proposed road is shown in yellow in Figure 1. The road will be an extension of the existing Flora Road through Dana Bay, will cut through Portion 7 of Farm Rietvalley No. 225 and connect to the N2 at the Herbertsdale intersection.

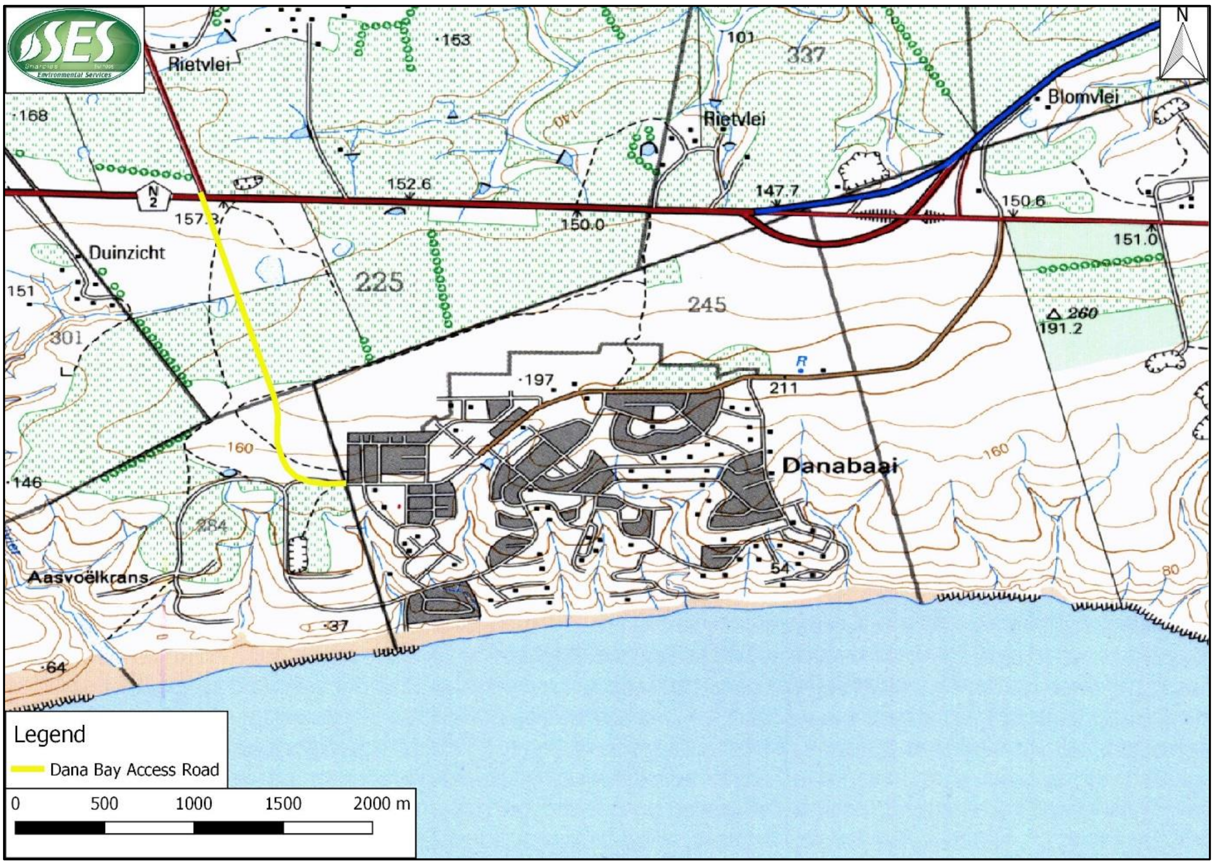

Figure 1: Location map showing the proposed location of the road in relation to the town of Dana Bay

1.2 Background

In the Mossel Bay Municipality Spatial Development Framework of May 2018 it is mentioned that an alternative Access Road into Dana Bay is being investigated as there are no evacuation escape routes out of the town. The alternative proposed here, extending Flora Road to the R327, are the recommended option since the other shorter routes has challenges related to land ownership. Figure 2 on the next page shows the proposed route as included in the SDF.

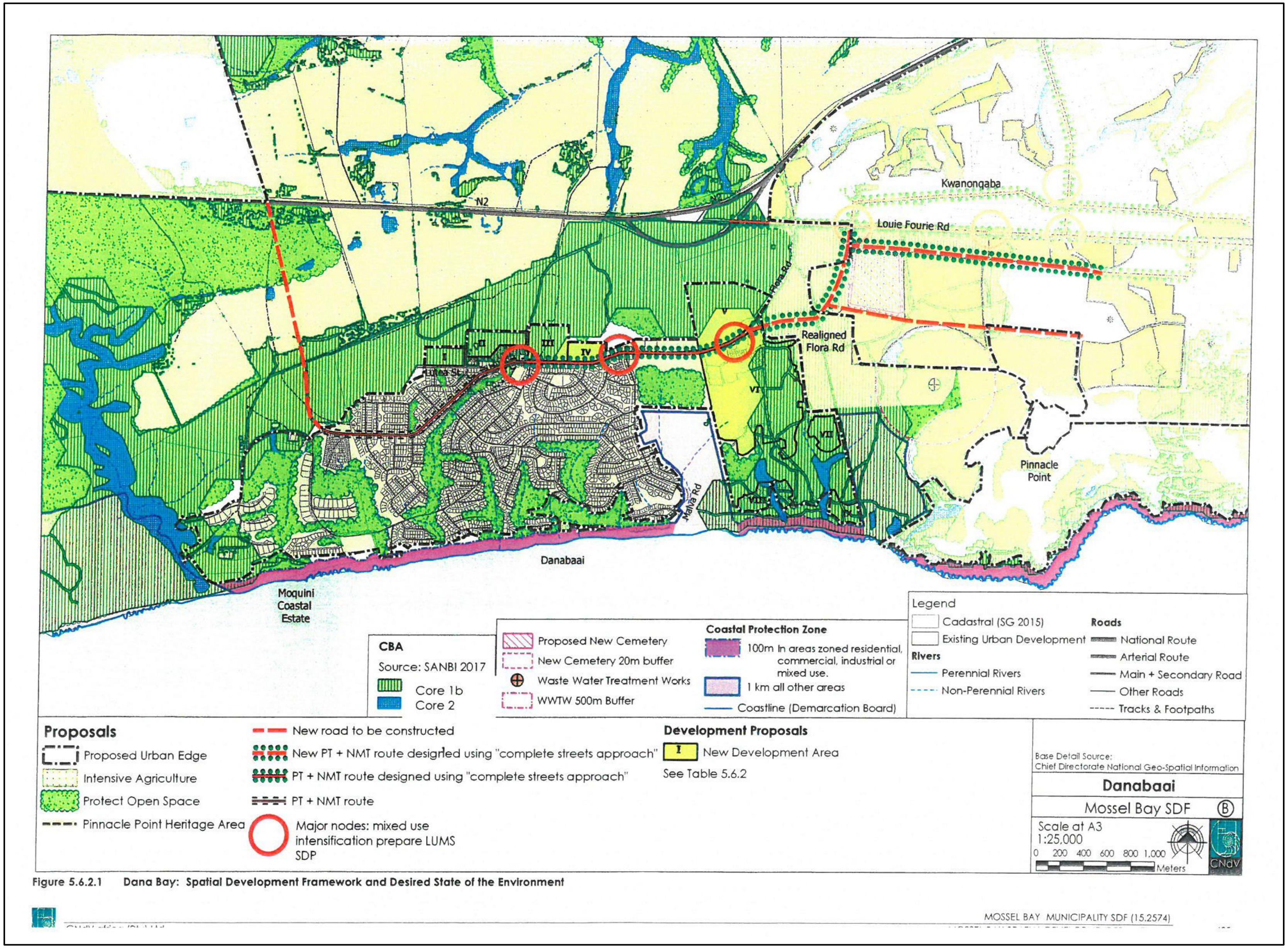

Figure 2: Proposed new access road to Dana Bay route as contained in the 2018 Mossel Bay SDF.

1.3 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).
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, course 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.

1.4 Scope of Work

The Scope of Work in accordance with the specific Terms of Reference supplied by Sharples Environmental Services cc are described below:

Phase 1

- ✓ Contextualization of the study area in terms of important biophysical characteristics and the latest available aquatic conservation planning information.
- ✓ Desktop delineation and illustration of all watercourses within the study area utilising available site-specific data such as aerial photography, contour data and water resource data.
- ✓ A risk/screening assessment of these identified watercourses to determine which ones will be impacted upon by the proposed development areas.

Phase 2

- ✓ Ground truthing, infield identification, delineation and mapping of any 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*.
- ✓ 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
- ✓ Conduct a Present Ecological State (PES), functional importance assessment and Ecological Importance and Sensitivity (EIS) assessment of the delineated wetland habitats, utilising:
  - → Level 1 WET-Health tool (Macfarlane *et al*., 2009) – PES
  - → WET-Ecoservices (Kotze *et al*., 2009) - 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.
- ✓ Identification, prediction and description of potential impacts on aquatic habitat during the construction and operational phases of the project.
- ✓ Identify direct, indirect, and cumulative impacts the proposed development will have on aquatic habitats and the significance of these impacts. Rate the significance of the impacts.
- ✓ Recommend actions that should be taken to prevent impacts on aquatic habitat, in alignment with the mitigation hierarchy, and any measures necessary to restore disturbed areas or ecological processes.
- ✓ The identification, description and assessment of opportunities/constraints of the site.
- ✓ Determination of No Go and buffer zones.

- ✓ Identify legislation and permit requirements that are relevant to the development proposal from an aquatic perspective.

2 STUDY AREA

2.1 Climate

The area has a moderate climate with an annual mean temperature of 17˚C. The annual rainfall in the area is 430 mm with the highest rainfall occurring in October and March and the lowest in December. Analysis of the climate in this area for future water requirements and planning must however give consideration to the predicted impacts of climate change; such as decreased rainfall and increased temperatures.

2.2 Drainage network

The site is located within the DWS Quaternary catchment K10A and falls within the Breede Gouritz Water Management Area. The catchment has fairly short rivers that drain the coastal area into the Indian Ocean. The Blinde River is one of the largest rivers in this catchment and are located west of the study area.

Mapping the locality of aquatic habitat is essential for classification into the different wetland and river ecosystem types across the country, which in turn can be used with other data to identify aquatic systems of conservation significance. The National Freshwater Ecosystem Priority Area project (NFEPA) provides strategic spatial priority areas for conserving South Africa's aquatic ecosystems and supporting sustainable use of water resources. These priority areas are called Freshwater Ecosystem Priority Areas (FEPAs) and the main output of the NFEPA project was the creation of FEPA maps. 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).

There NFEPA projects identified wetlands within close proximity to the proposed road (Figure 3). In the northern section of the road a FEPA wetland was identified on the eastern side of the road and a non-FEPA wetland on the western side. Both wetlands are approximately 90 m from the road. In the southern portion of the road there are also FEPA wetlands identified. These wetlands are approximately 230 m and 320 m away from the road.

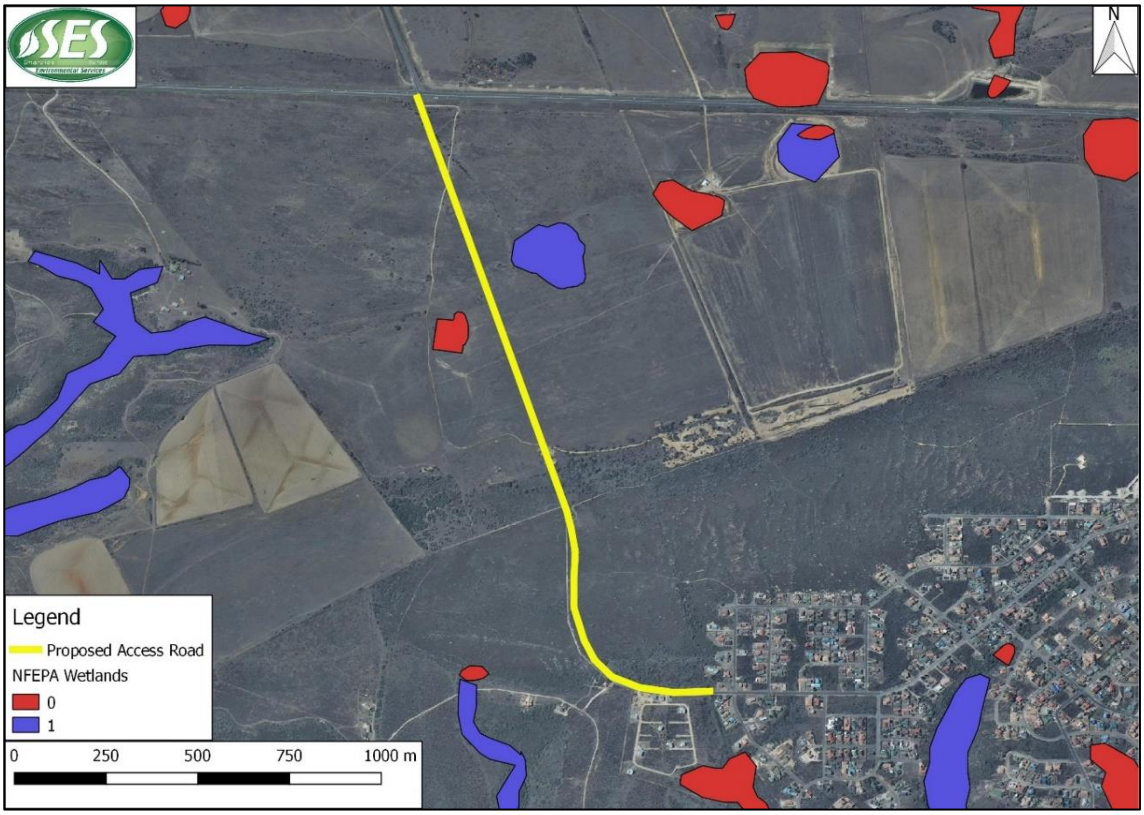

Figure 3: Map of NFEPA project identified aquatic areas in relation to the study area

The South African National Wetlands Map (NWM5) provides information on the location, spatial extent and ecosystem types of estuarine and inland aquatic ecosystems (Van Deventer *et al.*, 2018). The latest version is the National Wetland Map 5, that was released in 2019. The wetlands identified, as shown in Figure 4, are in similar locations as the NFEPA identified wetlands. The two wetlands in the south and the wetland to the west of the study area are all classified as seep wetlands that are located within Albany Thicket. The wetlands east of the study area are classified as a depression occurring in the Southern Fynbos Bioregion.

The wetland vegetation group is classified as Southern Sandstone Fynbos according to the National Wetland Map 5 (2019). This unit is listed by the dataset as critically endangered and lacking protection.

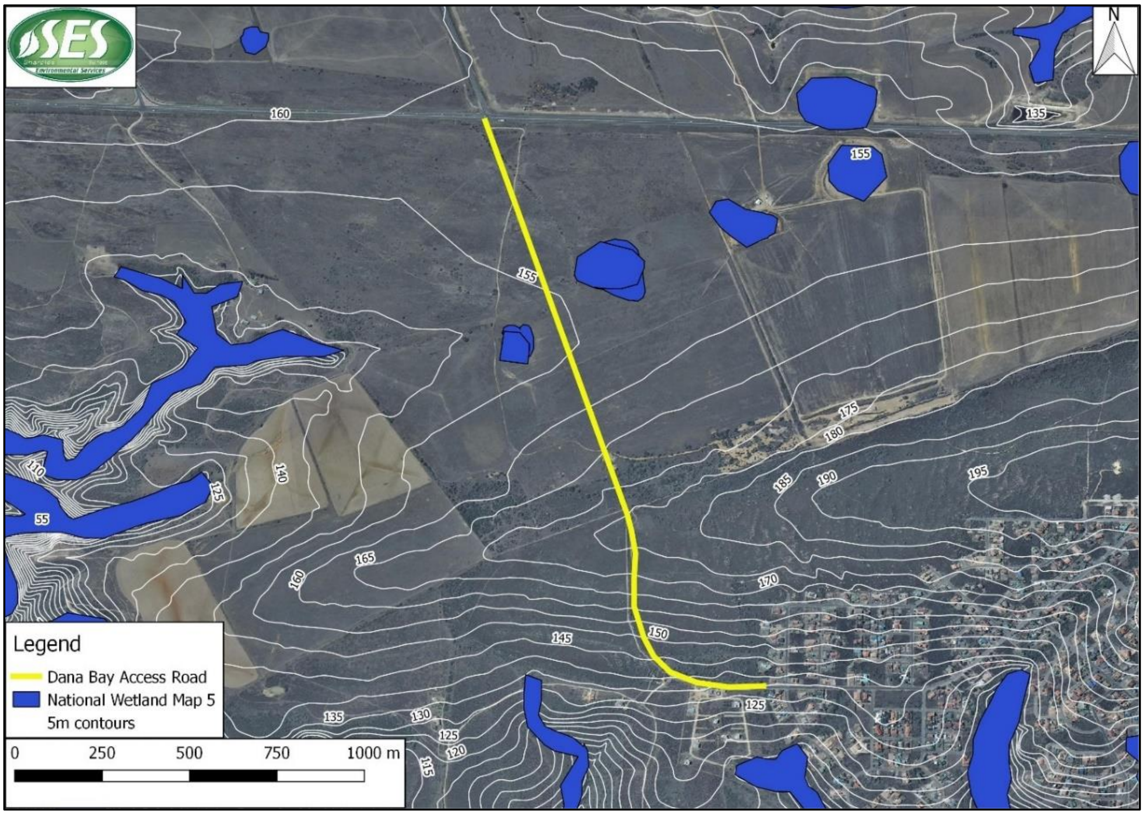

Figure 4: Wetlands surrounding the road as identified by the Wetland Map 5 (Van Deventer et al., 2018).

2.3 Vegetation

Mucina and Rutherford (2006) delineated vegetation units throughout Southern Africa and updated this data in 2012 and again in 2018. According to the most recent available vegetation mapping the road will cross through various vegetation types. The largest part of the road, the section closest to the N2, crosses through North Langeberg Sandstone Fynbos. The road also crosses through Canca Limestone Fynbos and Hartenbos Dune thicket in its southern half (Figure 5). The terrestrial threat status of the study area was determined to be Least Concern in 2018. The botanical report should be consulted for groundtruthed information regarding the vegetation types found on site.

Figure 5: 2018 Vegetation map of the site according to Mucina and Rutherford.

2.4 Conservation status

The Western Cape Biodiversity Spatial Plan (WCBSP) is recognized by both the Department of Environmental Affairs and South African National Biodiversity Institute. 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. Critical Biodiversity Areas (CBAs) are required to meet biodiversity targets. These areas have high biodiversity and ecological value and therefore must be kept in a natural state without further loss of habitat or species. The WCBSP made a distinction between areas likely to be in a natural condition (CBA1) and areas that could be degraded (CBA2). Ecological Support Areas (ESAs) are not essential for meeting biodiversity targets but are important as they support the functioning of CBAs and Protected Areas (PAs). ESAs support landscape connectivity, surrounds ecological infrastructure that provide ecosystem services, and strengthen resilience to climate change. These areas include Endangered vegetation; water source and recharge areas; and riparian habitat around rivers and wetlands. The WCBSP also made a distinction between ESAs in a functional condition (ESA1) and degraded areas in need of restoration (ESA2).

According to the WCBSP (Pence 2017), the wetland areas east and west of the proposed road, as identified by the NFEPA project and the National Wetland Map 5, contain wetland CBA (Figure 6). The remainder of the aquatic habitat identified in proximity to the study area are classified as Ecosystem Support Area. The CBA's directly adjacent to the road are all classified as terrestrial CBA.

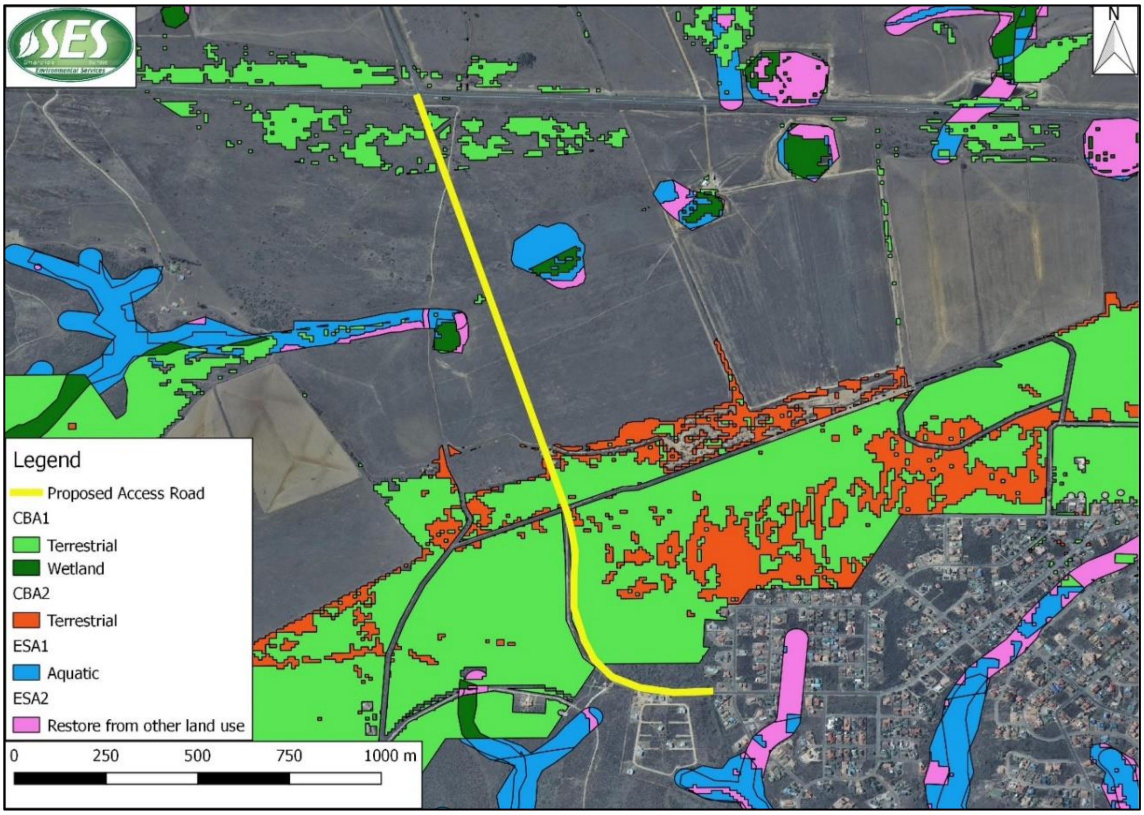

Figure 6: Map showing the CBAs and ESAs relative to the proposed road (Pence, 2017)

2.5 Geology

According to the 2019 data, the largest portion of the proposed study area is located within a geological area characterised by limestone, sandstone and conglomerate. A small northern section of the road will be in an area characterised by quartzitic sandstone and minor shale.

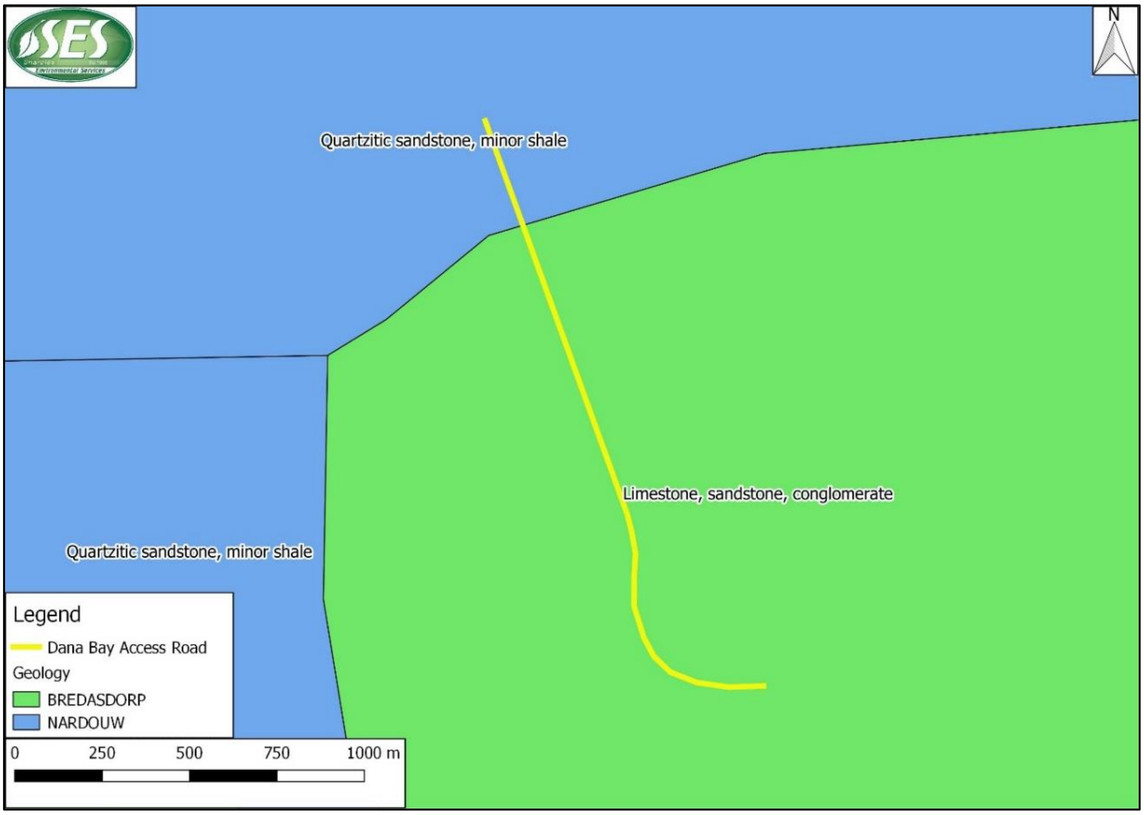

Figure 7: Geology of the study site

2.6 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. Figure 8 – 10 below show historical imagery of the land use in the area of the proposed road. These images indicate that agriculture was the predominant land use dating back to the 1960's and therefore the current status quo of the area has likely been consistent for decades. In 1991 the development of the town of Dana Bay in the area of the southern section of the proposed road can be seen.

Except for agricultural activities the area is largely unimpacted. The main agricultural impact is caused by grazing pastures. Planted pastures replace natural habitat, alter surface water movement, and reduce flows. Grazing in riparian areas and wetlands is a natural phenomenon, but excessive grazing, or conversion from natural vegetation cover to planted pastures, reduces vegetation and habitat complexity, and is usually associated with a reduction in vegetation robustness (reduced stature and resistance offered to floods). These changes reduce the flood attenuation and sediment trapping efficiencies. Another indirect effect of grazing could be trampling of aquatic habitat.

Figure 8: Study area in 1964

Figure 9: Study area in 1973

Figure 10: The study area in 1991

3 APPROACH AND METHODS

3.1 Desktop Assessment Methods

- The contextualization of the 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 3).
- 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 2: 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 (2018)
National Biodiversity Assessment Threatened Ecosystems (GIS Coverage)	SANBI (2018)
Geology	Surveyor General (2019)
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)
National Wetland Map 5	Van Deventer, et al. (2018)

3.2 Baseline Assessment Methods

- Infield site assessments were conducted on the 20th of February 2020 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 habitat.
  - ➢ The health/condition or Present Ecological State (PES) of the wetland was assessed using the Level 1 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).
- Determination of the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) assessment of the delineated river/riparian habitats was undertaken utilising:
  - ➢ Qualitative Index of Habitat Integrity (IHI) tool adapted from (Kleynhans, 1996) – PES
  - ➢ DWAF (DWS) River EIS tool (Kleynhans, 1999) - EIS
- 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 3: 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 Ecosystems in South Africa & WET-Ecoservices*	(Ollis *et al*., 2013, Kotze *et al*., 2009)	12.2
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
Present Ecological State (PES) Assessment (River)	*Rapid IHI (Index of Habitat Integrity) tool developed Kleynhans (1996), Modified by DWAF*	(Ecoquat)	12.6
Ecological Importance & Sensitivity (EIS) Assessment (River)	*DWAF EIS tool developed by Kleynhans (1999)*	(Kleynhans, 1999)	12.7

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 is determined. The DWS Risk Matrix was completed to determine the risk significance level.
- 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.
- 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.

4 ASSUMPTIONS AND LIMITATIONS

The following assumptions and limitations are relevant:

- The location of the proposed road was provided by the client in shapefile format. However, the extent of the road in width is not shown.
- No alternatives were provided for assessment as of yet.
- No stormwater plan was provided by the client as of yet.
- 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.
- 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.

- 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 good.
- The study does not include flood line determination or offset calculations.
- The past land use disturbances to the soil profile and vegetation composition of this area, as well as the highly seasonal nature of the systems, decrease the accuracy of infield delineations.

5 RESULTS

Following desktop and field analysis of the aquatic habitats, relevant to the proposed project, the subsequent results were obtained. The aquatic habitats within the 500m regulated area of the proposed activity were identified and mapped on a desktop level utilising available data, following which, the infield site assessment confirmed the location and extent of these systems (Figure 11).

It was then determined that aquatic ecosystems occurring on site could potentially be impacted upon by the road. 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. Factors considered for determining if a system was at risk included if a system's flow (surface or groundwater), water quality, biota or habitat would be negatively altered by the project. A depression wetland is situated within the proposed road route and therefore would be infilled and lost. The other systems were determined to have a low risk of being impacted upon by the project.

5.1 Identification and Delineation

The vegetation, soil, hydrological, and morphological characteristics of the proposed site were investigated using observation, soil augering, and GPS coordinates, amongst other methods detailed above. The following aquatic habitats were identified within the 500m regulated area of the proposed road:

- A depression wetland
- Artificial depressions
- Non perennial streams

The wetland and non perennial streams are assessed in detail below. Figure 11 below shows the delineated extent of each feature in the landscape in relation to the site.

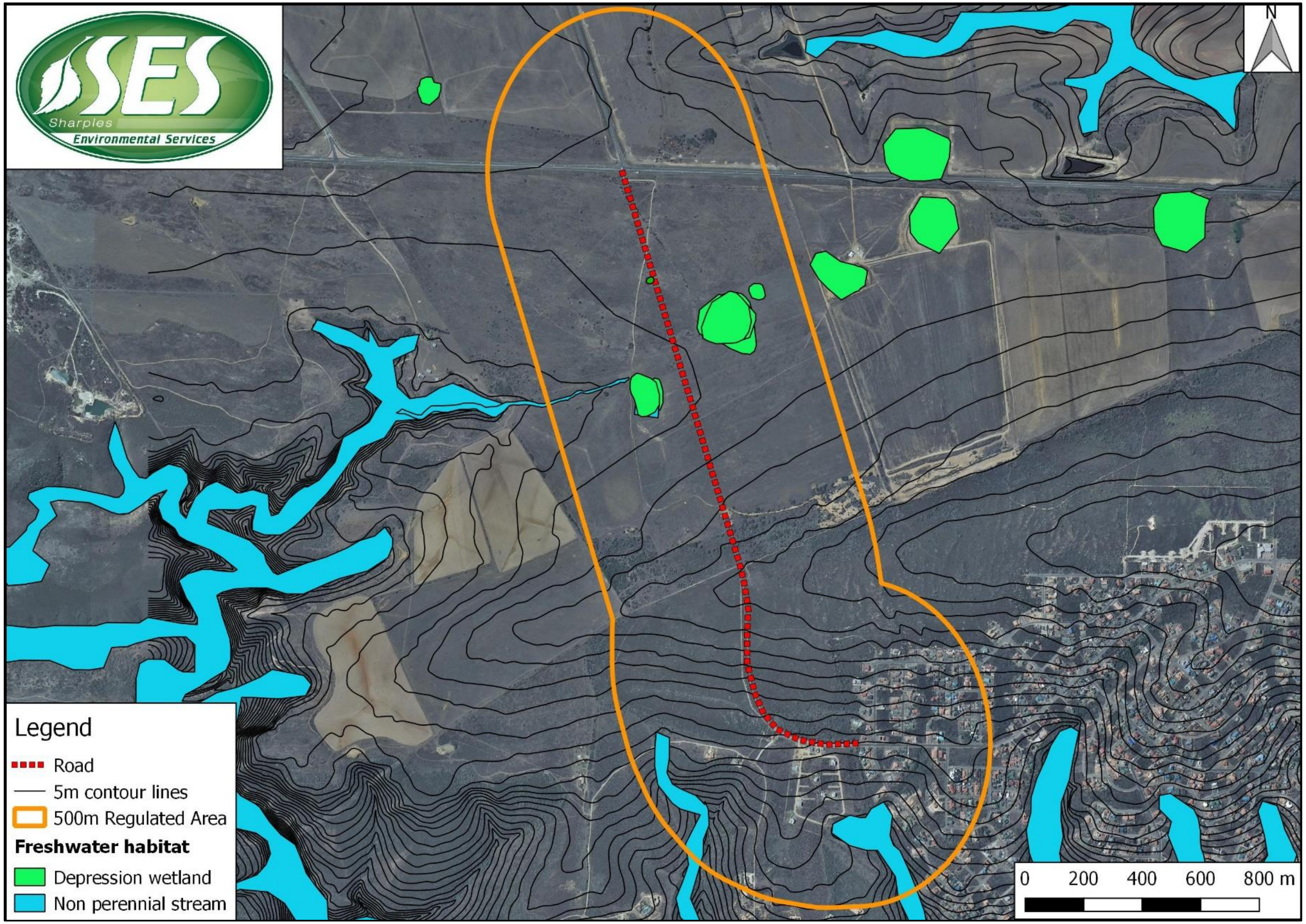

Figure 11: A map indicating the delineated features in relation to the proposed road and 500m radius

5.2 Artificial depressions

The depressions located within 500m of on either side of the proposed road are artificial in nature. These are past excavations dug for livestock drinking water and potentially irrigation water. The depressions dam local rainfall and surface runoff. It is likely that these areas were connected to the nearby drainage lines, and were seepage areas, but have become disconnected by the small impoundments. The stream to the west has also been straightened and drained directly downslope of the one dam. Therefore, as these depressions are artificial dams and no longer connected to the drainage network, they were not assessed in further detail. The impact of this transformation is rather included within the assessment of the riparian area that the flow may have naturally entered downslope.

There is however one very small depression on site that does contain wetland habitat. It is located along the proposed road route.

5.3 Wetland Habitat

There is a very small and shallow depression on the plateau between the N2 Road and Dana Bay. It was dry at the time of assessment. The definition of a depression wetland is "a wetland or aquatic ecosystem with closed (or at least near-closed) elevation contours, which increases in depth from the perimeter to a central area of greatest depth and within which water typically accumulates" (Grenfell *et al.* 2019). The wetland identified is not connected to the river network and the water source is likely to be rainfall dominated and prolonged flooding from restricted infiltration by a sub-surface clay layer. There is only temporary wetness and thus it is dominated by grass species. Soil augering within the depression showed evidence of periods of soil saturation with the presence of mottles within 50cm of the surface.

The wetland can be classified as a geochemical depression (Grenfell *et al.* 2009). It is rarely inundated and temporary. It is located in a highly disturbed area and there is a possibility that it is artificial and has formed as a result of some agricultural activity (Figure 12). However, this cannot be confirmed with absolute certainty and therefore geomorphological and ecological reasons for the formation of the depression were also investigated.

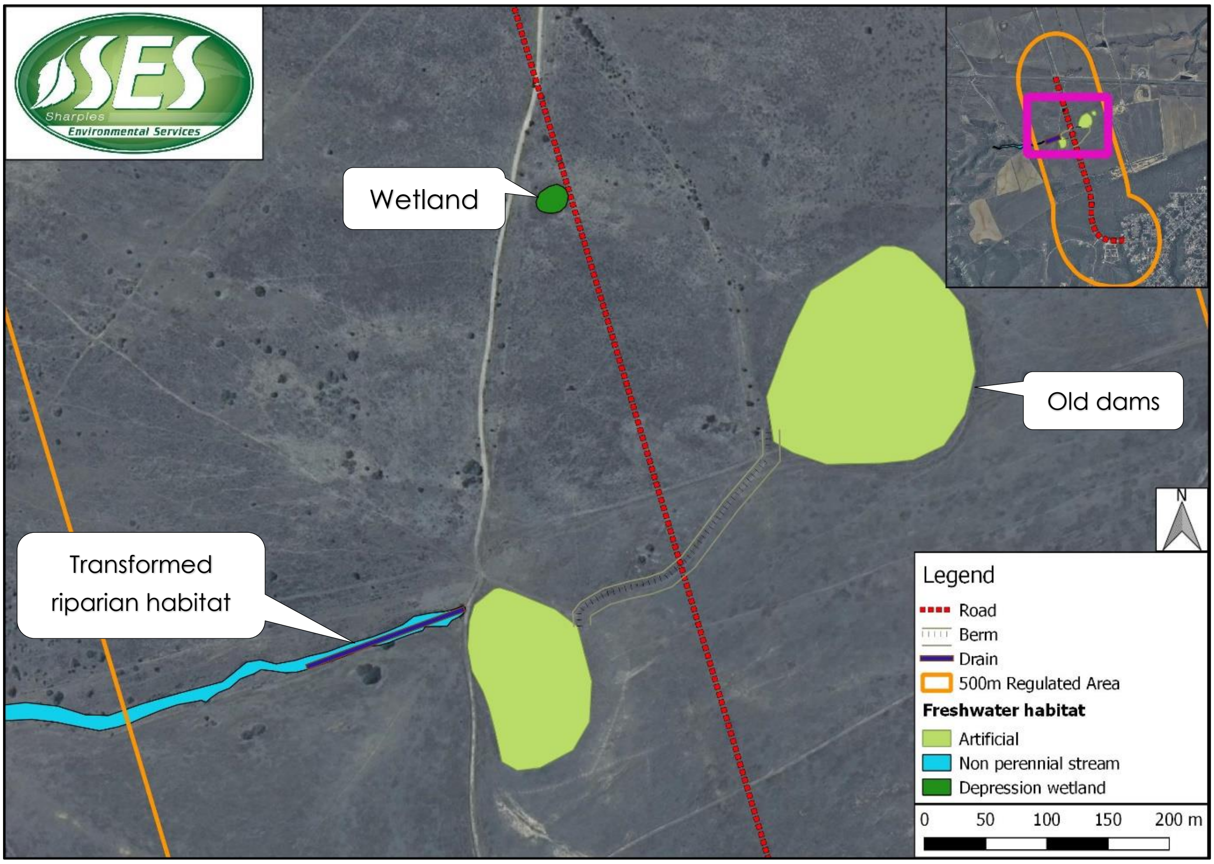

Figure 12: Map of the identified wetland in relation to the proposed road route and surrounding landscape

The depression can be defined as a wetland as it has intermittently saturated soils, lies within a circular area of low relief, and it has saturated hydric soils within 50cm of the land surface (Figure 13 & 15). However, there is no wetland plant indicator species and the depression is isolated within the landscape. There are some rocks within the depression which are most probably placed here in the past by a farmer. There is a high density of burrows within the circular depression and the grass is shorter (potentially grazed by small mammals). It is possible that it is home to the Cape Gerbil and the density of burrows appears to be highest within the depression (Figure 14).

Figure 13: Photograph of the depression (circled by the pink polygon) showing the rocks and shorter grass

Figure 14: Photographs of the rodent burrows within the depression

Figure 15: Photograph of the mottled temporary zone soils within the depression

It is unclear as to how this wetland habitat originated as it could be a result of natural processes or human disturbance. There is a high likelihood that it is a dissolution depression formed on the calcrete rocks of this area. They are formed due to subsidence as the underlying calcareous rocks are dissolved. The limestone geology of sites within the region has resulted in similar systems nearby (although most have been lost to agricultural land uses). In some cases, they may be lined with clay, effectively sealing the base of the wetland to groundwater losses. Geochemical depression wetlands are particularly vulnerable to changes in catchment hydrology (e.g., increased run-off, reduced infiltration) as saturation is often fundamental to the geochemical processes required for their formation (Grenfell *et al.* 2019).

If the depression wetland is a naturally occurring feature, then it has not have deviated significantly from the estimated reference condition. The PES was determined to be within the 'B' ecological category indicating that the wetland is in a near natural state (Table 4). It has a low to moderate level of ecological importance and sensitivity (Figure 16) as it seems to provide refuge for local biota on the coastal plain (the Gerbil specifically). However, it has limited habitat diversity and is in a disturbed landscape and has little research potential. It lacks functional importance in the form of direct services to society and provides limited indirect ecological benefits. It is recommended that the wetland be avoided by the road to prevent any habitat loss and to maintain the system in its current state. However, the loss of the habitat will not result in any irreplaceable ecosystem functions.

Table 4: the WET-Health Version 2 PES assessment summary for the depression wetland

	Wetland PES Summary			
Wetland name	**Geochemical depression**			
Assessment Unit	**Depression wetland**			
Wetland area (Ha)	0,465 Ha			
PES Assessment	HYDROLOGY	GEOMORPHOLOGY	WATER QUALITY	VEGETATION
Impact Score	1,6	1,6	0,4	3,5
PES Score (%)	84%	84%	96%	65%
Ecological Category	**B**	**B**	**A**	**C**
Combined Impact Score	1,8			
Combined PES Score (%)	82%			
Combined Ecological Category	**B**			
Hectare Equivalents	0,4 Ha			
Confidence	Moderate: Site assessment level			

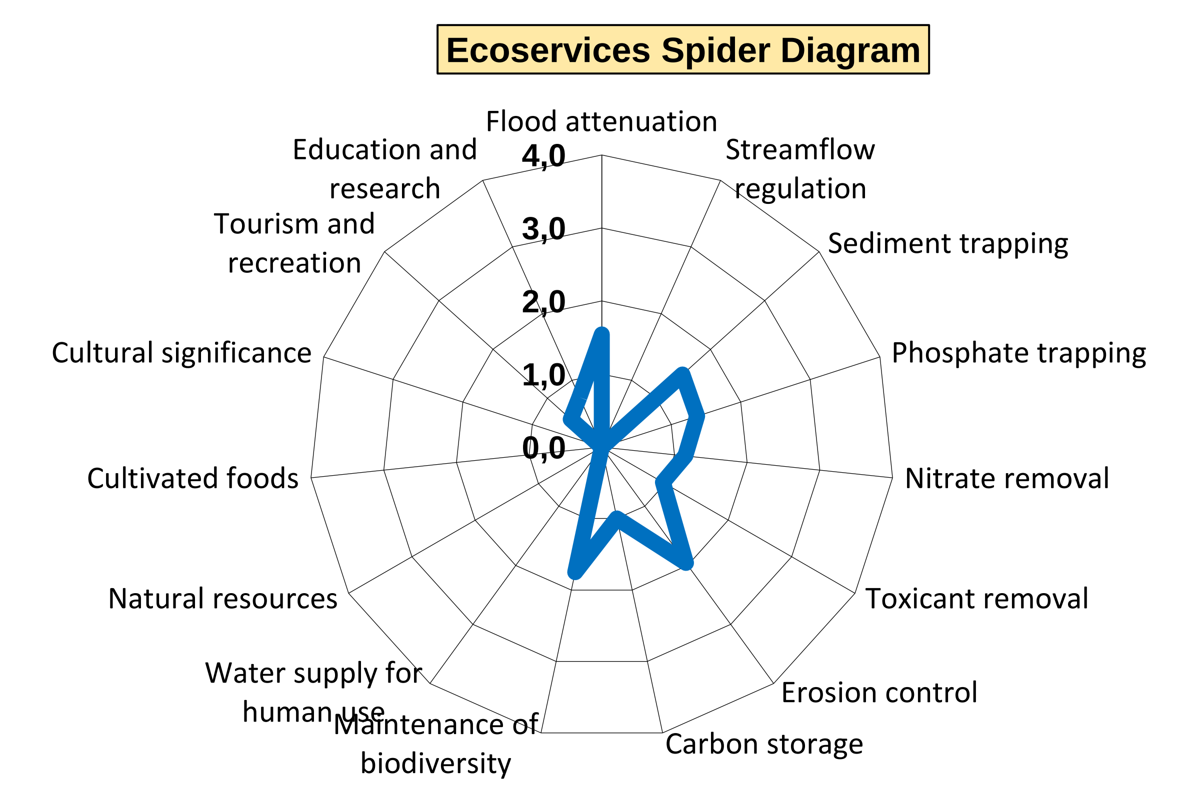

Figure 16: Summary of WET-Ecoservices assessment of the depression wetland

5.4 Non perennial streams

In the historic natural state of the freshwater habitat in the study area it is likely that there was a higher level of drainage connectivity in the landscape. It is probable that temporary seep wetlands situated on the coastal plateau, at the head of drainage lines, fed non perennial streams as the valleys narrowed and steepened. However, these linkages have been disconnected by agricultural use of the gently sloped plain upslope of the steep valleys.

All of the tributaries are small systems with ephemeral flow. The systems are of similar ecological integrity as they share biophysical characteristics and have been similarly impacted by land use and cover changes (Figure 17). The streams have been impacted upon by various land uses and associated activities. There are numerous small dams and dirt track crossings along the systems that interrupt longitudinal linkages and have destroyed habitat. Additionally, there is evidence of past tillage for agricultural lands that has caused soil and hydrological changes in the catchment and the direct clearance and infilling of riparian habitat. Although land clearance and some infrastructure encroachment has resulted in a narrower riparian zone all of the tributaries remain functional. The riparian zone is dominated by shrubs and thicket, with some of these terrestrial species having encroached into the channel after a prolonged dry period. It is dominated by indigenous vegetation but alien invasive plant species such as Rooikrans have encroached into the riparian zone. The instream vegetation consists of herbaceous species, mostly sedges, but the channel is narrow and limits the extent of this vegetation. The plant species of the riparian zones (drainage areas) are well described within the botanical report. Thicket species observed within the riparian area were Searsia sp., Gymnosporia sp, Grewia sp., and *Diospyros dichrophylla*.

Figure 17: Photograph showing the characteristics of the non perennial stream closest to the proposed road

Therefore, the tributaries scored a 'C' for PES as they are in a fair condition. However, the ecological importance and sensitivity category of the tributaries was determined as being 'Low'. The systems do not have a high sensitivity as they are only episodically inundated with no significant diversity of habitat along the reach. The species associated with these riparian systems are likely very tolerant of increases and decreases in flow. A very low proportion of the biota is expected to be only temporarily dependent on flowing water for the completion of their life cycle. Sporadic and seasonal flow events expected to be sufficient. There is a low diversity in aquatic habitat types do to the shallow, straight, and episodically flowing systems with a uniform substrate material. The systems have a limited ability to provide refuge to biota during times of environmental stress. This is due to the limited diversity of habitat and low flows. These are streams with habitat types rarely sensitive to water quality change related to flow decreases or increases. The tributaries are a moderately important link in terms of connectivity for the survival of biota upstream and downstream and are moderately sensitive to modification.

The recommended management objective for these drainage areas is to maintain the habitat in its present state. This is considered to be easy to achieve if road construction avoids riparian habitat, as is proposed in the current layout.

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. There are no impacts associated with the No Go Alternative.

6.1 Disturbance / loss of aquatic habitat

The disturbance or loss of aquatic vegetation and habitat refers to the direct physical destruction or disturbance of aquatic habitat caused by infilling, vegetation clearing, disturbance of wetland habitat, encroachment and colonisation of habitat by invasive alien plants. The construction of the road will result in direct loss of the depression wetland.

6.1.1 Construction Phase

The construction of the road will require land clearance, excavations, land re-surfacing, and infilling along the proposed route and the proposed road reserve. The depression wetland is within the road route and will thus be cleared of vegetation, infilled and compacted for road construction. This will result in direct habitat loss. The other identified aquatic habitats are not within the proposed construction corridor but could be indirectly disturbed by various activities. The machinery, vehicles and workers (i.e. turning areas and crossings) needed to construct the road could encroach into riparian habitat and laydown areas will alter the catchment land cover. The movement of topsoil and incorrectly placed stockpiles could bury aquatic habitat. However, disturbance of the non perennial streams can be avoided.

6.1.2 Operational Phase

Localised scour around structures may result and alter the streams natural bank and channel downslope. Road drainage can concentrate diffuse flows and can also inadvertently trigger gully formation. The stormwater infrastructure of the road will increase and concentrate flows into the downslope watercourses. This may lead to erosion in the systems that compromises remaining habitat. The project will promote the establishment of disturbance-tolerant biota, including colonization by invasive alien species, weeds and pioneer plants near the riparian habitat. Although this impact is initiated during the construction phase it is likely to persist into the operational phase. Road maintenance activities will have similar impacts to the construction phase activities.

6.2 Sedimentation and erosion

Sedimentation and erosion refers to the alteration in the physical characteristics of wetlands and rivers 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

The wetland is proposed to be infilled as it is located along the road route and will therefore not be affected by sedimentation or erosion. Additionally, as it is a depression wetland system these impacts would be of low significance to the wetland despite infilling. However, the riparian streams downslope of the working corridor may be impacted upon by sedimentation and erosion. Vegetation clearing and exposure of bare soils upslope of the aquatic 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. This may cause the burying of aquatic habitat and also cause aquatic faunal fatalities. 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. However, the gentle slope and non perennial nature of the drainage lines will limit the effects of this impact.

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 on water resources in the study area. The increase in hardened surface by the road can will result in further erosion/sedimentation in the non perennial streams. Surface runoff and velocities will be increased, and flows may be concentrated by stormwater infrastructure. Stormwater management during operation will be critical in ensuring that runoff characteristics mimic the natural scenario and do not lead to increased floodpeaks and flow velocities which could lead to increased erosion and sedimentation risks that could potentially affect the downstream watercourses.

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). The result is only disturbance tolerant species remaining. There is negligible open water within the study area. Therefore, the risk to water quality of any resources is limited.

6.3.1 Construction Phase

During construction there are usually a number of potential pollution inputs into the aquatic systems (such as hydrocarbons and raw cement). 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 downslope streams by means of surface runoff or through dumping by construction workers (in high rainfall events). 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

No wetland habitat is likely to be impacted by water pollution as it is assumed that the depression wetland is to be infilled and transformed to road area. Also, even if it should be conserved, the wetland is so rarely inundated that it is unlikely that there will be any water to receive pollutants. The streams are likely to flow very intermittently for short periods of time and are therefore at low risk of water pollution. If the No Go Map is adhered to then water pollution will become highly unlikely to occur.

6.3.2 Operational Phase

The greater the extent of hardened surfaces the lower the infiltration of stormwater and therefore the greater the surface runoff and increase in flood peaks in downslope watercourses. A change in water distribution generally results in altered wetness regimes, which in turn affect the biophysical processes and the vegetation patterns. Stormwater runoff is a threat to freshwater biodiversity not only because of the increased hydrological disturbance and habitat loss, but also because of an increased delivery of pollutants to streams. These pollutants often do not have a chronic effect on aquatic biota but their negative and collective effects may be realised over longer periods of time. The increase in vehicles on the property due to the development increases the potential for pollutants to enter the systems. If not prevented, litter, and contaminants, including sand, silt, and dirt particles, will enter storm water runoff and pollute the watercourses. As mentioned above, the intermittent flow characteristics of the riparian areas limits these impacts. During maintenance of the development there could be water pollution impacts similar to those encountered in the construction phase.

6.4 Flow Modification

This includes the changes in the quantity, timing and distribution of water inputs and flows within a watercourse. 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. However, the activities associated with the proposal are unlikely to cause any significant flow modifications. The systems are rarely inundated/flowing and with appropriate stormwater management this should remain unchanged. It is assumed that the depression wetland will not be impacted upon through flow modification as it is proposed to be infilled. Even if the wetland habitat is preserved there will not be significant changes to the hydrological regime. The No Go Map will ensure that no flow modifications occur as the non perennial streams would be avoided and stormwater managed appropriately.

6.4.1 Construction Phase

Land clearing and earth works upslope of the watercourses 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. However, the land upslope of the streams is already transformed from the natural condition. The road will not substantially change the infiltration rates or runoff volumes from the present state of the catchment. The stormwater runoff outlets, if poorly designed, may concentrate surface flows and alter the manner in which flow enters the systems. However, this would be only a slight increase and occur infrequently during high rainfall events.

6.4.2 Operational Phase

Hardened/artificial infrastructure will alter the natural processes of rainwater infiltration and surface runoff, promoting increased volumes and velocities of storm water runoff, which can be detrimental to the rivers and wetlands receiving concentrated flows from these areas. 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 road and discharging into down-slope watercourses can alter the natural ecology of the systems, increasing the risk of erosion and channel incision/scouring. The impact of permanent flow modifications caused by the development is likely to be minimal. Provided that erosion is prevented there is a low likelihood of any significant flow changes.

6.5 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. The impacts of the proposed road, when assessed on its own, are found to be of Low significance (after mitigation). But, due to increasing rate and demand of urban development in the area the impact can become cumulatively more significant. Despite this, there are no foreseeable high negative cumulative impacts anticipated. The project will not affect any habitat identified within the national spatial datasets or impact water resource protection targets. The most effective and proactive solution is sustainable land use planning with a broader spatial and temporal focus. The Mossel Bay Municipality has applied this approach in the investigation of some of the areas surrounding the urban centres. The catchment of the Blinde River that joins the ocean near Dana Bay should be studied as a whole in relation to future development plans. This identification and protection of sensitive aquatic habitat on a catchment scale will minimise the amount of negative cumulative impacts.

7 RISK ASSESSMENT

Following the assessment of the characteristics of the aquatic habitats, the DWS Risk Assessment Matrix (2016) was applied to ascertain the significance of perceived impacts of the proposal on the key drivers and response processes (hydrology, water quality, geomorphology, habitat and biota) of the aquatic habitat. The confidence level is high, being based on quantifiable information gathered in the field.

These results are summarised in Table 5 below. The identified impacts during construction of the road were determined to be of Moderate Risk significance (score of 63) as it will result in wetland habitat loss. This potential impact significance should influence the decision regarding the proposed activity and requires a clear and substantiated need and desirability for the project to justify the risks. The Moderate risk assessment implies that the water use activities associated with the proposed project would need to be authorised by means of a water use licence for the Section 21(c) and (i) water uses. If wetland habitat loss was avoided by re-routing the road then a Low risk may be achieved and authorisation through General Authorisation would be possible.

During the operational phase, assuming that the depression wetland is no longer present and infilled, it is only the downslope non perennial streams that are at risk of being impacted upon. Poorly designed stormwater management measures for the road runoff may result in erosion in downstream watercourses. The management of storm water prior to discharge and the manner in which water is released into the natural environment will be critical in managing and protecting downstream aquatic resources from degradation and to allow for the continued capacity of these natural areas to receive and absorb/transmit storm water from the site. An appropriate storm water management plan must be designed for the project in line with best practice. If operational phase mitigation is adopted, then the significance of this risk was determined to be Low.

Following the risk assessment, mitigation measures were compiled to serve as guidance throughout the construction and operational phases. The risk assessment assumes that a high level of mitigation is implemented and thus the risk rating provided in the table below is calculated post-mitigation. Refer to Section 8 of this report for detailed mitigation measures.

The DWS guidelines for the completion of a risk matrix state that it is compulsory to apply the highest significance rating for severity (a score of 5) when an activity is located within the delineated boundary of a wetland. This application of a high severity rating for all risk assessments results in disproportionately elevated risk scores. Therefore, after discussions with Dr Wietsche Roets of the Department of Water and Sanitation, it was decided that specialists should use their judgement in applying the severity rating to each case. In this risk matrix, completed for the proposed road, the severity ratings have been assessed on a scale from 1 (Insignificant / non-harmful) to 5 (Disastrous / extremely harmful).

Table 5: Risk matrix assessment summary for the proposed Dana Bay access road

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Confidence level	PES AND EIS
1. Freshwater Habitat Loss/ Disturbance	CONSTRUCTION PHASE	The construction of the road will require land clearance, excavations, land re-surfacing, and infilling along the proposed route and the proposed road reserve	Habitat loss due to infilling the wetland	Direct loss of wetland habitat and biota. Infilling will cause the burying of aquatic habitat and cause aquatic faunal fatalities (the Cape Gerbil)	2	7	9	63	**MEDIUM**	90	PES (B); EIS: LOW
	OPERATIONAL PHASE	The stormwater infrastructure of the road will increase and concentrate flows into the downslope watercourses.	Erosion and sedimentation from stormwater	Indirect disturbance of riparian habitat causing deterioration of aquatic ecosystem integrity and a reduction of habitat	1,25	5,25	10	52,5	**LOW**	80	PES (D); EIS: LOW

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8 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 (Figure 18). 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). Avoidance of the wetland habitat must be the first consideration to mitigate against any impacts. If the wetland cannot be avoided by the road, and will be infilled, then the need for the application of offsets (such as compensation) should be investigated.

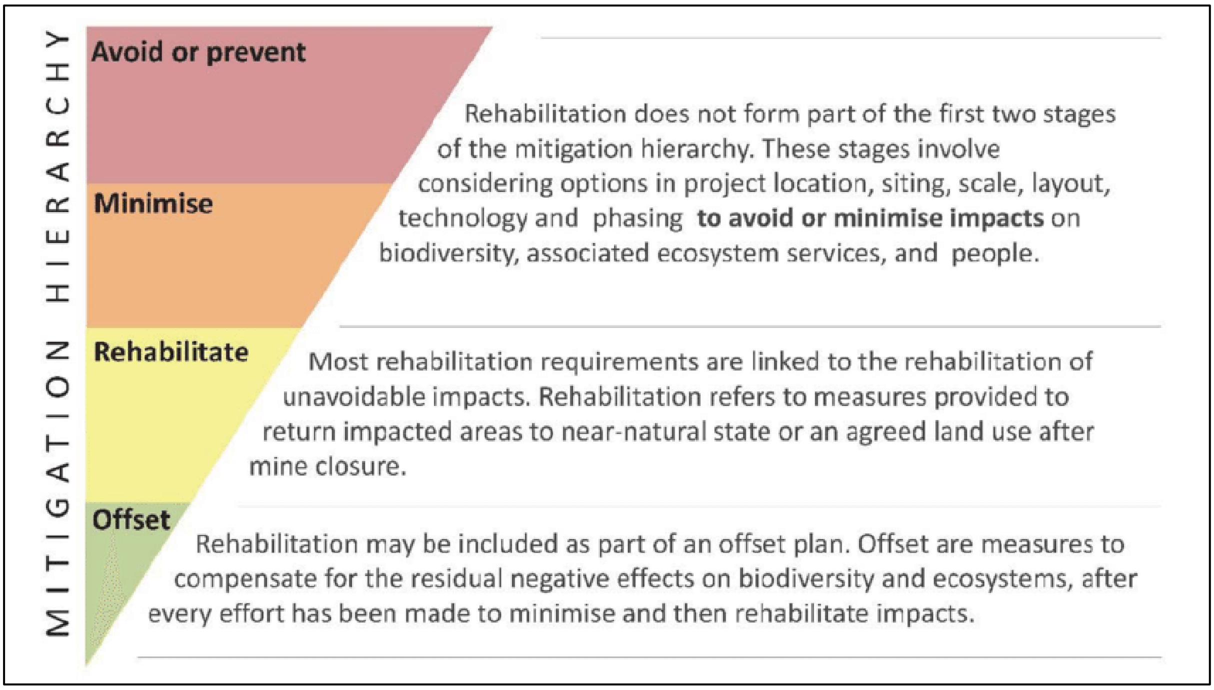

Figure 18: Diagram illustrating the 'mitigation hierarchy' (after DEA et al., 2013).

The mitigation measures detailed within this report must be taken into consideration during financial planning of the construction and maintenance phases. 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 EMPr must be amended to ensure the mitigation measures are included. The most important mitigation measure to be adhered to is the avoidance of riparian habitat and appropriate stormwater management.

8.1 Wetland offsets

The direct loss of the very small depression wetland (0.465ha) may seem irrelevant but must be assessed in the broader context of its catchment and water resource protection. Loss of any wetland area is undesirable from an ecological perspective. Where wetlands are lost or degraded as a result of development impacts then some level of offset should be considered.

Wetland offsets are applied within the mitigation hierarchy and are only aimed at compensating for significant residual impacts of project development on the environment after all appropriate steps have first been taken to avoid/prevent, minimise/reduce and remediate/rehabilitate impacts. In the case of the proposed road, it is not realistically feasible to realign the route, and therefore the wetland cannot be avoided. The infilling of the depression will result in complete loss of habitat and therefore there is no option to minimise or rehabilitate the residual impacts. A wetland offset investigation was undertaken to determine if such an approach is required to mitigate the residual impacts of loss of the depression. It determined that due to the negligible size and importance of the depression there would not in fact be any remaining significant residual negative impacts on biodiversity. Whilst the need and desirability of biodiversity offsets will still need to be confirmed by the regulating authority, a preliminary investigation of potential offset requirements was undertaken through the rapid application of available wetland offset guidelines and tools.

The potential loss of the wetland area was assessed using the DWS Wetland Offset Calculator (as developed by McFarlane *et al* (2014) and included in the 2017 Draft National Offset Guidelines (GN 276 of March 2017)) to determine the wetland targets that would need to be achieved by the proposed wetland offset. The offset calculations include consideration of wetland condition, extent, existing buffer condition, likely wetland condition in a development context, wetland importance in local, regional and bioregional conservation plans and the impacts of development on so-called wetland functionality. The offset calculation is based on the loss of 0.465 ha of depression wetland. A summary of the wetland offset targets for the wetland area to be lost is provided in Table 6 below.

It was determined that no functional wetland offsets are required. The small depression does not provide significant ecological functions at any scale and therefore there is a negligible loss. The same result was calculated for species conservation offset targets as there are no species of conservation concern within, or supported by, the wetland. However, it was determined that the loss of the wetland may require ecosystem conservation offsets of 0.2 habitat hectare equivalents. The ecosystem conservation target is based on the critically endangered threat status of the wetland vegetation unit and the lack of protection afforded to it. Therefore, it is more realistic from a wetland perspective to assume that the ecosystem conservation targets are also negligible and need not be offset.

The loss of the depression wetland will not influence any biodiversity conservation targets or compromise water resource protection in any way, or on any scale. There is no need for wetland offsets to be implemented. However, compensation is encouraged to achieve a net gain. Perhaps the loss of this wetland can motivate for the use of municipal resources for ecological management and monitoring activities of other watercourses. Any activities to improve nearby watercourses, such as the Blind River (in the same catchment) or engaging with CapeNature and the Dana Bay Conservancy regarding planning, would be an example of such voluntary compensation for wetland loss.

Due to non-significant offset targets, protection and management of the downslope watercourses through appropriate sustainable urban drainage systems could be seen as appropriate mitigation. Mitigation measures for the maintenance of the downslope watercourses are detailed in the chapters below.

Table 6: Summary of wetland offset calculations

Wetland Functionality Targets			
Impact Assessment	Prior to development	Wetland size (ha)	0,0465
		Functional value (%)	80
	Post development	Functional value (%)	0
		Change in functional value (%)	80
	Key Regulating and Supporting Services Identified		None
	Development Impact (Functional hectare equivalents)		0,0
Offset calculation	Offset Ratios	Triggers for potential adjustment in exceptional	None
		Functional Importance Ratio	
	Functional Offset Target (Functional hectare equivalents)		0,0
Further considerations	Have other key Provisioning or Cultural Services Identified that require		No
	Additional compensatory mechanisms proposed	None	

Ecosystem Conservation Targets				
Impact Assessment	Prior to development	Wetland size (ha)	0,0465	
		Habitat intactness (%)	80	
	Post development	Habitat intactness (%)	0	
		Change in habitat intactness (%)	80	
	Development Impact (Habitat hectare equivalents)		0,0372	
Determining offset ratios	Ecosystem Status	Wetland Vegetation Group (or type based on local clasification)	Southern Sandstone Fynbos	
		Threat status of wetland	Threat status	CR
			Threat status Score	15
		Protection level of wetland	Protection level	Not Protected
			Protection level Score	2
			Ecosystem Status Muliplier	30
	Regional and National Conservation context	Priority of wetland as defined in Regional and National Conservation Plans	Not specifically identiifed as important	0,5
			Regional & National Context Multiplier	0,5
	Local site attributes	Uniqueness and importance of biota present in	Low biodiversity value	0,5
		Buffer zone integrity (within 500m of wetland)	Buffer compatability score	0,2
		Local connectivity	Low connectivity	0,5
			Local Context Multiplier	0,4
			Ecosystem Conservation Ratio	6,60
Offset Calculation	Development Impact (Habitat hectare equivalents)		0,0372	
	Ecosystem Conservation Ratio		6,6	
	Ecosystem Conservation Target (Habitat hectare equivalents)		0,2	

Species Conservation Targets			
Target Species 1:		No species of concern	
Impact Assessment	Impact measure	No species of concern	Habitat measure
		No species of concern	Habitat measure
		Description and rationale for species impact measure selected	
		No species of concern	
	Prior to development	Species impact measure	0
	Post development	Species impact measure	0
		Change in species impact measure	0
	Development Impact (Species impact measure)		0
Determining offset ratios	Offest Ratios	Offset Ratio	0,0
		Description and rationale for offset ratio selected	
		No species of concern	
		Species Conservation Ratio	0,0
Offset Calculation	Development Impact (Species impact measure)		0,0
	Species Conservation Ratio		0,0
	Species Conservation Target (Species measure)		0,0

8.2 Construction footprint

- Use the smallest possible working corridor. Outside the working corridor, all watercourses are to be considered no go areas. Any unnecessary intrusion into these areas is prohibited. Where intrusion is required, the working corridor must be kept to a minimum and identified and demarcated clearly before any construction commences to minimise the impact.
- All freshwater habitats outside of the demarcated construction area must be considered 'No-Go' areas for the duration of the construction phase.

8.3 Erosion and sedimentation

- The mitigation of impacts must focus on managing the runoff generated by the road and introducing it responsibly into the receiving environment. The stormwater flows must enter the drainage areas in a diffuse flow pattern without pollutants.
- Sedimentation must be minimised with appropriate measures.
- Construction must have contingency plans for high rainfall events during construction.
- Excavated rock and sediments from the construction zone, and including any foreign materials, should not be placed within the delineated riparian areas in order to reduce the possibility of material being washed downstream.
- Stockpiling should be restricted to level areas safe from flood prone areas.

8.4 Waste

- 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.
- Spoil material must be hauled to a designated spoil site. No spoil material must be pushed down slope or discarded on site.
- Portable chemical toilets will be utilised and maintained.
- All solid waste generated during the construction process (including packets, plastic, rubble, cut plant material, waste metals etc.) must be placed in the waste collection area in the construction camp and must not be allowed to blow around the site, be accessible by animals, or be placed in piles adjacent the skips / bins. Burying of waste, rubble on site is prohibited.

8.5 Vegetation

- Clearing of riparian vegetation should be prevented or to be kept to a minimum. When practicable, prune or top the vegetation instead of grubbing/uprooting.
- 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. 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.

- Rubble is often placed aside during construction and never removed. It buries habitat and alters the sediment composition of the area, allowing alien plants to encroach.

8.6 Pollutants

- The entire area must be protected from direct or indirect spills of pollutants, e.g. sediment, refuse, sewage, cement, oils, fuels, chemicals, wastewater etc. Should any spills of hazardous materials occur on the site or in the storage area, the relevant clean-up specialists must be contacted immediately. In the event of a spillage that cannot be contained, and which poses a serious threat to the local environment, the following Departments must be informed of the incident in accordance with Section 30 of the National Environmental Management Act, Act 107 of 1998, within forty-eight (48) hours:
    - The Local Authority;
    - The Department of Mineral Resources
    - Department of Water and Sanitation;
- Mixing and/or decanting of all chemicals and hazardous substances must take place on a tray, shutter boards or on an impermeable surface and must be protected from stormwater.
- Cement/concrete batching is to be located in an area of low environmental sensitivity away from the river channels and pre-approved by the ECO. No batching activities shall occur on unprotected ground. Adequate surface protection will be required. Concrete batching should be restricted to a level and bunded/sealed surface above the riverbanks.
- Contaminated water containing fuel, oil or other hazardous substances must never be released into the environment. It must be disposed of at a registered hazardous landfill site.
- Stormwater exit points must include a best management practice approach to trap any additional suspended solids and pollutants originating from the proposed development.

8.7 Rehabilitation

- All disturbed areas beyond the construction site that are intentionally or accidentally disturbed during the construction phase must be rehabilitated immediately to the satisfaction of the ECO.

- 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.
- Consult WET-RehabEvaluate, WET-RehabMethods (Cowden and Kotze, 2009), and the river rehabilitation manual developed by Day *et al*. 2016, for further information.

8.8 Monitoring

- The monitoring of the activities is essential to ensure the mitigation measures are implemented. Therefore, compliance with the mitigation recommendations must be monitored by a suitably qualified individual. 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.
- 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. The monitoring should be regular and additional visits must be taken when there is potential risk to freshwater habitat.
- Any contractors found working inside the 'No-Go' areas should be fined as per a fining schedule/system setup for the project.

9 WATER USE AUTHORISATION CONSIDERATIONS

The proposed road will require water use authorisation. Any activity within the 500m radius regulated area of a wetland requires water use authorisation and registration under Section 21 (c) and (i) of the National Water Act (Act 36 of 1998). The risk assessment was undertaken using the Risk Matrix which is specified in the Government Notice R509 of 2016 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 (1998).

The findings of the Aquatic Risk Matrix Assessment undertaken show that due to development risk being calculated as 'Moderate' (after mitigation) the development cannot be authorised in terms of the GA (General Authorisation) for Section 21 (c) and (i) water use under this scenario and requires a full license application. Authorisation is possible under General Authorisation (GA) if the risk rating is determined to be Low by the freshwater specialist. However, this proposal includes the destruction of a small depression wetland and was determined to have a Moderate risk rating (score of 63).

Therefore, the proposed project does not fall within the ambit of GA and a water use license application may be required by the BGCMA/DWS.

10 CONCLUSION

The aquatic habitats within the regulated area of the proposed road were identified and mapped on a desktop level utilising available data, following which, the infield site assessment confirmed the location and extent of these systems. It was determined that a small depression wetland will be directly impacted upon by the proposed road and that downslope riparian areas may be indirectly modified by stormwater runoff in the operational phase. The activity would result in the complete loss of the wetland through infilling for the road during construction. Following the assessment of the characteristics of the identified aquatic habitats, the DWS Risk Assessment Matrix (2016) was conducted to ascertain the significance of perceived impacts of the proposal on the key drivers and response processes (hydrology, water quality, geomorphology, habitat and biota) of the aquatic habitat. During construction of the road the wetland habitat loss resulted in a Moderate risk score. The operational risks (largely associated with road runoff towards drainage lines) were determined to be of low significance.

Although the wetland loss would not equate to any significant residual impacts (as it does not provide irreplaceable functions or affect the water quality objectives of the catchment) it still resulted in Moderate risk significance under assessment. It is recommended that the wetland be avoided by the road. If this is unavoidable there will be residual impacts, but these were determined to be of negligible consequence to overall water resource protection. The cumulative impact can be considered as low, especially if the protection and management of the downslope watercourses through sustainable road drainage systems could be seen as appropriate mitigation. Therefore, the change to aquatic habitat due to the proposed road is deemed as acceptable after the adoption of mitigation.

The proposed project does not fall within the ambit of GA and a water use license application may be required by the BGCMA/DWS.

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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.

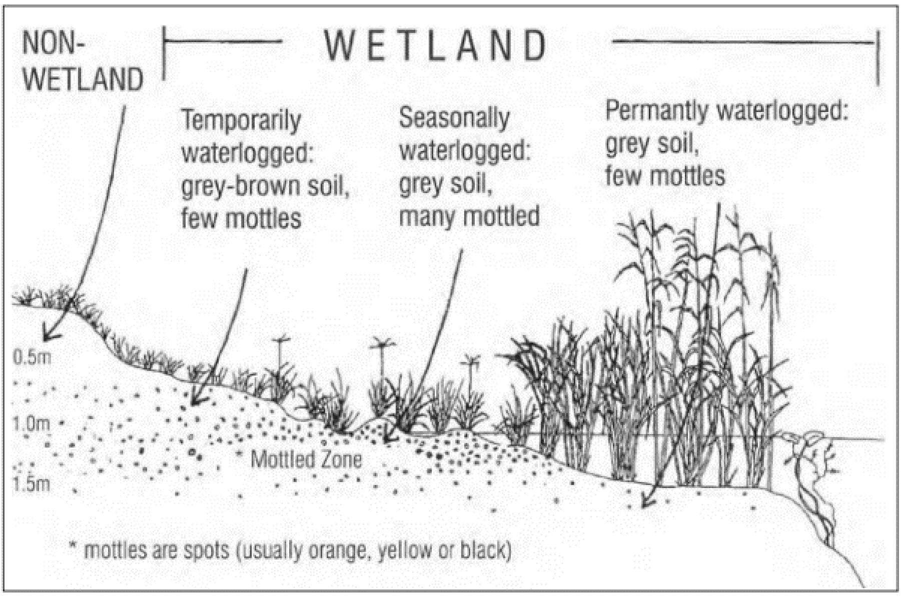

Figure A12.1a: Cross section through a wetland, indicating how the soil wetness and vegetation indicators change as one moves along a gradient of decreasing wetness, from the middle to the edge of the wetland. Source: Donovan Kotze, University of KwaZulu-Natal.

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 A12.1a)

A12.1a: 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 A12.1b: 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 A12.1b).

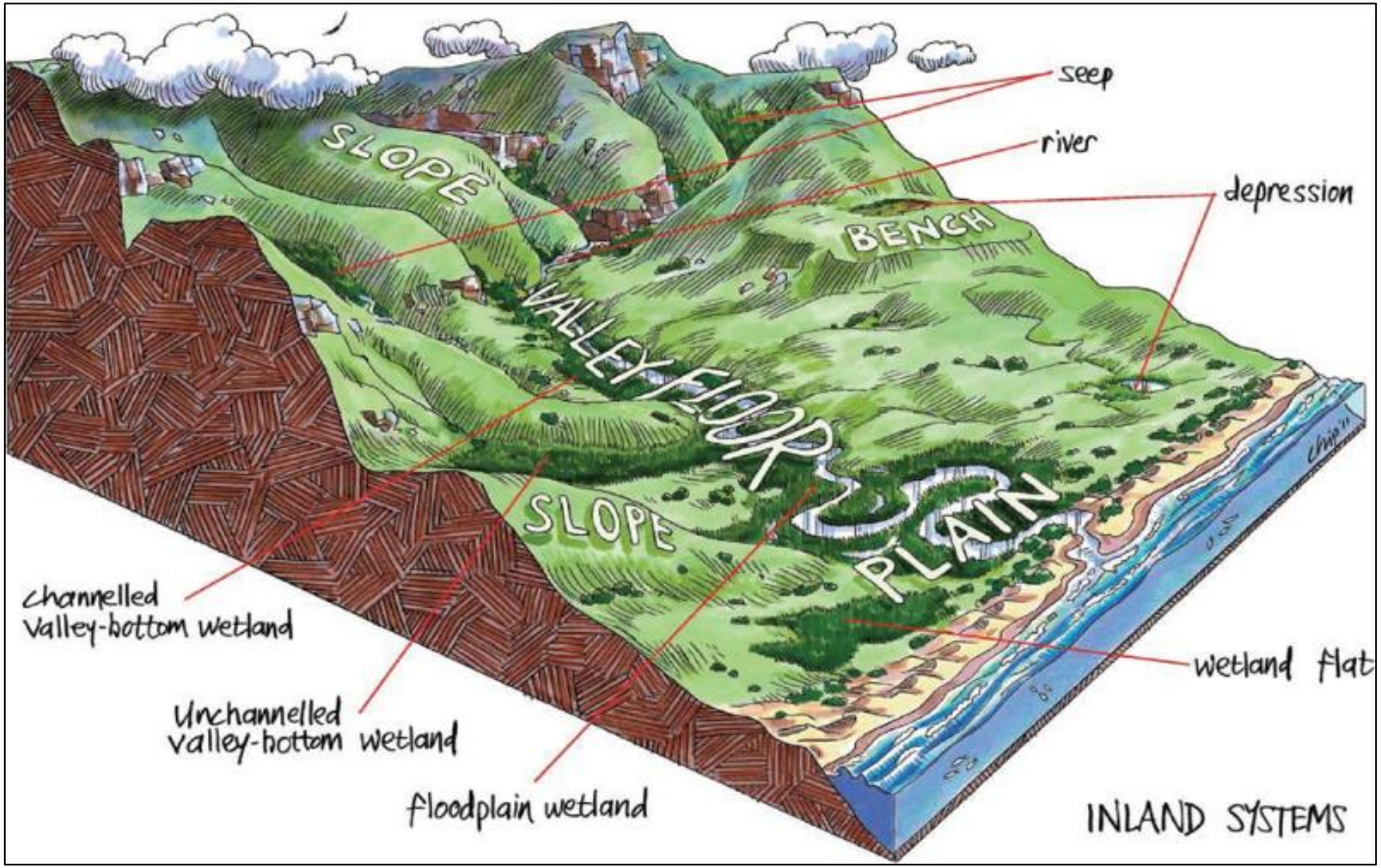

Figure A12.1b: Illustration of wetland types and their typical landscape setting (From Ollie et al. 2013)

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 12.2a). 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), 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.

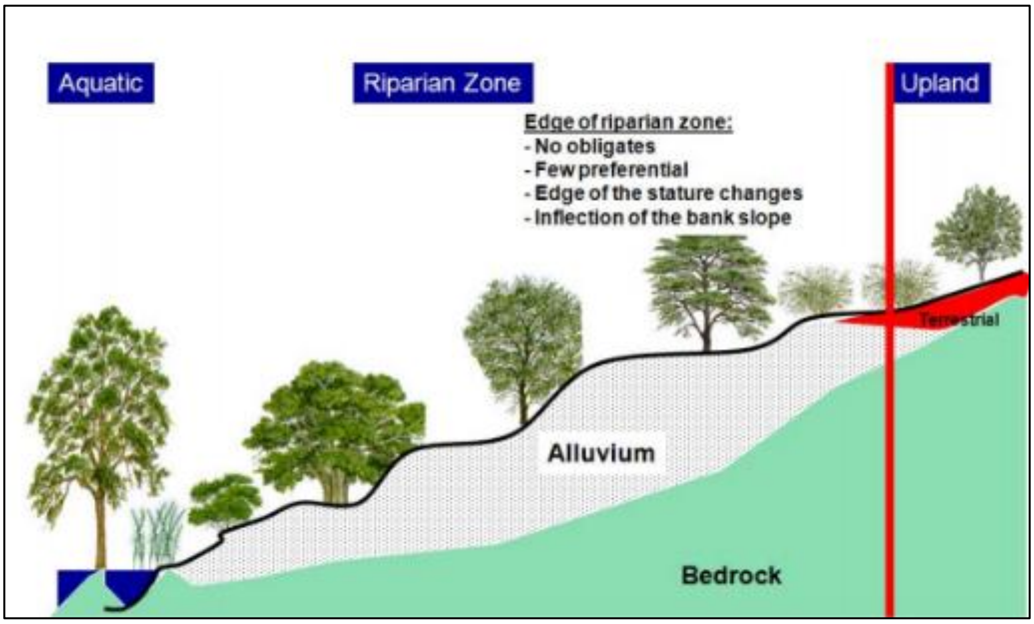

Figure A12.2a: A schematic diagram illustrating the edge of the riparian zone on one bank of a large river. Note the coincidence of the inflection (in slope) on the bank with the change in vegetation structure and composition. The edge of the riparian zone coincides with an inflection point on the bank; where there are not obligates upslope; few preferential. The boundary also coincides with the outer edge of the stature differences (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 of the wetlands impacted upon by the Dambuza Road upgrade.

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 A12.2a).

Table A12.2a: 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 A12.2b, below. This classification is consistent with DWAF categories used to evaluate the present ecological state of aquatic systems.

Table A12.2b. 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 20 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 (listed in Table A12.4a) - that is, the benefits provided to people by the ecosystem.

Ecosystem services supplied by wetlands	Indirect benefits	Regulating and supporting benefits		Flood attenuation	The spreading out and slowing down of floodwaters in the wetland, thereby reducing the severity of floods downstream
				Streamflow regulation	Sustaining streamflow during low flow periods
			Water quality enhancement benefits	Sediment trapping	The trapping and retention in the wetland of sediment carried by runoff waters
				Phosphate assimilation	Removal by the wetland of phosphates carried by runoff waters
				Nitrate assimilation	Removal by the wetland of nitrates carried by runoff waters
				Toxicant assimilation	Removal by the wetland of toxicants (e.g. metals, biocides and salts) carried by runoff waters
				Erosion control	Controlling of erosion at the wetland site, principally through the protection provided by vegetation.
				Carbon storage	The trapping of carbon by the wetland, principally as soil organic matter
	Direct benefits	**Biodiversity maintenance[2]**			Through the provision of habitat and maintenance of natural process by the wetland, a contribution is made to maintaining biodiversity
		Provisioning benefits		Provision of water for human use	The provision of water extracted directly from the wetland for domestic, agriculture or other purposes
				Provision of harvestable resources	The provision of natural resources from the wetland, including livestock grazing, craft plants, fish, etc.
				Provision of cultivated foods	The provision of areas in the wetland favourable for the cultivation of foods
		Cultural benefits		Cultural heritage	Places of special cultural significance in the wetland, e.g., for baptisms or gathering of culturally significant plants
				Tourism and recreation	Sites of value for tourism and recreation in the wetland, often associated with scenic beauty and abundant birdlife
				Education and research	Sites of value in the wetland for education or research

Table A12.4a: Ecosystem services assessed by WET-Ecoservices

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 A12.5a. The scores are then placed into a category of very low, low, moderate, high and very high as shown in Table 12.5b.

Table A12.5a: 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 A12.5b: 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