Proposed Mageza Mall in the Msunduzi Local Municipality, KwaZulu-Natal

AQUATIC & WETLAND ECOSYSTEM IMPACT ASSESSMENT REPORT

30th November 2021

Project Details

Project Name	Proposed Mageza Mall in the Msunduzi Local Municipality, KwaZulu-Natal
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Declaration of Independence

This is to certify that 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. 40772 Government Gazette, 4 December 2014 (as amended); and

- The Department of Water & Sanitation for Water Use Licensing and wetland assessment, as outlined in the 'Regulations Regarding the Procedural Requirements for Water Use License Applications and Appeals' contained in the Government Gazette No. 40713 of 24 March 2017.

I, **Adam Teixeira-Leite**, hereby declare that this report has been prepared independently of any influence or prejudice as may be specified by the Department of Water and Sanitation (DWS), Department of Forestry, Fisheries and the Environment (DFFE) and/or the KZN Department of Economic Development, Tourism and Environmental Affairs (EDTEA).

Signed:

Date:
19 November 2021

Executive Summary

Verdant Environmental was appointed to undertake a combined Aquatic (River) and Wetland Ecological Impact Assessment for the development of the Mageza Shopping Mall, adjacent to the existing Mageza Service Station (SASOL fuel filling station) at Ridge Park, on the corner of Archie Gumede Drive and Sikhumbuzo Ngwenya Road, Msunduze Municipality, KwaZulu-Natal. The purpose of the specialist assessment and report is to inform the relevant NEMA: EIA and Water Use Licensing requirements and processes for the development project.

The combined wetland and aquatic ecological assessment identified the following watercourses downstream of the planned Mageza Mall development (shown on the map in Figure A):

- a **seep wetland unit (W01)** located approximately 45m to the west of the development site; and
- the perennial **Slang Spruit River (R01)** located more than 200m west of the site.

The baseline assessment revealed that the wetland was found to be in a poor condition ('D' PES) and the Sang Spruit River reach assessed was in a Poor to Seriously Modified condition ('D/E' PES). Both watercourses were considered to be of low Ecological Importance and Sensitivity (EIS).

Table A. REC and RMO for the wetland units based on their PES and EIS ratings.

Watercourse Units	PES	EIS	REC	RMO
R01: Slang Spruit River	D/E	Low	D	Maintain PES & functioning
W01: seep wetland	D	Low	D	

Whilst none of the identified watercourses are not located on the development site and will therefore not be directly affected by the development, due to their location downslope there is the **potential risk that these water resources could be indirectly impacted.**

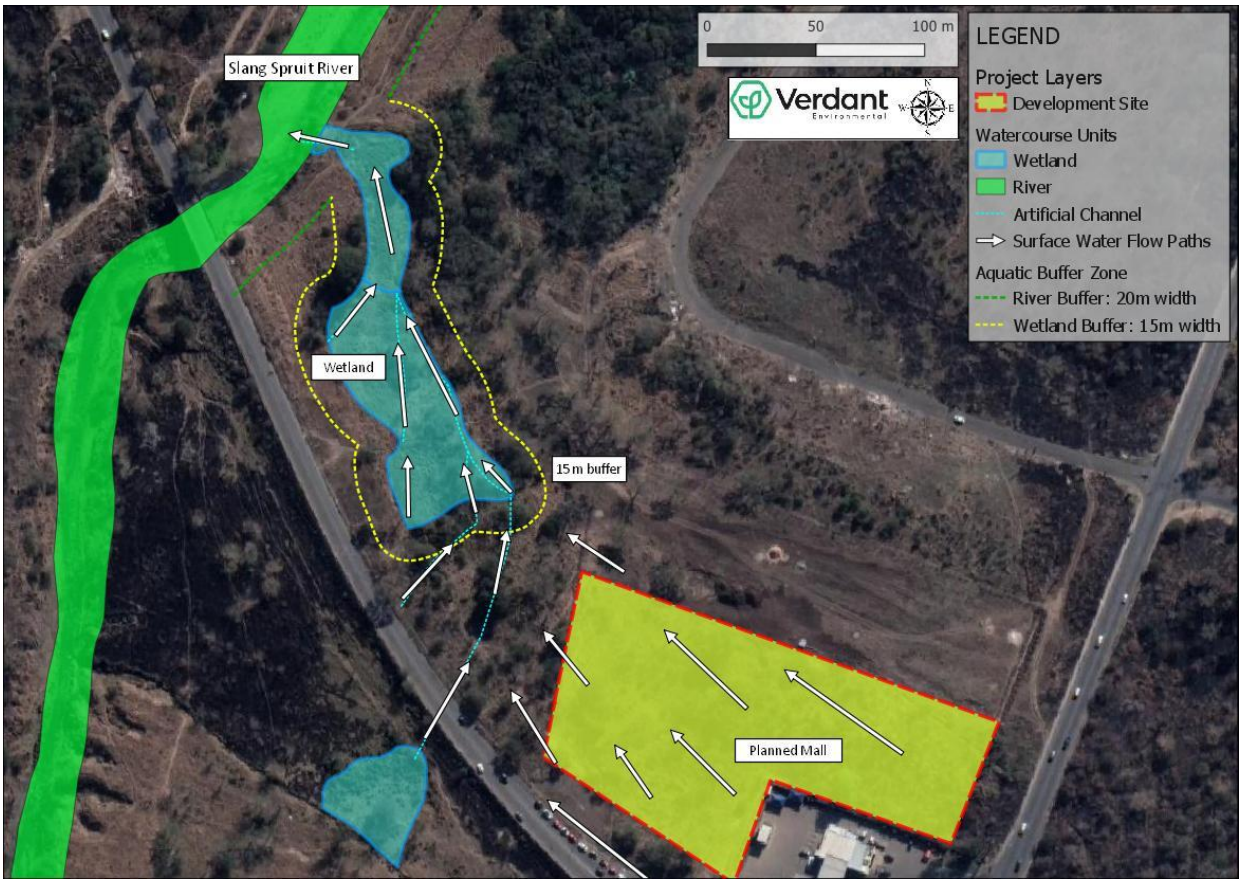

Figure A. Map showing location and extent of the Slang Spruit River and Seep Wetland downstream to the west of the Mageza Mall development site, with recommended 15m wetland buffer zone and 20m river buffer zone also indicated.

A suite of planning and design recommendations) have been provided (in Section 6) to assist in the formulation of a sustainable development plan and concept, as well as ensure that the environmental planning process unfolds according to the internationally accepted mitigation hierarchy. Most importantly, indirect impacts associated with site management during construction and the risk of erosion and sedimentation of downstream watercourses during operation (linked to storm water management mainly) need to be appropriately managed. Where the mitigation measures discussed in Section 6 are appropriately implemented, **impacts can potentially be reduced to relatively 'Low' significance levels**.

Risk can also be potentially mitigated to 'Low' levels and the project could potentially be authorised under a General Authorisation (GA) in terms of Section 21 c & i water uses, given also that other water uses (such as Section 21 a, b, g, f and k) will not be associated with the development project. It is therefore **recommended that an application for a General Authorisation**

(GA) in terms of Section 21 c & i water uses should be pursued, subject to further consultation with the DWS (Department of Water & Sanitation) to confirm this.

From a purely water resources (wetlands and rivers) perspective, there are no listed activities in terms of the NEMA: Environmental Impact Assessment (EIA) Regulations (of 2014, as amended) associated with the development, due to wetlands and rivers being located outside of the development footprint and no activities are anticipated that will directly impact the identified wetlands and the Slang Spruit River. *Note that other listed activities from a terrestrial vegetation and biodiversity perspective could be associated with the development and these need to be investigated further.*

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1. Introduction & Background

1.1. Location and Description of the Proposed Development Activities

A new shopping mall development is being planned adjacent to the existing Mageza Service Station (SASOL fuel filling station) at Ridge Park, on the corner of Archie Gumede Drive and Sikhumbuzo Ngwenya Road, between the suburbs of Ridge Park and Masons Mill, Msunduze Municipality, KwaZulu-Natal. A locality map of the project site is provided in Figure 1.

Figure 1. Project locality map.

The new shopping mall is planned to include the following:

- Various line shops (retail space);
- Anchor store;
- Hardware store;
- Small office space and toilets;
- Restaurant (KFC);
- Pedestrian walkways; and
- Paved parking areas.

The proposed site development plan is shown below in Figure 2.

Figure 2. Site development plan (CCA Architects, drawing 1333_D5_Rev B).

1.2. Purpose of the Assessment

The proposed development activities require a Water Use Licence (WUL) in terms of the National Water Act (Act 36 of 1998) (NWA) and Environmental Authorisation (EA) in term of the National Environmental Management Act (No. 107 of 1998) (NEMA). In this regard, Verdant Environmental were appointed by the Environmental Assessment Practitioner, Mondli Consulting, to undertake a combined aquatic & wetland impact assessment to inform the WUL and EA applications.

1.3. Scope of Work

The scope of work completed as part of this assessment was as follows:

- Undertake of a desktop review of the biophysical setting and freshwater ecosystem conservation planning context of the project site.
- Undertake the desktop mapping of all watercourses (i.e. stream / river channels, riparian areas, wetlands, dams etc.) within a 500m radius of the project activities.
- Undertake a watercourse 'likelihood of impact' assessment to identify the wetlands to be measurably negatively affected by the proposed project activities.
- Infield delineation of all wetlands that stand to be measurably negatively affected by the proposed project activities occurring within 500m of the development activities.
- Subdivision of the desktop and infield delineated wetlands into definable resource / hydrogeomorphic (HGM) units and the classification of these units according to the national wetland ecosystem classification system (Ollis *et al*., 2013).
- Provision of a description of the key biophysical characteristics of the infield delineated wetlands (i.e. soils, vegetation and hydrology) based on the infield sampling and data collection.
- Assessment of the Present Ecological State (PES) of the infield delineated rivers, streams and wetlands.
- SASS5 macroinvertebrate assessment of perennial rivers only.
- Water chemistry sampling and analysis of perennial rivers only.
- Assessment of the supply, demand and importance of the direct and indirect ecosystem services provided by the infield delineated wetlands.
- Assessment of the Ecological Importance and Sensitivity (EIS) of the infield delineated rivers and wetlands.
- Determination of the recommended ecological category (REC) recommended management objectives for each of the river and wetland units assessed.

- Identification, description and assessment of the direct and indirect impacts of the proposed project on local rivers and wetlands.
- Assessment of the risk of potential impact to freshwater ecosystems (rivers, wetlands).
- Provision of project design, construction phase and operational phase mitigation measures to avoid, minimize and/or rehabilitate the potential impacts.

1.4. Key definitions and concepts

An ecosystem is a group of plants, animals and other organisms interacting with each other and with non-living (abiotic) components of their environment. Ecosystems can be classified broadly into terrestrial and aquatic ecosystems. Terrestrial ecosystems occur on land where water is a limiting factor, whereas aquatic ecosystems occur within landforms that are permanently or periodically inundated with flowing or standing water (Ollis *et al*., 2013). Freshwater ecosystems are a subset of the Earth's aquatic ecosystems and include all inland freshwater rivers, streams, wetlands, lakes, ponds and springs. This broad range of freshwater ecosystem types contains a multitude of habitats of varying ecological complexity and diversity (Wrona *et al*., 2016). Wetlands, streams and rivers fall under the umbrella term of "freshwater ecosystems".

Wetlands, streams and rivers fall under the umbrella term of 'watercourse' in the National Water Act (Act No. 36 of 1998) (NWA) of South Africa. Section 1(1)(xxiv) of the NWA defines a 'watercourse' as:

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

This assessment focusses on the assessment of natural watercourses and their associated habitats / ecosystems likely to be measurably affected by the proposed development, focussing specifically on wetlands. For the purposes of this assessment, wetlands, streams and rivers are defined as follows:

- **Wetlands** are areas that have water on the surface or within the root zone for extended periods throughout the year such that anaerobic soil conditions develop which favour the growth and regeneration of hydrophytic vegetation (plants which are adapted to saturated and anaerobic soil conditions). In terms of Section 1 of the NWA, wetlands are legally

defined as: (1) "…land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil."

- **Rivers and streams** are natural channels that are permanent, seasonal or temporary conduits of freshwater. In terms of ecological habitats, rivers and streams comprise in-stream aquatic habitat and riparian habitat. Generally, riparian zones mark the outer edge of stream and river systems. Streams and rivers are differentiated in terms of channel dimensions and generally fall within the broad category of rivers / riverine ecosystems in this report.
- **Instream habitat** is the aquatic habitat (or alluvial in the case of intermittent / ephemeral watercourses) within the active channel that includes the water column, river bed and the inundated active channel margins, and associated vegetation. In terms of Section 1 of the NWA, instream habitat is legally defined as habitat that includes "…the physical structure of a watercourse and the associated vegetation in relation to the bed of the watercourse."
- **A riparian zone** is a habitat, comprising bare soil, rock and/or vegetation that is: (i) associated with a watercourse; (ii) commonly characterised by alluvial soils; and (iii) inundated or flooded to an extent and with a frequency sufficient to support vegetation species with a composition and physical structure distinct from those of adjacent land areas (DWAF, 2005). In terms of Section 1 of the NWA, riparian habitat is legally defined as: 'habitat that "…includes 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 land areas."

1.5. Legislative Context Relevant to Freshwater Ecosystems

Rivers and wetlands are not formally protected by law but their alteration is regulated by three different pieces of legislation in South Africa, namely:

- National Water Act (No. 36 of 1998) ('NWA');
- National Environmental Management Act (No. 107 of 1998) ('NEMA'); and
- Conservation of Agricultural Resources Act (No. 43 of 1983) ('CARA').

1.5.1. National Water Act (Act No. 36 of 1998) ('NWA')

Section 21 of the National Water Act (No 36 of 1998) lists eleven (11) activities that constitute water uses that require a Water Use License (WUL) prior to the activities commencing, unless the use is excluded. The water uses included in Section 21 are:

a) taking water from a water resource;
b) storing water;
c) impeding or diverting the flow of water in a watercourse;
d) engaging in a stream flow reduction activity contemplated in section 36;
e) engaging in a controlled activity identified as such in section 37(1) or declared under section 38(1);
f) discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;
g) disposing of waste in a manner which may detrimentally impact on a water resource;
h) disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process;
i) altering the bed, banks, course or characteristics of a watercourse;
j) removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people; and
k) using water for recreational purposes.

Typically, development activities that directly and indirectly alter the characteristics of watercourses are considered Section 21(c) and 21(i) water uses and are the most common water uses.

1.5.2. National Environmental Management Act (No. 107 of 1998) ('NEMA')

Listed Activities that may negatively affect watercourses are included in three (3) Listing Notices in the EIA Regulations (2017) published under Section 24(5) and 44 of NEMA. Listed activities require Environmental Authorisation (EA) subject to conducting either a basic assessment or full Environmental Impact Assessment (EIA) prior to the project activities commencing.

1.5.3. Conservation of Agricultural Resources Act (No. 43 of 1983) ('CARA')

Regulated activities that may negatively affect watercourses are included in the CARA Regulations as amended (2001) published under Section 29 the CARA. Formal approval / permission from an executive officer is required before such regulated activities can take place.

2. Methods

2.1. Desktop Review of Freshwater Ecosystem Context

Freshwater ecosystems are typically linear features that are connected over regional scales in the landscape and embedded in the terrestrial matrix. Furthermore, freshwater ecosystems are typically located at topographical low points in the landscape, thereby collecting and conveying materials (water and dissolved and particulate matter) from within their entire catchment (UN Environment, 2018). It is thus important to first contextualise the onsite freshwater ecosystems in terms of local and regional setting, and conservation planning. An understanding of the biophysical and conservation context of the site will assist in the assessment of the importance and sensitivity of the onsite freshwater ecosystems, the setting of management objectives and the assessment of the significance of anticipated impacts. The following data sources and GIS spatial information listed in Table 1 was consulted to inform the specialist assessment. The data type, relevance to the project and source of the information is provided.

Table 1. Data sources and GIS information consulted to inform the freshwater ecosystem assessment.

Data/Coverage Type		Relevance	Source
Biophysical / Ecological Context	**Latest Google Earth ™ imagery**	*To supplement available aerial photography where needed and to inform catchment level impacts*	Google Earth™ On-line
	National Rivers (GIS Coverage)	*Highlight potential onsite and local rivers and map local drainage network*	DWS
	South African Quaternary catchments	*Locates the project area within the principal water resource management units in South Africa*	DWS

Data/Coverage Type		Relevance	Source
	South African Quinary catchments	*Locates the project area within the principal water resource management units in South Africa*	DWS
	DWA Eco-regions (GIS Coverage)	*Understand the regional biophysical context in which water resources within the study area occur*	DWA (2005)
	South African Vegetation Map (GIS Coverage)	*Classify vegetation types and determination of reference vegetation*	SANBI (2006 - 2018)
	South African Inventory of Inland Aquatic Ecosystems (SAIIAE), 2018 – River Ecosystems	*Shows location of river within the relevant inventories*	Van Deventer *et al.* (2018a)
	South African Inventory of Inland Aquatic Ecosystems (SAIIAE), 2018 – Wetland Ecosystems	*Shows location of wetlands within the relevant inventories*	Van Deventer *et al.* (2018a)
Conservation Context	**The National Freshwater Ecosystem Priority Area (NFEPA) Assessment (2011)** – Wetland FEPAs	*Shows location of national wetland ecosystem conservation priorities*	CSIR (2011)
	The National Freshwater Ecosystem Priority Area (NFEPA) Assessment (CSIR, 2011) – River FEPAs	*Shows location of national river ecosystem conservation priorities*	CSIR (2011)
	National Biodiversity Assessment – Terrestrial Realm (GIS Coverage)	*Terrestrial ecosystem / vegetation type threat status*	Skowno et al. (2018)
	National Biodiversity Assessment – Inland Aquatic / Freshwater Realm (GIS Coverage)	*Freshwater ecosystem / vegetation type threat status*	Van Deventer *et al.* (2018b)
	KZN Biodiversity Sector Plan: Critical Biodiversity Areas Irreplaceable (GIS Coverage)	*Provincial conservation planning importance.*	EKZNW (2016)
	KZN Biodiversity Sector Plan: Critical Biodiversity Areas Optimal (GIS Coverage)	*Provincial conservation planning importance.*	EKZNW (2016)
	KZN Terrestrial KZN Aquatic Systematic Conservation Plan (GIS Coverage	*Provincial conservation planning importance.*	EKZNW (2011)
	KZN Aquatic Systematic Conservation Plan (GIS Coverage)	*Provincial conservation planning importance.*	EKZNW (2007)

2.2. Baseline Assessment

2.2.1. Determination of the Extent of the Study Area

For the purposes of this assessment, the study area for infield assessment comprised **all rivers within 100m and wetlands within 500m of the of the development footprint that stand to be measurably negatively impacted**. The wetlands and rivers likely to be impacted were identified using the 'likelihood of impact' guidelines in Table 2.

Table 2. Qualitative 'likelihood of impact' ratings and descriptions.

Likelihood of Impact Rating	Description of Rating Guidelines
Definite	These resources are likely to require impact assessment and a Water Use License in terms of Section 21 (c) & (i) of the National Water Act for the following reasons: ➢ resources located **within the footprint** of the proposed development activity and will be impacted by the project; and/or ➢ resources located **within 15m upstream and/or upslope** of the proposed development activity and trigger requirements for Environmental Authorisation according to the NEMA: EIA regulations; and/or ➢ resources located **within 15m or downslope** of the development and trigger requirements for Environmental Authorisation according to the NEMA: EIA regulations; and/or ➢ resources located downstream within the following parameters: ○ **within 15m downstream** of a low-risk development; ○ **within 50m downstream** of a moderate risk development; and/or ○ **within 100m downstream** of a high-risk development e.g. mining, large industrial land uses.
Likely / Possible	These resources may require impact assessment and a Water Use License in terms of Section 21 (c) & (i) of the National Water Act for the following reasons: ➢ resources located **within 32m but greater than 15m upstream, upslope or downslope** of the proposed development; and/or ➢ resources located within a range at which they are likely to incur indirect impacts associated with the development (such as water pollution, sedimentation and erosion) based on development land use intensity and development area. This is generally resources located downstream within the following parameters: ○ **within 32m downstream** of a low-risk development; ○ **within 100m downstream** of a moderate risk development; and/or ○ **within 500m downstream** of a high-risk development (note that the extent of the affected area downstream could be greater than 500m for high-risk developments or developments that have extensive water quality and flow impacts e.g. dams / abstraction and treatment plants);
Unlikely	These resources are unlikely to require impact assessment or Water Use License in terms of Section 21 (c) & (i) of the National Water Act for the following reasons: ➢ resources located a distance upstream, upslope or downslope (>32m) of the proposed development and which are unlikely to be impacted by the development project; and/or

Likelihood of Impact Rating	Description of Rating Guidelines
	➢ resources located downstream but well beyond the range at which they are likely to incur impacts associated with the development (such as water pollution, sedimentation and erosion). This is generally resources located downstream within the following parameters: ○ **greater than 32m downstream** of a low-risk development; ○ **greater than 100m downstream** of a moderate risk development; and/or ○ **greater than 500m downstream** of a high-risk development (note that the extent of the affected area downstream could be greater than 500m for high-risk developments or developments that have extensive water quality and flow impacts e.g. dams / abstraction and treatment plants);
None	These resources will not require impact assessment or a Water Use License in terms of Section 21 (c) & (i) of the National Water Act for the following reasons: ➢ resources located within another adjacent sub-catchment, and which will not be impacted by the development in any way, shape or form.

2.2.2. Data Collection

A field assessment to delineate and assess the rivers and wetlands within the study area was undertaken on **24th May 2021**. Data collection involved the following:

- Systematic soil sampling across all valley lines, valley bottom areas, valley heads, hillslopes and depressions using a clay auger to confirm the presence and extent of wetland and alluvial (riparian) soils according to the guideline: '*A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas'* (DWAF, 2005). Soil sample points were recorded onsite using a hand-held GPS. Soil sample points were recorded onsite using a hand-held GPS.
- Instream aquatic sampling of perennial rivers was conducted as per the SASS 5 macroinvertebrate assessment protocol (Dickens & Graham, 2002).
- The recording of the dominant plant species and general composition of the wetland and riparian vegetation in the vicinity of the soil sample points based on visual observations. Observations points were recorded onsite using a hand-held GPS.
- The recording of the landscape / terrain position at each sample point based on visual observations. Observations points were recorded onsite using a hand-held GPS.
- The recording of existing river and wetland impacts (such as extent of existing infilling) using a hand-held GPS.

2.2.3. Data Analysis

The methods and tools that were used as part of the baseline wetland ecosystem assessment are summarised in Table 3, below.

Table 3. Summary of methods used in the assessment of the affected rivers and wetlands.

Method/ technique	Reference for methods/ tools used
Wetland and river /riparian delineation	• '*A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas'* (DWAF, 2005).
Classification of Aquatic Ecosystems (rivers & wetlands)	• National Wetland Classification System for Wetlands and other Aquatic Ecosystems in South Africa (Ollis *et al*., 2013).
Present Ecological State (PES)	• Level 1 WET-Health assessment (Macfarlane *et al.,* 2020) • The IHI (Index of Habitat Integrity), version 2 (Kleynhans, 1996, updated in 2012) • SASS 5 instream aquatic macroinvertebrate assessment (Dickens & Graham, 2002) • Water chemistry sampling and laboratory analysis.
Functional Importance	• Level 2 WET-EcoServices assessment (Kotze *et al*., 2020).
Ecological Importance & Sensitivity (EIS)	• Wetland EIS assessment (Kotze *et al*., 2020). • River EIS assessment (Keynhans, 1999).

2.3. Impact Assessment

Impact significance is defined broadly as a measure of the desirability, importance and acceptability of an impact to society (Lawrence, 2007). A significant impact is defined in the NEMA EIA Regulations 2017 as follows:

> "*…an impact that may have a notable effect on one or more aspects of the environment or may result in non-compliance with accepted environmental quality standards, thresholds or targets and is determined through rating the positive and negative effects of an impact on the environment based on criteria such as duration, magnitude, intensity and probability of occurrence*."

Wetland and river ecosystem impacts can be grouped into the following broad impact types:

1. **Direct ecosystem modification or destruction / loss impacts** – This impact refers to the direct physical destruction and/or modification of wetland communities, habitat and

associated biota. Such impacts may be attributed to a range of activities including vegetation / habitat clearing (stripping / grubbing), earthworks (i.e. excavation and infilling) and deep flooding by impoundments.

2. **Alteration of hydrological and geomorphological processes** – This impact refers to all the indirect impacts resulting from human activities within the watercourse or catchment that alter hydrological and geomorphological processes i.e. rates of erosion and sedimentation. This includes activities that: (i) modify landcover characteristics that alter the quantity and pattern of catchment runoff and sediment inputs e.g. earthworks, surface hardening, plantations, etc.; (ii) activities that regulate, reduce or increase flows e.g. impoundment / dams, abstraction, return flows and decant flows; and activities alter wetland flow hydraulics e.g. establishment of drains, flow canalisation, flow constrictions and flow diversions.
3. **Water pollution impacts** – This impact refers to the alteration of the chemical and biological characteristics of soil and water within watercourses and the associated ecological impacts. In the context of this impact assessment, water quality is assessed in relation to changes to its fitness for use (e.g. for domestic, recreational or agricultural purposes) and ability to maintain the health of aquatic ecosystems. This impact includes a full spectrum of activities ranging from direct inputs (e.g. spillages / point source discharges) through to diffuse source inputs from land use activities that affects the quality of water entering watercourses (e.g. hazardous substances handling, storage & transport; urban stormwater management; irrigation return flows and acid mine drainage).
4. **Ecological connectivity and edge disturbance impacts** – This impact refers to the alteration of local and regional ecological processes resulting from the transformation of land and disturbance within and/or surrounding a watercourse. Key ecological processes of relevance in this regard include ecological connectivity and edge effects edge effects that are impacted by habitat fragmentation, patch size reduction, increased alien invasive plant invasion, noise pollution, vibrations, light pollution, and the occurrence of barriers to propagule and animal movement.

The significance of the potential construction and operational impacts was assessed using an impact assessment method developed by Eco-Pulse (2020) included in **Annexure A**. In this method, the significance of the potential wetland ecosystems impacts are interpreted in terms of the degree of change to the following aspects that drive wetland and river importance:

1. Provision of regulating ecosystem services and their contribution to water resource management, disaster risk management, climate resilience / adaptation, human safety and biodiversity / conservation.
2. Biodiversity maintenance and conservation importance (ecosystem, habitat and species conservation).
3. Provision of provisioning and cultural ecosystem services and their contribution to human livelihoods and wellbeing.

The impact assessment was undertaken for the following mitigation scenarios only:

1. **Realistic Poor Mitigation Scenario**: This scenario involves the implementation of the proposed development plan and designs that are currently proposed with the associated implementation of standard construction and operational phase mitigation measures. In terms of implementation success, this scenario assumes a realistic / likely poor implementation scenario based on the author's experience with such activities.
2. **Realistic Good Mitigation Scenario**: This scenario involves the implementation of the development plan and designs that incorporate all the project planning and design, construction, operational and decommissioning phase mitigation measures recommended by the author. In terms of implementation success, this scenario assumes a realistic best-case scenario for implementation based on the author's experience with such activities.

2.4. Section 21(c) and 21(i) Water Use Risk Assessment Matrix

Government Notice 509 of 2016 published in terms of Section 39 of the NWA sets out the terms and conditions for the General Authorisation of Section 21(c) and 21(i) water uses, key among which is that only developments posing a 'Low Risk' to watercourses can apply for a GA. Note that the GA does not apply to the following activities:

- Water use for the rehabilitation of a wetland as contemplated in GA 1198 contained in GG 32805 (18 December 2009).
- Use of water within the 'regulated area' of a watercourse where the Risk Class is Medium or High.
- Where any other water use as defined in Section 21 of the NWA must be applied for.
- Where storage of water results from Section 21 (c) and/or (i) water use.

- Any water use associated with the construction, installation or maintenance of any sewerage pipeline, pipelines carrying hazardous materials and to raw water and wastewater treatment works.

To this end, the DWS have developed a Risk Assessment Matrix/Tool to assess water risks associated with development activities. The DWS Risk Matrix/Assessment Tool (based on the DWS 2015 publication: 'Section 21 c and I water use Risk Assessment Protocol') was applied to the proposed project. The tool uses the following approach to calculating risk:

RISK = CONSEQUENCE X LIKELIHOOD
whereby:
CONSEQUENCE = SEVERITY + SPATIAL SCALE + DURATION
and
LIKELIHOOD = FREQUENCY OF ACTIVITY + FREQUENCY OF IMPACT + LEGAL ISSUES + DETECTION

The key risk stressors associated with each of the four (4) impact groups / types considered were:

1. Direct transformation and modification of habitat – Physical disturbance
2. Indirect impacts resulting from alteration of hydrological and geomorphic processes as a result of activities within and outside of the watercourse – Erosive surface runoff, sediment and increased and/or reduced water inputs
3. Water pollution impacts – Chemical, organic and biological pollutants
4. Ecological process and disturbance impacts – Alien invasive plants, noise pollution, dust pollution

For each of the above stressors, risk was assessed qualitatively using the DWS risk matrix tool.

It is important to note that the risk matrix/assessment tool also makes provision for the downgrading of risk to low in borderline moderate/low cases subject to independent specialist motivation granted that (i) the initial risk score is within twenty-five (25) risk points of the 'Low' class and that mitigation measures are provided to support the reduction of risk. The tool was applied to the project for the highest risk activities and watercourses was used to inform WUL requirements for the proposed development.

3. Desktop Assessment

3.1. Review of Ecosystem Context and Setting

3.1.1. Climate Setting

An overview of the key climatic characteristics of the Bioregion (i.e. **Sub-Escarpment Grassland**) and Ecoregion (**South Eastern Uplands)** is provided in Table 4 below.

Table 4. Overview of the key climatic characteristics of the region.

Aspect	Description
Elevation Above Mean Sea Level	650 - 670m a.m.s.l.
Mean Annual Precipitation (MAP)	840 mm/annum
Potential Evapotranspiration (PET)	1200 mm/annum
MAP: PET Ratio	0.7
Mean Annual Runoff (MAR)	74.9 mm^3
Rainfall seasonality	Summer rainfall

3.1.2. Geology and Topography

The study area is underlain predominantly by **shale geology** (with shin siltstone and sandstone in the uppermost part) belonging to the Pietermaritzburg Formation (part of the Ecca Group). This results in clay and silt rich soils that characterise the area.

The site is located in the KZN Interior, being relatively flat to undulating topography dissected by seasonal and perennial rivers. The valley that characteries the site slopes gently to the north (north-facing), with a perennial river (the Slang Spruit River) draining in a general northerly direction.

3.1.3. Terrestrial Vegetation Type

The reference or primary terrestrial vegetation type for the area is **Dry Coast Hinterland (Ngongoni) Grassland** within the Savanna Biome and Sub-Escarpment Grassland Bioregion (Mucina & Rutherford, 2006). The vegetation is described by Mucina & Rutherford (2006) as comprising "*dense, tall grassland overwhelmingly dominated by unpalatable wiry Ngongoni grass (Aristida junciformis) with this monodominance associated with low species diversity*". Wooded areas comprising thornveld are found in valleys at lower altitudes.

3.1.4. Drainage and River Setting

The main drainage feature in the study areas is the perennial **Slang Spruit River** located in the valley to the immediate west of the site and draining in a general northerly direction, within **quaternary catchment U20J**, as shown in Figure 3 below. The Slang Spruit discharges into the uMnsunduze River, approximately 1.5km north of the site.

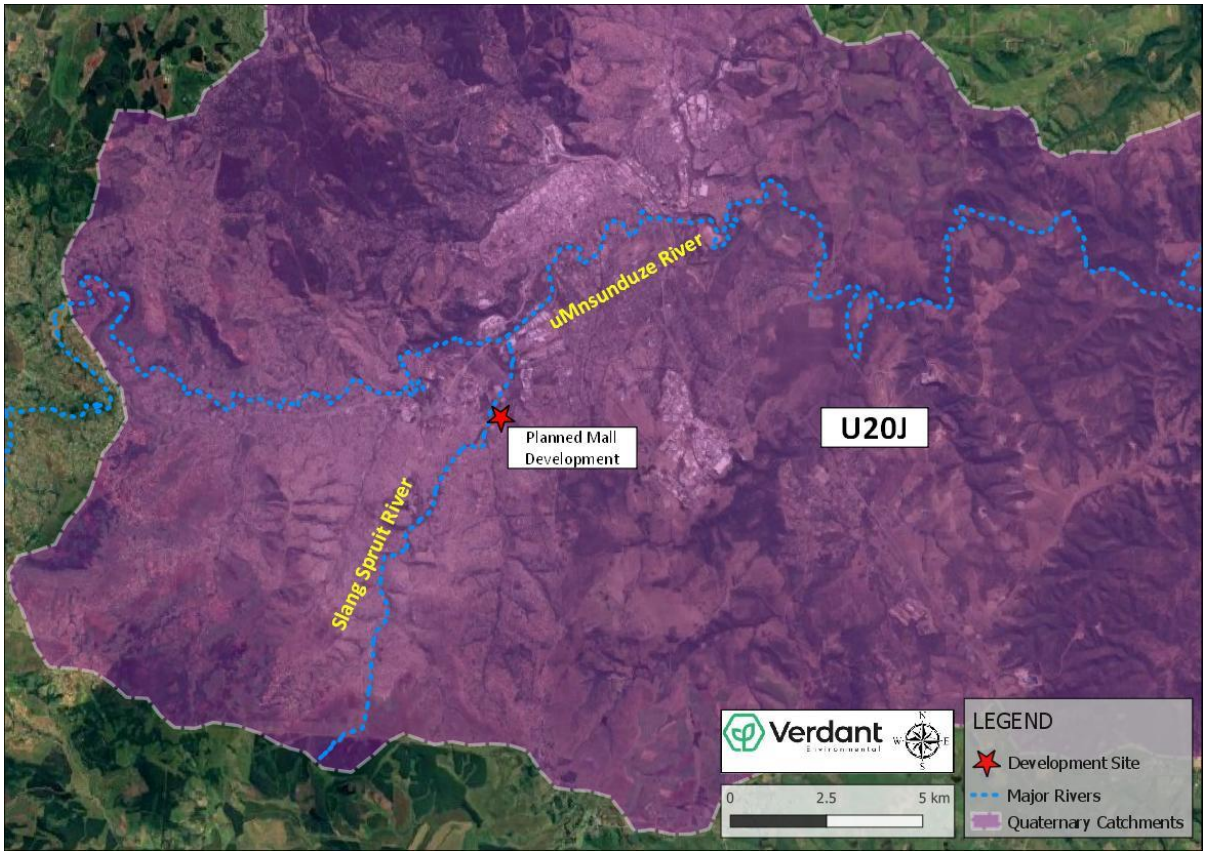

Figure 3. Drainage and river ecosystem setting of the study area, within catchment U20J.

3.1.5. Wetland Setting

The National Wetland Map (Van Deventer *et al*., 2018) indicates the presence of a **relatively broad seep wetland** positioned on the valley side to the immediate east of the Slang Spruit River, as shown in Figure 4. *Based on the National Wetland Map V5, **seep wetlands** of the type identified in the study area are considered **'Critically Endangered'** at a national level according to Van Deventer et al. (2018).*

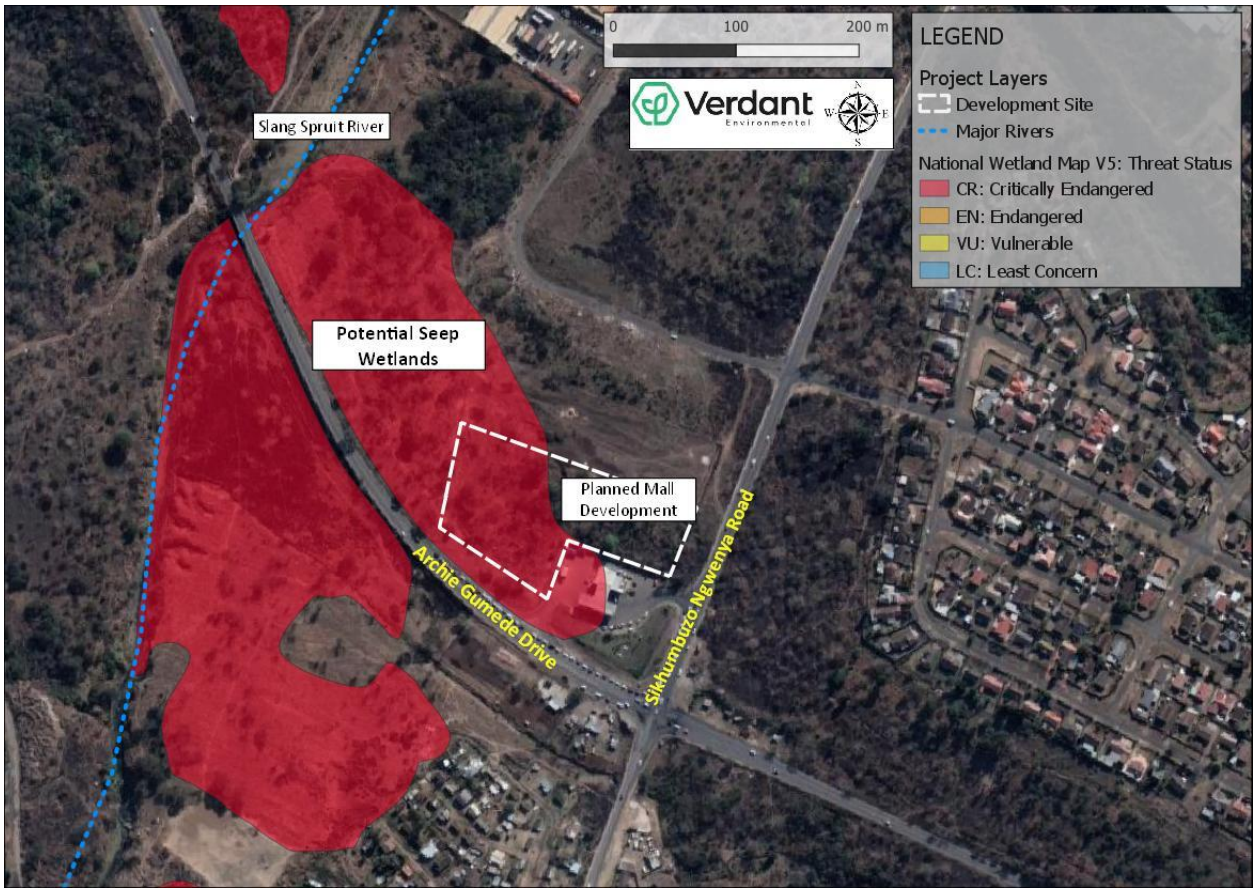

Figure 4. Study area in relation to the wetland mapping from the National Wetland Map Version 5 (NBA, 2018).

3.1.6. Water Resource Management Context

The study area is not located within a Strategic Water Source Area (SWSA) and no large dams are located downstream. The closest significant water resource is the **uMsunduze River**, located approximately 2km downstream.

3.1.7. Conservation Context

A summary of the conservation planning and threat status of the ecological features in the study area is provided in Table 5. Noteworthy features include:

- The terrestrial vegetation type of the study area, Dry Hinterland Grassland, is currently listed as **Vulnerable (VU)** in the NBA (SANBI, 2018) at the national level, and shares that same conservation/threat status at the provincial level in KZN (Scott-Shaw & Escott, 2012).
- The sub-quaternary catchment within which the study area is located is not listed as an important area in terms of the National Freshwater Ecosystem Priority Areas (NFEPA) project. Also, none of the mapped wetland areas that stand to be potentially impacted have been identified as FEPAs (Freshwater Ecosystem Priority Areas).
- The wetland vegetation group for the study area is the 'Sub-Escarpment Savanna' group, which is regarded as being 'Least Threatened' in terms of ecosystem threat status and 'well-protected' (CSIR, 2011). Based on the National Wetland Map V5, **seep wetlands** of the type identified in the study area are considered **'Critically Endangered'** at a national level according to Van Deventer *et al*. (2018).
- The relevant reach of the Slang Spruit River is currently listed as **endangered** in the NBA (SANBI, 2018).
- The site of the development has not been categorised as in the KZN Terrestrial Systematic Conservation Plan (EKZNW, 2016), which suggests that terrestrial conservation priorities are located elsewhere.

Table 5. Key conservation context details for the study area.

Conservation Planning Dataset		Relevant Conservation Feature	Conservation Planning / Threat Status	Location in Relation to Project Site
NATIONAL LEVEL CONSERVATION PLANNING CONTEXT				
National Freshwater Ecosystem Priority Areas (NFEPA)	River	Slang Spruit River	Non-FEPA River	Adjacent to site
		uMsunduze River		2 km
	Wetland	Seep wetlands	Non-FEPA wetland	On site
2018 National Biodiversity Assessment	Terrestrial	Dry Hinterland Grassland	Vulnerable	On site

Conservation Planning Dataset		Relevant Conservation Feature	Conservation Planning / Threat Status	Location in Relation to Project Site
	River	Slang Spruit River	Endangered	Adjacent to site
	Wetland	Seep wetlands	Critically Endangered	On site
PROVINCIAL AND REGIONAL LEVEL CONSERVATION PLANNING CONTEXT				
KZN Biodiversity Conservation PlanFreshwater		Catchment Planning Unit	Available[1]	Entire project site
KZN Vegetation Type Threat Assessment		KZN Dry Hinterland Grassland	Vulnerable	On site
		Temperate Alluvial Vegetation	Vulnerable	On site

3.2. Desktop Mapping within 500m and Confirmation of the Study Area

All the potential wetlands (natural and artificial) occurring within 500m of the proposed development site and associated activities were mapped and classified in terms of hydrogeomorphic (HGM) types as shown in Figure 5. An indication of the 'likelihood of impact' for each of the mapped rivers and wetlands is depicted visually on the map in Figure 6.

[1] "Available" suggests that the catchment has not specifically been identified as a provincial priority area aquatic conservation priority.

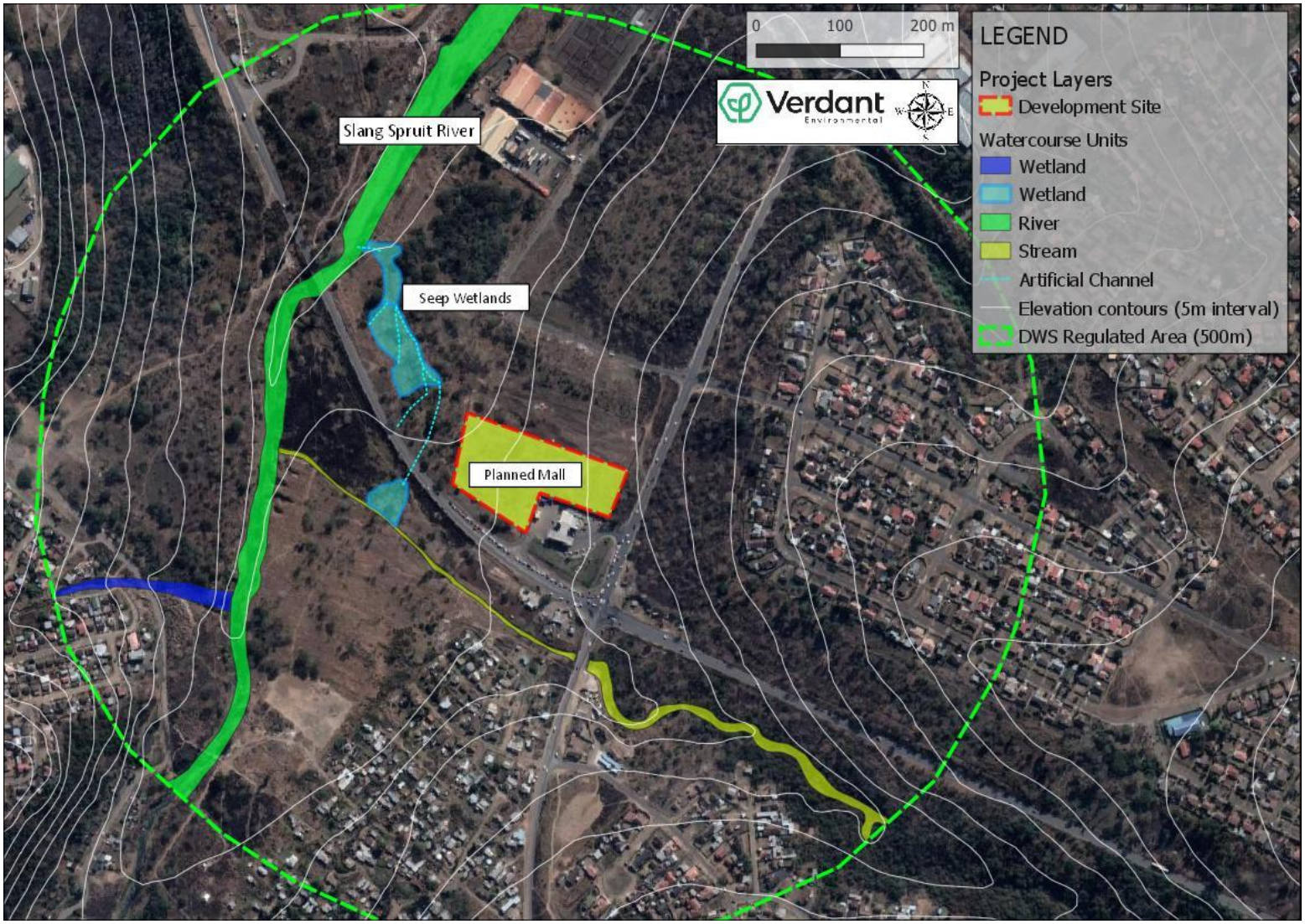

Figure 5. Rivers and wetlands within 500m of the project site categorised into hydrogeomorphic types.

Figure 6. Indication of the 'likelihood of impact' related to rivers and wetlands.

4. Infield Baseline Assessment

The infield baseline assessment focused on the wetland ecosystems likely to be measurably negatively impacted by the project development activities only. The extent (infield delineation), classification, habitat characteristics, present ecological state (PES) and ecological importance and sensitivity (EIS) of the rivers and wetlands are discussed in this section of the report.

4.1. Delineation, Classification & Habitat Characteristics

Soil and vegetation sampling in conjunction with the recording of terrain type enabled the delineation and classification of:

- a **seep wetland unit (W01)** located approximately 45m to the west of the development site; and
- the **perennial Slang Spruit River (R01)** located more than 200m west of the site.

These are shown on the delineation map in Figure 7 (next page), with a summary of the key biophysical characteristics of each provided in the tables that follow.

Note that whilst none of the identified watercourses are not located on the development site and will therefore not be directly affected by the development, due to their location downslope there is the potential risk that these water resources could be indirectly impacted.

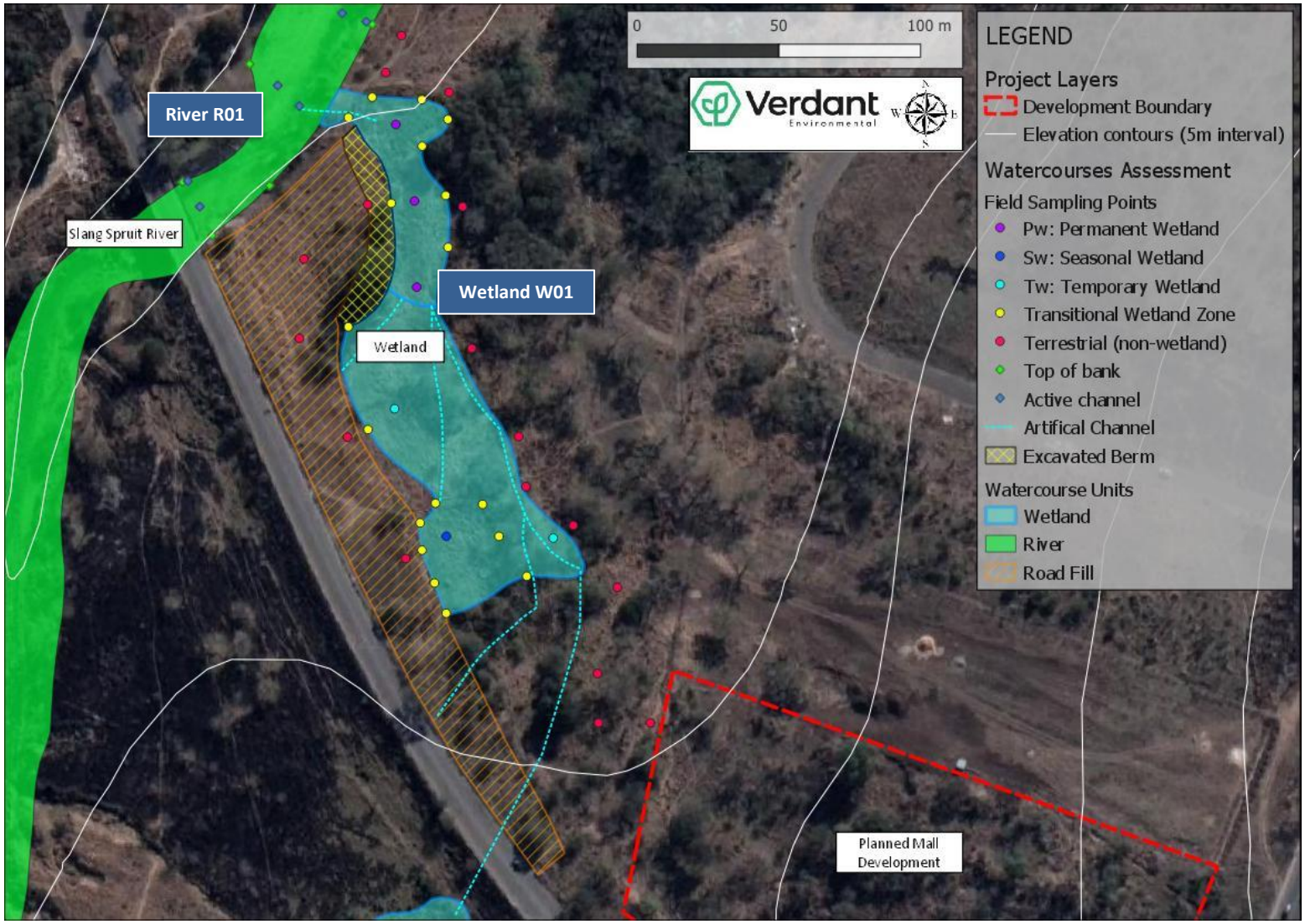

Figure 7. Delineation map showing the location and extent of river and wetland units assessed on the project site and downstream.

Table 6. Summary of the key hydro-geomorphic and biophysical characteristics of Wetland Unit W01.

Unit W02: seep wetland	
HGM classification	Seep wetland
Size	~0.6 hectares
Dominant wetness zone(s)	Permanent and seasonal saturation
Dominant water input	Intercepts fluctuating perched water table and lateral subsurface seepage
Low flow pattern	Subsurface diffuse flow
Sampled soil characteristics	**Temporary and seasonal wetland soils:** Soils were typically clay / clay loam textured (linked to the underlying shale geology), with wetland soils being grey to dark grey compared to the drier, brown terrestrial soils at the site. A significant amount of road fill material was encountered in places. <u>Sample 1: terrestrial (non-wetland)</u> • 0-10cm depth: Dry brown clay loam (7.5YR 3/3) no mottles. • 40-50cm depth: As above. <u>Sample 2: permanent wetland</u> • 0-10cm depth: Wet, dark grey clay (10YR 3/1-2) with no mottles, low organics. • 40-50cm depth: As above.
Vegetation characteristics	The vegetation communities comprise a mix of short secondary wet grassland and sedgeland with emergent wetland vegetation in the lowest lying areas where standing water was encountered: • **Mixed sedgeland in seasonal and permanent wetness zones**: comprising mainly the indigenous giant sedge, *Cyperus dives,* bulrushes (*Typha capensis*), with a mixture of native grasses such as *Sporobolus pyramidalis*. • **Seasonally wet grassland**: dominated by the water-loving grass, *Leersia hexandra* (Wild rice grass), with smaller sedges such as *Carex sp*. and *Kyllinga melanosperma.* Alien invasive species present included *Paspalum sp, Ageratum houstonianum, Lantana camara* and *Tagetes minuta.*
Other comments	• The wetland has been notably disturbed, primarily as a result of the construction of the municipal road which crosses the wetland, with a large portion of the seep potentially having been infilled. Artificial drains have also been constructed to more efficiently convey storm water from the road surface away and through the seep. This disturbance has also led to an increase in invasive alien plants and weeds in the wetland habitat. • Potential artificial water inputs to the wetland from the nearby SASOL garage (storm water runoff and runoff from car wash facility) and broken municipal water pipes along the roadside, have likely increased the saturation levels within the wetland, making the soils wetter and

Unit W02: seep wetland	
	more capable of supporting more permanent wetland habitat and vegetation communities. • In our opinion the wetland is not an artificial seep but rather a modified natural seep wetland, for the following reasons: - the National Wetland Map V5 suggests that there is a natural seep located to the west of the development site, which has been bisected by Archie Gumede Road; - the elevation contours show a natural preferential seepage zone; - the presence of standing water and wetland plants such as *Leersia hexandra & Cyperus dives* (which prefer more permanent soil saturation levels), assumes a more permanent wetland presence given that sampling was done in winter (end of May 2021);

Selected Photos of Wetland W01:

Photo 01: View of the seasonal to permanent sedgeland dominated by *Cyperus dives*.

Photo 02: View of mixed hygrophilous (wet) grassland.

Table 7. Summary of the key hydro-geomorphic and biophysical characteristics of River Unit R01(Slang Spruit River).

Unit R01: Slang Spruit River	
Classification	Perennial River
Flows	Permanent (perennial) flow
Dominant water input	Catchment runoff
Low flow pattern	Channelled flow
Sampled soil characteristics	No soils were sampled within the channel as all soils encountered within the channel were waterlogged
Vegetation characteristics	Short exotic grasses including *Pennisetum clandestinum* (Kikuyu grass) comprise the riverbanks and flood benches, with tufts of *Aristida junciformis* and scattered woody species (e.g. *Vachellia siberiana*) and alien invasive plants

Unit R01: Slang Spruit River	
	such as *Lantana camara, Solanum mauritianum.* Instream vegetation largely absent due to the depth of water and flows. Some patchy cover of *Cyperus dives* and *Sporobolus pyramidalis* on the wetted permitter of the channel.
Other comments	Notably disturbed habitat and water quality as a result of catchment activities, urban runoff and the impacts of the immediate upstream road bridge.

Selected Photos of River R01 (Slang Spruit River):

Photo 03: View over the Slang Spruit River taken from the right-hand side looking downstream.

Photo 04: View over the Slang Spruit River channel looking upstream towards the road bridge.

4.2. Present Ecological State (PES) Assessment

4.2.1. Wetland PES

This section presents and discusses the results of the river and wetland PES assessments. PES is defined as a measure of the similarity or deviation from a natural or reference state (Macfarlane *et al*., 2020). The impact scores were interpreted using the PES categories and descriptions in Macfarlane *et al*. (2020). The results of the wetland PES assessment are summarised in Table 8. Overall, the PES of Wetland W01 (seep) was rated as a **'D' Category or 'Poor'**: '*The modification has a clearly detrimental impact on wetland integrity and approximately 50% of wetland integrity has been lost'*.

Key impacts that have resulted in the poor condition of the seep wetland include:

- **Hydrological impacts:**

- Modified water inputs and floodpeaks as a result of road storm water runoff and urban water inputs (road, catchment urban residential land use, SASOL garage, broken municipal water pipes);
- Altered water distribution patterns due to artificial drains constructed in the wetland to assist with draining road storm water runoff;

- **Geomorphological impacts:**
  - partial infilling associated with road fill;
  - increased sediment inputs due to catchment land use and land degradation;
- **Water quality impacts:**
  - Reduced water quality associated with urban storm water runoff;
- **Vegetation impacts:**
  - increased levels of soil saturation due to external water inputs, affecting vegetation community characteristics;
  - disturbance leading to scattered infestations of invasive alien plants and weed, replacing native plant species.

Table 8. PES Summary for the wetland unit W01 assessed.

Wetland Unit	Hydro	Geomorph	Water Quality	Vegetation	Overall PES
W01: seep	35% intact E: Seriously Modified	51% intact D: Poor	68% intact C: Fair	50% intact D: Poor	**46% Intact** **D: Poor**

4.2.2. River PES

As with wetlands, there are various ecological drivers of river health (PES) and components such as water quality, aquatic biota, instream and riparian habitat, nature of flows and geomorphology can all be investigated to provide a comprehensive overview of the health of a river reach.

4.2.2.1 Water Quality

The term 'water quality' is used to describe the microbiological, physical and chemical properties of water resources as defined by the National Water Act (Act No. 36 of 1998) that determine its fitness for a specific use and is determined by substances which are either dissolved or suspended in the water (DWAF, 2001). In this context, water quality therefore refers to its fitness for maintaining the

health of aquatic ecosystems and ensuring no impact to downstream water quality or water users (if any).

Water samples were collected at a single site on the Slang Spruit River in winter (May 2021) and analysed at a SANAS accredited laboratory (Talbot & Talbot). The samples were collected using the provided vessels and kept refrigerated until delivered to the laboratory for analysis. Each sample was then analysed for the following eight (8) determinands at a minimum:

- Chemical Oxygen Demand (COD)
- Electrical Conductivity (EC)
- Ammonia
- Nitrate/Nitrite
- pH
- Orthophosphate
- Suspended Solids
- *E. coli* bacteria

These determinands were tested for to provide information on the prevailing physico-chemical water quality information at the time of sampling and to provide ancillary data to assist in the interpretation of aquatic macro-invertebrate (SASS5) assessments, and to inform the assessment of habitat integrity (Index of Habitat Integrity).

The chemical analysis revealed **relatively 'poor' water quality**, due to elevated nitrate/nitrite and *E.coli* bacterial concentrations, revealing typical contamination from urban sources in the catchment (Table 9):

- Nitrite/Nitrate is a biologically available form of nitrogen essential for plant growth. River systems are however generally naturally nitrogen-poor, with the presence of excessive nitrogen in a water resource typically being an indicator of human impacts (Lee *et al*., 2018). Unnaturally high concentrations of Nitrate/Nitrite can contribute to the eutrophication of aquatic ecosystems. The excessive algal growth noted along sections of the Slang Spruit River reach assessed is likely linked to the elevated nutrient concentrations and is indicative of eutrophication within the system.
- The elevated *E. coli* levels at the site suggest that the source of elevated nutrients is sewage contamination as *E. coli* is a commonly found coliform bacterium in intestines of warm-blooded organisms, including human beings (Baur *et al*., 1996, Dallas, 2004). The source of sewage along the assessed river is likely linked to the densely urbanized upstream catchment, which largely consists of formal and informal high density residential areas.

Table 9. Summary of the results of water quality sampling and analysis.

Variable / Determinant	Unit of measure	TWQR[2] (DWAF, 1996)	Result
Chemical Oxygen Demand	mg O^2/l	*Not to be changed by more than 15% from normal.*	<25
Ammonia	mg N/l	*Not to be changed by more than 15% from normal.*	<1.5
E. coli	colonies per 100ml	*130*	**46 110**
Electrical conductivity	mS/m at 25°C	*Not to be changed by more than 15% from normal.*	40.1
Nitrate/Nitrite	mg N/l	*Not to be changed by more than 15% from normal.*	**3.59**
Orthophosphate	mg P/l	*Not to be changed by more than 15% from normal.*	<0.1
pH	pH units	*Not to vary by more than 0.5 pH units or by more than 5% from normal.*	7.8
Suspended solids at 105°C	Mg/l	*Not to be increased by more than 10% from normal.*	<18

4.2.2.2 SASS5

The South African Scoring System version 5 (SASS 5) (Dickens & Graham, 2002) is a rapid bio-assessment method for determining the health or condition of rivers based on sampling and rating of aquatic macroinvertebrate communities and used to gauge the ecological state of aquatic ecosystems (Thirion, 2007). SASS5 is based on the families of aquatic invertebrates present at the sampled site with each taxon being allocated a sensitivity score (Quality Value) based on their resistance to declining water quality conditions and environmental stress (Dicken and Graham, 2002).

The South African Scoring System Version 5 or SASS5 (Dickens & Graham, 2002) was used to assess the environmental water quality of R01 (Slang Spruit River) using aquatic macroinvertebrate communities as response indicator.

According to the South Africa Scoring System (SASS) Data Interpretation Guidelines (Dallas, 2007) the assessed river reach is part of the 'South Eastern Uplands – Upper' spatial group. The SASS5 Score and ASPT place the assessed reach of the Slang Spruit River (R01) into the **E/F: Seriously / Critically Modified Ecological Category** (Table 10). A total of 12 taxa were netted and identified during the SASS5 assessment. The full list of these taxa, including their sensitivity

[2] **Target water quality:** Note that river water quality data cannot be compared against the General Limit Values (GLVs) or Special Limit Values (SLVs) as these limits are prescribed for 'discharge' into a watercourse. Water quality results should be compared instead against an environmental ecosystem standard such as the Target Water Quality Range (TWQR) for Aquatic Environments contained in the SOUTH AFRICAN WATER QUALITY GUIDELINES. Volume 7: Aquatic Ecosystems (DWAF, 1996).

scores, is shown in Table 11. The average score per taxon (ASPT) for the identified macroinvertebrate taxa was 4.67.

Whilst certain biotopes were somewhat limited at the sample site, the overall biotope score was 71%. This suggests that the quality and variety of biotopes along the sample reach is not a major factor limiting aquatic macroinvertebrate community composition. It is therefore reasonable to conclude the water quality along R01 has been altered, and this is influencing the diversity of aquatic macroinvertebrates within the river system, with remaining taxa being either highly or moderately tolerant of poor water quality conditions.

Table 10. Summary of the SASS5 results for the assessed reach of R01: Slang Spruit River.

Biotope Types	**Biotope Scores (out of 5)**
Stones in Current	5
Stones out of Current	4
Bedrock	3
Aquatic Vegetation	0
Marginal Vegetation in Current	5
Marginal Vegetation out Of Current	4
Gravel	4
Sand	4
Mud	3
Biotope Score (%)	**71**
SASS Score	**56**
No Taxa	**12**
Average Score Per Taxon (ASPT)	**4.67**
SASS5 Derived Ecological Category	**E/F: Seriously / Critically Modified**

Table 11. Comprehensive list of taxa sampled along R01 including their respective sensitivity score (after Dickens & Graham, 2002).

Taxa	**Sensitivity Score (out of 15)**
Oligochaeta (Earthworms)	1
Hirudinea (Leeches)	3
Baetidae (2 species)	6
Caenidae (Squaregills/Cainfles)	6
Aeshnidae (Hawkers & Emperors)	8
Gomphidae (Clubtails)	6
Naucoridae (Creeping water bugs)	7
Hydropsychidae (1 species)	4
Dytiscidae/Noteridae (Diving beetles)	5

Taxa	Sensitivity Score (out of 15)
Chironomidae (Midges)	2
Simuliidae (Blackflies)	5
Lymnaeidae (Pond snails)	3

Key for interpreting sensitivity scores based on Dickens and Graham (2002):

Sensitivity Score (Dickens & Graham, 2002)		
	1	Highly tolerant to pollution (Low/Very Low Sensitivity taxa)
	5	
		Moderately tolerate to pollution (Moderate Sensitivity taxa)
	10	
		Intolerant to pollution (High Sensitivity taxa)
	15	

4.2.2.3 Habitat Assessment (IHI)

The IHI (Index of Habitat Integrity), version 2 (Kleynhans, 2012) is used in order to determine both riparian and instream habitat integrity of the Sterkspruit River. As part of the IHI assessment a specific set of defined impact indicators are assessed qualitatively for both the instream and riparian components of the river unit. Sampling for the IHI assessment involves recording visual observations at selected points at each sampling site. This information was supplemented with the SASS5 data and water quality data collected, as well as a with a desktop analysis of catchment land cover and land uses observed using colour aerial photography, as appropriate.

The results of the IHI assessment are summarised in Table 12 and indicate that overall river habitat quality was rated as **'Poor ('D' PES)** during the winter (May 2021) survey, with key contributing habitat impacts indicated in Table 12. A large loss of biota, habitat and ecosystem functions have occurred.

Table 12. Summary of the IHI assessment results for R01: Slang Spruit River.

Site	Instream PES	Riparian PES	Combined PES based on habitat	PES Drivers
R01: Slang Spruit River	D	E	**D: Poor**	Poor water quality, flow modifications from urbanised upstream catchment, exotic vegetation, removal of riparian vegetation, upstream road bridge, bank erosion, infilling of river floodplain for development, solid waste dumping.

4.2.2.4 Overall River PES

Taking into account water quality, SASS5 (macroinvertebrate health) and the outcomes of the instream and riparian habitat assessment (IHI), overall river PES is summarised below in Table 13 and is considered to be a **'D/E' PES Category: Poor to Seriously Modified**.

Table 13. Summary of combined river PES for R01: Slang Spruit River.

Site	Water Quality	SASS5	IHI	Combined River PES
R01: Slang Spruit River	D	E/F	D	**D/E: Poor to Seriously Modified**

4.3. Ecosystem Services: Wetland Functional Assessment

This section discusses the results of the wetland ecosystem service assessments. Ecosystem services are broadly defined as the benefits people obtain from ecosystems (Kotze *et al*., 2020). A broader definition is that they are all the aspects of ecosystems utilized (actively or passively) to produce human well-being (Kotze *et al*., 2020). The ecosystem services scores were interpreted using the categories and descriptions provided in Table 14, below.

Table 14. Ecosystem services importance categories and descriptions.

Importance Category		Description
Very Low	0-0.79	The importance of services supplied is very low relative to that supplied by other wetlands.
Low	0.8 – 1.29	The importance of services supplied is low relative to that supplied by other wetlands.
Moderately-Low	1.3 – 1.69	The importance of services supplied is moderately-low relative to that supplied by other wetlands.
Moderate	1.7 – 2.29	The importance of services supplied is moderate relative to that supplied by other wetlands.
Moderately-High	2.3 – 2.69	The importance of services supplied is moderately-high relative to that supplied by other wetlands.
High	2.7 – 3.19	The importance of services supplied is high relative to that supplied by other wetlands.
Very High	3.2 - 4.0	The importance of services supplied is very high relative to that supplied by other wetlands.

The results of the WET-Ecoservices assessment are summarised in Table 15. Most ecosystem services are considered to be of **'Low' to 'Very Low' importance** for wetland W01, given that:

- the wetland is small and degraded and not well positioned to provide key services; and
- lack of current use of / demand for the wetlands for many purposes owing to the urban setting.

Table 15. Summary of the outputs of the WET-EcoServices assessment for wetland seep W01.

Ecosystem Service		W01	
		Importance Score	Rating
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0,0	Very Low
	Stream flow regulation	1,0	Low
	Sediment trapping	0,8	Very Low
	Erosion control	0,3	Very Low
	Phosphate assimilation	0,5	Very Low
	Nitrate assimilation	0,8	Very Low
	Toxicant assimilation	0,8	Very Low
	Carbon storage	1,0	Low
	Biodiversity maintenance	1,2	Low
PROVISIONING SERVICES	Water for human use	0,0	Very Low
	Harvestable resources	0,0	Very Low
	Food for livestock	0,8	Very Low
	Cultivated foods	0,3	Very Low
CULTURAL SERVICES	Tourism and Recreation	0,0	Very Low
	Education and Research	0,0	Very Low
	Cultural and Spiritual	0,0	Very Low

4.4. Ecological Importance & Sensitivity (EIS) Assessment

This section discusses the results of the Ecological Importance and Sensitivity (EIS) assessment. Ecological Importance (EI) is the expression of the importance of rivers and wetlands in terms of the maintenance of biological diversity and ecological functioning at a local and landscape level (Kotze et al., 2020). Ecological Sensitivity (S) refers to ecosystem fragility or the ability to resist or recover from disturbance (Kotze et al., 2020).

4.4.1. Wetland EIS

A summary of the wetland EIS scores and ratings is provided in Table 16.

Wetland Unit W01 was assessed as being of **'Low' EIS** driven by the degraded condition and reduced overall habitat sensitivity, small size and limited importance in terms of providing ecosystem services: *"Wetlands that are not ecologically important and sensitive at any scale, the biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications, and they play an insignificant role in moderating the quantity and quality of water in major rivers"*

Table 16. Summary of EIS scores and overall EIS rating for wetland unit W01.

Determinants	Wetland W01
Biodiversity Importance	1.2 Low
Functional Importance	1.0 Low
Socio-cultural Importance	0.8 Low
Ecological Sensitivity	0.4 Very Low
Final EIS Score	**1.0**
EIS Category & Rating	**Low**

4.4.2. River EIS

A summary of the river EIS scores and ratings is provided in Table 17. The Slang Spruit River reach (R01) was assessed as being of **'Low' EIS** driven by the degraded river condition and reduced overall instream and riparian habitat sensitivity, poor water quality and lack of habitat diversity for supporting aquatic biota of conservation importance.

Table 17. Summary of EIS scores and rating for the Slang Spruit River (R01).

BIOTA (RIPARIAN & INSTREAM)	
Rare & endangered (range: 4=very high - 0 = none)	0.0 None
Unique (endemic, isolated, etc.) (range: 4=very high - 0 = none)	0.0 None
Intolerant (flow & flow related water quality) (range: 4=very high - 0 = none)	0.0 None/Low
Species/taxon richness (range: 4=very high - 1=low/marginal)	1.0 Low
RIPARIAN & INSTREAM HABITATS	
Diversity of types (4=Very high - 1=marginal/low)	0.5 Low
Refugia (4=Very high - 1=marginal/low)	0.5 Low
Sensitivity to flow changes (4=Very high - 1=marginal/low)	3.0 Moderate
Sensitivity to flow related water quality changes (4=Very high - 1=marginal/low)	2.0 Moderately Low
Migration route/corridor (instream & riparian, range: 4=very high - 0 = none)	1.0 Low
Importance of conservation & natural areas (range, 4=very high - 0=very low)	2.0 Moderate
ECOLOGICAL IMPORTANCE AND SENSITIVITY CATEGORY (EIS)	**LOW**

5. Recommended Ecological Category (REC)

The recommended ecological category (REC) is the target or desired state of freshwater ecosystems required to meet water resource management objectives and quality targets. It is determined through the consideration of the PES, EIS and realistic opportunities to improve the PES that is driven by the context / setting. The modus operandi followed by DWAF's Directorate: Resource Directed Measures (RDM) is that if the EIS is high or very high, the ecological management objective should be to improve the condition of the watercourse (Kleynhans & Louw, 2007). However, the causes related to a PES should also be considered to determine if improvement is realistic and attainable (Kleynhans & Louw, 2007). This relates to whether the problems in the catchment can be addressed and mitigated (Kleynhans & Louw, 2007). If the EIS is evaluated as moderate or low, the ecological aim should be to maintain the river in its PES (Kleynhans & Louw, 2007). Within the Ecological Reserve context, Ecological Categories A to D can be recommended as future states depending on the EIS and PES (Kleynhans & Louw, 2007). Ecological Categories E and F PES are regarded as ecologically unacceptable, and remediation is needed if possible (Kleynhans & Louw, 2007). A generic matrix for the determination of RECs for water resources is shown in Table 18, below.

Table 18. Generic matrix for the determination of REC for water resources.

			EIS			
			Very high	**High**	**Moderate**	**Low**
PES	**A**	**Pristine/Natural**	A Maintain	A Maintain	A Maintain	A Maintain
	B	**Largely Natural**	A Improve	A/B Improve	B Maintain	B Maintain
	C	**Good - Fair**	B Improve	B/C Improve	C Maintain	C Maintain
	D	**Poor**	C Improve	C/D Improve	D Maintain	D Maintain
	E/F	**Very Poor**	D Improve	E/F Improve	E/F Maintain	E/F Maintain

Based on the above matrix (Table 18), the regional management objective for all watercourses located downstream of the development site would be to 'maintain PES and functioning' (see Table 19 on the next page for the REC and RMO for all assessed wetlands and river units):

- Whilst the developer would not be solely required to achieve this objective (given that the wetland and Slang Spruit River is located beyond the development site and on Municipal-owned land), there is still a requirement to manage risks and impacts associated with stormwater runoff and water quality leaving the site to support the management of offsite wetlands and rivers.
- Any indirect negative impacts as a result of the proposed development activities would be undesirable from a water resource management perspective and therefore the management objective must be to ensure that the project impacts are mitigated such that the current supply of ecosystem services remains the same.

Table 19. REC and RMO for the wetland units based on their PES and EIS ratings.

Watercourse Units	PES	EIS	REC	RMO
R01: Slang Spruit River	D/E	Low	D	Maintain PES & functioning
W01: seep wetland	D	Low	D	

6. Recommended Mitigation Measures

This section outlines the mitigation measures recommended to avoid, reduce / minimise, and rehabilitate the freshwater ecosystem impacts discussed in **Section 7** that follows this section. This is in accordance with the 'mitigation hierarchy' approach to wetland ecological impact mitigation.

6.1. Project Planning and Design Measures

6.1.1. Site Layout Planning

The Mitigation Hierarchy:

The protection of water resources (wetlands & rivers/streams) begins with the avoidance of adverse impacts and where such avoidance is not feasible; to apply appropriate mitigation in the form of reactive practical actions that minimizes or reduces such impacts. Driver *et al.* (2011) recommend that the management of freshwater ecosystems should aim to prevent the

occurrence of large-scale damaging events as well as repeated, chronic, persistent, subtle events which can in the long-term be far more damaging.

'Impact Mitigation' is a broad term that covers all components involved in selecting and implementing measures to conserve biodiversity and prevent significant adverse impacts as a result of potentially harmful activities to natural ecosystems. The mitigation of negative impacts on freshwater ecosystems is a legal requirement for authorisation purposes and must take on different forms depending on the significance of impacts and the particulars of the target area being affected. This generally follows some form of 'mitigation hierarchy' (see Figure 8, below) which aims firstly at avoiding disturbance of ecosystems and loss of biodiversity, and where this cannot be avoided, to minimise, rehabilitate, and then finally offset any remaining significant residual impacts.

The mitigation hierarchy is inherently proactive, requiring the on-going and iterative consideration of alternatives in terms of project location, siting, scale, layout, technology and phasing until the proposed development can best be accommodated without incurring significant negative impacts to the receiving environment.

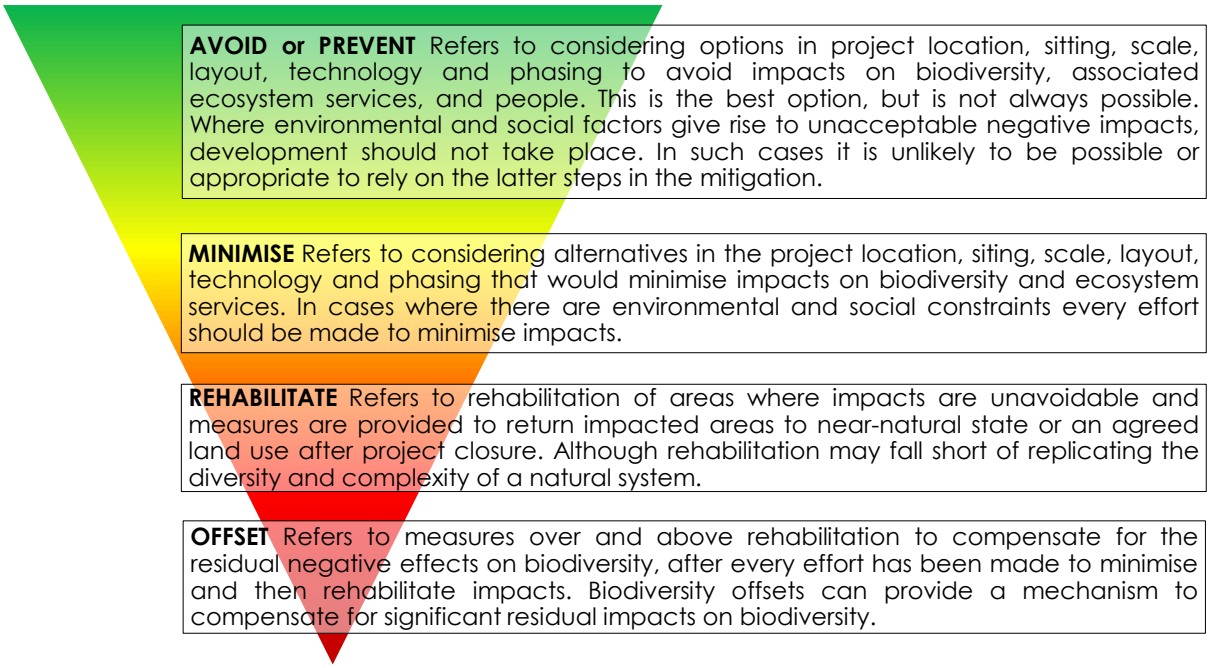

Figure 8. Diagram illustrating the 'mitigation hierarchy' (Eco-Pulse, 2019; DEA *et al*., 2013).

Site Layout Planning:

The mitigation hierarchy must be followed in the site layout plan design. To assist with guiding this process, following planning measures are listed in chronological order of investigation in line with the mitigation hierarchy:

Step 1: Avoidance:

- Ensure that all development stays outside of wetlands and the 15m buffer zone as recommended in Section 6.1.2.

Step 2: Minimisation:

- Implement best practice controls and mitigation measures during construction.
- Implement best practice storm water management design and operation.

Step 3: Remediation:

- Any accidental wetland encroachment and loss should be mitigated through onsite rehabilitation.

Step 4: Offset:

- Not applicable to this project (*direct impacts to wetlands are avoided*).

6.1.2. Aquatic Buffer Zones (Development 'Set-Backs')

'Buffer zones' (also termed development "set-backs") are essentially strips of vegetated undeveloped land typically designed to act as a protective barrier between human activities and sensitive habitats such as wetlands, rivers and forests. Research shows that buffer zones are useful at performing a wide range of functions such as sediment trapping and nutrient retention, and in doing so, play an important role in protecting water resources from the adverse impacts that are typically associated with various land-uses and developments. Although there are no legislative requirements regarding the establishment of buffers around water resources in the South African legislation, the application of buffers is aligned with the principles of the National Water Act (1998), which is to provide for the sustaining of water quality and preserving natural aquatic habitats and ecosystem functions.

According to the draft Guidelines for Biodiversity Impact Assessment in KZN (EKZNW, 2011), a standard buffer width of 30m from the outer edge of the delineated wetland areas in the Province of KZN, often irrespective of site conditions and development/land use type. The guideline document goes on to recommend that the determination of ecological buffers should rather be based on a number of site-specific factors. A national protocol for buffer determination around rivers, wetlands and estuaries has recently been developed (Macfarlane & Bredin, 2016) and represents emerging best-practice in aquatic buffer zone determination.

The national buffer zone determination tool for wetlands and rivers (Macfarlane & Bredin, 2016) was applied for the seep wetland (W01) and Slang Spruit River (R01) and used to allocate suitable buffers based on the generic risk levels associated with the proposed development type (refined at a site level). The "Mixed Commercial/Retail" land use/development type was used to inform operational risks/threats in the buffer model.

Based on the buffer model outputs, the following buffer zone widths have been recommended (see map in Figure 9 on the next page):

- **Wetland buffer width = 15m**
- **River buffer width = 20m**

Given that the development footprint boundary is positioned more than 40m from the delineated wetland edge and more than 200m from the edge of the Slang Spruit River, these buffers will easily be achieved. However, it is important that the following activities take cognisance of the buffer zones indicated on the map in Figure 9 and that these be located outside of the recommended buffers:

- Construction site camps;
- Materials storage and laydown areas;
- Construction vehicle parking and temporary access roads;
- Soil, vegetation and materials stockpiles;
- Any ancillary services such as telecommunications, sewer and water pipelines, etc.

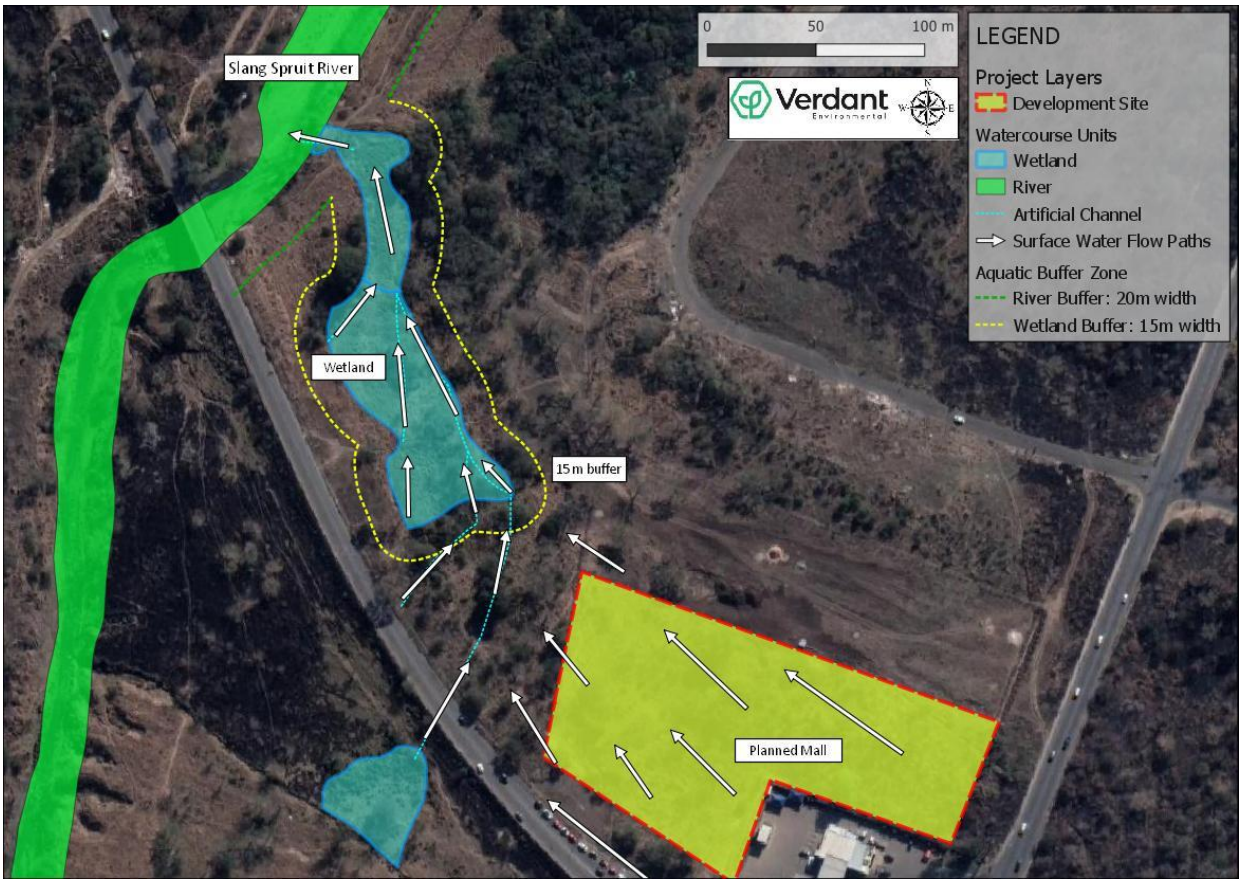

Figure 9. The location and extent of the recommended 15m wetland buffer zone and 20m river buffer.

6.1.3. Stormwater Management

When developing a stormwater management plan for the site, it will be critical that due consideration is given to the collection and treatment of stormwater prior to discharge into the natural environment. It is therefore recommended that the stormwater management plan be developed with appropriate ecological input and be developed based on Sustainable Drainage Systems (SUDS). The following best practice stormwater management design measures are recommended based on our understanding of the soils, geology and sensitivity of the site:

- Rainwater harvesting and storage should take place onsite and runoff from roofs should be collected in closed-top tanks or landscaped features for irrigation and non-potable purposes.

- Ideally, all stormwater runoff generated by the proposed development during all design storm events (1:1yr – 1:100yr) should be attenuated within the development footprint to pre-development levels prior to discharge to the freshwater environment. However, if such a system is unfeasible (to be confirmed by engineers), the attenuation should be designed to attenuate the 1:50yr storm event within the development footprint prior to discharge to the freshwater environment.
- Where within-footprint attenuation of storm events greater than 1:20yr is unfeasible for well substantiated reasons, a 'major system' should be incorporated into the design of the stormwater management system and development footprint. This system would need to address pollution risks and include attenuation structures to cater for flood storage not dealt with by the within-footprint ('minor') system.
- Where 100% attenuation onsite / within the development platform footprint is not feasible for well substantiated reasons, consideration would be given to the establishment of attenuation structures below the outlets (and within buffer zones) but not within the wetlands.
- Wherever possible, runoff infiltration onsite must be maximised. Recommended infiltration structures include underground storage tanks, bioretention areas and unlined detention basins, infiltration basins, and grassed swales.
- In terms of general stormwater conveyance, stormwater runoff generated by developed and hardened surfaces should be directed into, and conveyed by, open, impermeable[3] swales rather than into underground piped systems or concrete V-channels wherever feasible and practical. These features should be well vegetated with appropriate species and stabilised by means of gabion or concrete check walls to prevent erosion and vertical incision. This will provide for some filtration and removal of urban pollutants (e.g. oils and hydrocarbons), provide some attenuation by increasing the time runoff takes to reach low points, and reduce the energy of storm water flows within the stormwater system through increased roughness when compared with pipes and concrete V-drains.
- Many smaller stormwater outlets must be favoured over a few large outlets. This also applies to roads.
- All outlets must be designed to dissipate the energy of outgoing flows to levels that present a low erosion risk. In this regard, suitably designed energy dissipation (e.g. stilling basins) and erosion protection structures (Reno-mattresses) will need to be installed at appropriate locations. Pre- and post-discharge velocities at each outlet should be

[3] Feedback from civil engineers indicates that no infiltration will be allowed within/on the platform.

calculated to inform the appropriate design of the energy dissipation and erosion protection measures.

- All outlet erosion protection measures (e.g. Reno-mattresses) must be established to reflect the natural slope of the surface and located at the natural ground-level.
- If subsoil drains are required, the following outlet design recommendations should be adhered to:
    - Level spreaders must be installed at all subsoil drain outlets.
    - The level spreaders must be designed to accommodate the predicted flow velocities and, in this regard, the predicted flow velocities at each outlet must be calculated / estimated.
    - Alternatively, the outlets could feed into the infiltration channels.
    - Measures to capture solid waste and debris entrained in stormwater runoff must be incorporated into the design of the system and should include the use of either curb inlet/inlet drain grates and/or debris baskets/bags.
- All stormwater generated by any medium to high-risk contamination urban surfaces (internal roads, parking areas, washing areas, etc.) must receive basic filtering and treatment onsite prior to discharge into the freshwater environment. The higher the watercourse pollution risk, the more stringent the basic treatment methods. Furthermore, all treatment should occur within the development footprint. Recommended filtering interventions include: grit / oil separators and/or sand filter traps. These structures will require regular maintenance by the site owners / operators. In this regard, a 'first-flush' system should also be investigated.
- In order to function adequately, it is critically important that the onsite stormwater system be regularly maintained over time. Key maintenance will include litter and sediment clearing and the servicing and maintenance of key collection points like catch pits, filtering devices (e.g. grit / oil separators), detention tanks etc. Such maintenance should be the responsibility of the mall operator and budgeted for accordingly.

6.1.4. Sewerage and Water Infrastructure

It is assumed that flush toilet systems associated with the new mall development will simply tie into the existing Municipal waterborne sewage system that services the area and that the following will NOT be included in the development:

- Septic tanks or soakpits;
- Onsite sewer treatment plant; and

- New bulk sewage pipelines and pump stations.

Based on this assumption, the following mitigation is relevant:

- No sewer manholes or pump stations must be established within the delineated wetlands and 15m buffer zone.
- No pump stations may be located within 20m of the Slang Spruit River.
- For all other manholes that need to be established within the 15m wetland buffer zone, the following should be incorporated into the design:
    - All sewer manholes within 15m of any watercourses must be sufficiently sealed to ensure that surcharge events do not occur if there is a blockage.
    - For all sewer manholes within 30m but outside of 15m of any watercourse, permanent surcharge containment / emergency storage measures must be installed e.g. earthen bund, concrete box. In addition, these manholes should be raised by 1 metre to improve backup storage capacity if required.

6.1.5. Road Crossings

Not applicable: no road crossings through rivers or wetlands planned.

6.2. Construction Phase

The following mitigation measures must be implemented in conjunction with any generic measures provided in the Environmental Management Programme (EMPr).

6.2.1. Demarcation of 'No-Go' areas and construction corridors

- Prior to the commencement of any construction activities, the outer edge of the 15m buffer zone of the nearby wetlands must be staked out by a surveyor and demarcated using brightly coloured shade cloth.
- All areas within / inside the 15m buffer zone must be considered no-go areas for the entire construction phase. Any contractor found working within No-Go areas must be fined as per fining schedule/system setup for the project.
- The demarcation work must be signed off by the Environmental Control Officer (ECO) before any work commences.
- The demarcations are to remain until construction and rehabilitation is complete.

6.2.2. Method Statements for working in watercourses

Not applicable: no activities planned within delineated wetlands or rivers (which are all located well outside of the development footprint).

6.2.3. Runoff, erosion and sediment control

- Wherever possible, existing vegetation cover on the development site should be maintained during the construction phase. The unnecessary removal of groundcover from slopes must be prevented, especially on steep slopes which will not be developed.
- Clearing activities must only be undertaken during agreed working times and permitted weather conditions. If heavy rains are expected, clearing activities should be put on hold. In this regard, the contractor must be aware of weather forecasts.
- Sediment barriers (e.g.: silt fences/sandbags/hay bales) must be installed immediately downstream of active work areas (including soil stockpiles) as necessary to trap any excessive sediments generated during construction.
- All bare slopes and surfaces to be exposed to the elements during clearing and earthworks must be protected against erosion using rows of hay-bales, sandbags and/or silt fences aligned along the contours and spaced at regular intervals (e.g. every 2m) to break the energy of surface flows.
- Once shaped, all exposed/bare surfaces and embankments must be re-vegetated immediately.
- If re-vegetation of exposed surfaces cannot be established immediately due to phasing issues, temporary erosion and sediment control measures must be maintained until such a time that re-vegetation can commence.
- All temporary erosion and sediment control measures must be monitored for the duration of the construction phase and repaired immediately when damaged. All temporary erosion and sediment control structures must only be removed once vegetation cover has successfully recolonised the affected areas.
- After every rainfall event, the contractor must check the site for erosion damage and rehabilitate this damage immediately. Erosion rills and gullies must be filled-in with appropriate material and silt fences or fascine work must be established along the gulley for additional protection until vegetation has re-colonised the rehabilitated area.

- Regular maintenance of any sediment control dams must be undertaken during the construction / establishment period to ensure that these structures continue to function appropriately.

6.2.4. Hazardous substances / materials management

- The proper storage and handling of hazardous substances (e.g. fuel, oil, cement, etc.) needs to be administered.
- 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 the ingress and egress of stormwater.
- Drip trays should be utilised at all dispensing areas.
- No refuelling, servicing or chemical storage should occur within 30m of any watercourse.
- No vehicles transporting concrete, asphalt or any other bituminous product may be washed on site.
- Vehicle maintenance should not take place on site unless a specific bunded area is constructed for such a purpose.
- Hazardous storage and refuelling areas must be bunded prior to their use on site during the construction period following the appropriate SANS codes. The bund wall should be high enough to contain at least 110% of any stored volume. The surface of the bunded surface should be graded to the centre so that spillage may be collected and satisfactorily disposed of.
- All necessary equipment for dealing with spills of fuels/chemicals must be available at the site. Spills must be cleaned up immediately and contaminated soil/material disposed of appropriately at a registered site.
- 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.
- Spills must be cleaned up immediately and contaminated soil/material disposed of appropriately at a registered site.

6.2.5. Invasive Alien Plant control

- All alien invasive vegetation that colonise the construction site must be removed, preferably by uprooting. The contactor should consult the ECO regarding the method of removal.
- All bare surfaces across the construction site must be checked for IAPs every two weeks and IAPs removed by hand pulling/uprooting and adequately disposed.
- Herbicides should be utilised where hand pulling/uprooting is not possible. ONLY herbicides which have been certified safe for use in wetlands by independent testing authority are to be used. The ECO must be consulted in this regard. The herbicide contractor must be certified to apply/utilise the herbicide in question.

6.2.6. Noise, dust and light pollution minimisation

- Temporary noise pollution due to construction works should be minimized by ensuring the proper maintenance of equipment and vehicles and tuning of engines and mufflers as well as employing low noise equipment where possible.
- Water trucks will be required to suppress dust by spraying water on affected areas producing dust. This will likely be required daily in the drier months or during dry periods.
- No lights must be established within the construction area near the watercourses and buffer zones.

6.2.7. Prohibitions related to animals

- The handling and/or killing of any animal species present is strictly prohibited and all staff/personnel must be notified of such incidents.
- Wetland fauna (e.g. snakes, frogs, small mammals) that are encountered during the construction phase must be relocated to other parts of the wetland under the guidance of the EO or ECO.
- Poaching/snaring is strictly prohibited.

6.2.8. General rehabilitation guidelines

- 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.
- All land impacted by the proposed development must be rehabilitated by undertaking the following general tasks:
    - All foreign material must be removed from site.
    - Land must be regraded / re-shaped and topsoils must be reinstated.
    - Compacted soils must be adequately ripped/loosened where compacted, as informed by the ECO.
    - Re-vegetation should take place as follows:
        - For any permanently and seasonally saturated areas - via translocation / transplanting of resecured sods and, where there are not enough rescued sods, via the translocation / transplanting of sods from the surrounding wetland as advised a wetland ecologist.
        - For temporary and dryland areas - via hydroseeding using an appropriate indigenous seed mix as advised by a qualified ecologist.

6.2.9. Construction phase monitoring measures

- Compliance monitoring will be the responsibility of a suitably qualified/trained ECO (Environmental Control Officer) with any additional supporting EO's (Environmental Officers) having the required competency skills and experience to ensure that monitoring is undertaken effectively and appropriately.
- A photographic record of the state of the onsite wetlands prior to the commencement of clearing/construction must be kept for reference and rehabilitation monitoring purposes.
- The ECO must undertake bi-monthly compliance monitoring audits. Freshwater ecosystem aspects that must be monitored related to monitoring freshwater ecosystem impacts include:
    - The condition of the demarcation fence.
    - Evidence of any no-go area incursions.
    - The condition of the temporary runoff, erosion and sediment control measures and evidence of any failures.

  - Evidence of sedimentary deposits / plumes and elevated rates of sedimentation (i.e. vegetation smothering / burial).
  - Evidence of elevated river / stream turbidity levels.
  - Evidence of gully or bed/bank erosion.
  - Visual assessment of stormwater quality and instream water quality.
  - The condition of waste bins and the presence of litter within the working area.
  - Evidence of solid waste within the no-go areas.
  - Evidence of hazardous materials spills and soil contamination.
  - Presence of alien invasive and weedy vegetation within the working area.
  - Rehabilitation and re-vegetation methods and success.
- Once the construction and rehabilitation has been completed, the ECO should conduct a close out site audit 1 month after the completion of rehabilitation.

6.3. Operational Phase

6.3.1. Maintenance and management

- It is the applicant's responsibility to ensure the proper functioning of infrastructure that is likely to require regular on-going maintenance. This includes the stormwater management infrastructure, road infrastructure, water infrastructure and sewerage infrastructure.
- It is important that the location and extent of the wetlands in the vicinity of project activities be incorporated into all formal maintenance and repair plans for the project.
- In terms of management, alien invasive plant control must be practiced on an on-going basis in line with the requirements of Section 2(2) and Section 3 (2) the National Environmental Management: Biodiversity Act (NEM:BA), which obligates the landowner/developer to control IAPs on their property.

6.3.2. Monitoring

It will be important that long-term monitoring of the potential freshwater ecosystem impacts be undertaken to proactively to identity any environmental issues and impacts that may arise as a result of the operational phase of the project. The following key aspects should be monitored:

- Erosion and/or sedimentation in the onsite and downstream wetlands;
- Presence of alien invasive plants; and
- Water quality and evidence of pollution.

6.3.3. Remediation / Rehabilitation

Where appreciable direct vegetation/habitat impacts, water quality impacts (i.e. due to spills) or erosion/sedimentation impacts resulting from storm water releases to wetlands result, these must be reported immediately to the relevant environmental authorities, and an independent wetland specialist appointed to conduct a site inspection to assess the residual impacts and determine the need for any onsite remediation or rehabilitation requirements. Following this assessment, an implementable remediation and/or wetland rehabilitation plan may need to be compiled and implemented to the satisfaction of KZN EDTEA and DWS.

7. Impact and Risk Assessment

This section deals with the assessment of the construction and operational and phase impacts of the project on local freshwater ecosystems.

7.1. Activities and Impacts Assessed

The activities requiring assessment for this study and the associated potential impacts are summarised in Table 20, on the next page.

The impact descriptions and significance assessment has been based on the latest SDP (CCA Architects) as shown on the map in Figure 2 of this report.

7.2. Key Assumptions

The following assumptions apply to the impact assessment:

- The realistic good mitigation scenario assumes the following:

- All the planning and design measures recommended in Section 6.1 will be adhered to. If any of the recommended mitigation measures provided in Section 6.1 cannot be adhered to, the impact and risk assessments will need to be revised.
- The latest SDP (Site Development Plan) which avoids wetlands and buffer zones will be implemented to specification. Should there be any deviations from this plan, the impact signific assessment ratings could change appreciably.

Table 20. Summary of impacts assessed for each of the project activities.

Project Phasing & Activities	Impact Group	Impact Description	Potential to Mitigate Impact(s)
C1. Construction activities	**C1-1: Direct ecosystem destruction and modification impacts**	• Direct disturbance of riverine habitat and artificial wetlands onsite by clearing and trenching. • Accidental direct impacts to instream aquatic, riparian and/or wetland habitat and vegetation by heavy machinery during construction. • Degradation of wetland and river PES and loss of ecosystem services.	**AVOIDANCE:** Easily mitigatable by avoiding locating infrastructure within delineated rivers and wetlands and by implementing the aquatic buffer zone recommended.
	C1-2: Indirect hydrological and geomorphological impacts	• Erosion and/or sedimentation of instream aquatic, riparian and/or wetland ecosystems due to catchment and/or wetland / riparian zone soil and vegetation clearing and landcover disturbance during construction. • Fine, sandy/silty soils at the site will be relatively erodible if not properly managed, however, given the relatively gentle nature of the site, the risk of sediment mobilisation can be reduced with proper onsite management.	**AVOIDANCE & REDUCTION:** Moderately mitigatable by ensuring activities remain outside of the aquatic buffer zone and by administering practical measures onsite to avoid erosion/sedimentation.
	C1-3: Water quality impacts	• Pollution of rivers and wetland ecosystems on the site and possibly also downstream, due to the mishandling of hazardous substances and/or improper maintenance of machinery during construction (e.g. oil and diesel leaks and spills). • Any erosion leading to sedimentation of rivers and wetlands onsite/downstream could also lead to raised water turbidity and suspended solids concentrations, also affecting water quality.	**AVOIDANCE & REDUCTION:** Moderately mitigatable by ensuring activities remain outside of the recommended aquatic buffer zone and by administering practical measures onsite to avoid any spills or sedimentation impacts. **REMEDIATION & REHABILITATION:** Where spills or sedimentation impacts occur, these will need to be contained and any

Project Phasing & Activities	Impact Group	Impact Description	Potential to Mitigate Impact(s)
			affected water quality impact remediated, and the affected watercourses rehabilitated.
	C1-4: Fragmentation and ecological disturbance impacts	• Reduced wetland patch size and modified wetland/riverine ecological connectivity will not take place where impacts are restricted to outside of the wetland areas and recommended buffer zone. • Expanded / more intense edge impacts could occur as a result of buffer zone encroachment, deterioration in vegetation quality and cover and the potential for increased alien invasive plant invasion due to disturbance causing activities near to rivers and wetlands. • Noise pollution and vibrations associated with earthworks and the use of heavy machinery could affect local wildlife (birds, amphibians and small mammals especially). • Light pollution associated with construction crews and the use of heavy machinery use at night which could affect locally occurring nocturnal wetland species, such as amphibians, however this would only be significant during certain times of the year (i.e. the typical frog breeding season, for example). • Given that there are already existing facilities (operational buildings) in the vicinity of the property and a busy provincial road, existing noise and light impacts are already present and will therefore reduce the intensity of any further impacts which will be cumulative.	**AVOIDANCE & REDUCTION:** Moderately mitigatable by ensuring activities remain outside of the aquatic buffer zone and by administering practical measures onsite to reduce noise and light pollution. **REMEDIATION & REHABILITATION:** Edge impacts and alien plant infestation impacts can be quite easily remediated / rehabilitated should these occur.
O1: Operational activities	**O1-1: Direct ecosystem destruction and modification impacts**	• Accidental direct impacts to riverine, riparian and wetland habitat and wetland/buffer vegetation by heavy machinery during infrastructure repair and maintenance activities (particularly water and sewer pipelines and manholes for example).	**AVOIDANCE & REDUCTION:** Easily mitigatable by ensuring maintenance activities are closely monitored and supervised to ensure no accidental incursions into wetland areas.

Project Phasing & Activities	Impact Group	Impact Description	Potential to Mitigate Impact(s)
			REMEDIATION & REHABILITATION: Any accidental impacts can be potentially remediated / rehabilitated should these occur.
	O1-2: Indirect hydrological and geomorphological impacts	• Erosion and/or sedimentation of onsite wetlands and downstream rivers, with the main risk being as a result of catchment hardening, alteration of runoff and interflow patterns and stormwater management. • The fine sandy/silty soils at the site will be relatively erodible if not properly managed, however, given the relatively flat nature of the site, the risk of sediment mobilisation can be reduced with proper storm water management. • Controlled discharge of 'clean' storm water could have a potential positive impact on the seep wetlands, through enhanced saturation levels and increased levels of permanent wetness which could enhance habitat quality should this be considered desirable.	**REDUCTION:** Moderately mitigatable by ensuring storm water is appropriately managed according to an adequate storm management plan implemented to specification. **REMEDIATION & REHABILITATION:** Any indirect impacts to wetlands can be potentially remediated / rehabilitated should these occur.
	O1-3: Water quality impacts	• Potential accidental releases/spills from wastewater (sewer) pipelines and manholes through inadequate design, improper use of flush toilets (leading to blockages for example) or other unforeseen events (such as release of stormwater into sewer system, leading to potential overflow from manholes). • Any erosion leading to sedimentation of rivers and wetlands onsite/downstream could also lead to raised water turbidity and suspended solids concentrations, also affecting water quality. • Pollution of onsite and downstream rivers and onsite wetlands due to the mishandling of hazardous substances	**AVOIDANCE & REDUCTION:** Moderately mitigatable by ensuring sewer infrastructure is appropriately designed and sized, with adequate protection and by ensuring proper use of flush toilets. Also, by ensuring maintenance activities are closely monitored and supervised to ensure no

Project Phasing & Activities	Impact Group	Impact Description	Potential to Mitigate Impact(s)
		and/or improper maintenance of machinery during repair and maintenance activities (e.g. oil and diesel leaks).	accidental incursions into riverine and wetland areas. **REMEDIATION & REHABILITATION:** Where spills or sedimentation impacts do occur, these will need to be contained and any affected water quality impact remediated, and the affected watercourses rehabilitated.
	O1-4: Fragmentation and ecological disturbance impacts	• Expanded / more intense edge impacts could occur as a result of buffer zone encroachment, deterioration in vegetation quality and cover and the potential for increased alien invasive plant invasion due to disturbance causing activities taking place near to rivers and wetlands. • Noise and light pollution associated with the operational site could affect local wildlife and especially nocturnal wetland species, such as amphibians, however this would only be significant during certain times of the year (i.e. the typical frog breeding season, for example). • Given that there are already existing facilities (operational buildings) in the vicinity of the property and a busy provincial road, existing noise and light impacts are already present and will therefore reduce the intensity of any further impacts which will be cumulative.	**AVOIDANCE & REDUCTION:** Mitigating noise and light impacts will be difficult to enforce during the operation of the site, however lighting design to avoid casting light onto rivers/wetlands could be implemented. Edge impacts and alien plant infestation impacts can be quite easily controlled through maintenance activities within the aquatic buffer zone.

7.3. Impact Significance Assessment

The results of the wetland impact significance assessment for impacts to wetlands in the study area are summarised in Table 21, on the next page.

Construction phase impacts:

- During the construction phase, given that wetlands and rivers are located outside of the planned development footprint (>40 m away), the likelihood of direct impacts to wetland or riverine vegetation, habitat and biota is considered minimal.
- Indirect impacts such as the erosion/sedimentation and water quality impacts downslope of the development are considered to be of 'Moderately-Low' significance if poorly mitigated, given the potential erodibility of soils at the site.
- All impacts for the construction phase can be potentially reduced to appreciably 'Low' significance levels, where mitigated effectively and to all the specifications recommended in Chapter 6 of this report.

Operational phase impacts:

- Operational phase impacts are likely to be more significant where poorly mitigated, and this is linked primarily with the potential to properly manage storm water runoff from the operational site, given the erosion and sedimentation risks linked with increased hardened surfaces on the site.
- The significance ratings under a 'good' mitigation scenario can be reduced to a 'Moderately-Low' level, given the typical intensity and extent ratings for such impacts should they occur, regardless of the probability of occurrence.

Table 21. Summary of the wetland impact significance assessment under 'poor' and 'good' mitigation scenarios.

Phase	Impacts	Intensity	Extent	Duration	Probability	Significance
'Poor' Mitigation Scenario						
Construction	C1-1: Direct ecosystem destruction and modification impacts	Moderate	Site	Permanent	Possible	Low
	C1-2: Indirect hydrological and geomorphological impacts	Moderate	Local	Medium-term	Possible	Moderately-Low
	C1-3: Water quality impacts	Moderately-High	Local	Long-term	Possible	Moderately-Low
	C1-4: Fragmentation and ecological disturbance impacts	Moderate	Surrounding Area	Long-term	Possible	Low
Operation	O1-1: Direct ecosystem destruction and modification impacts	Moderate	Site	Permanent	Possible	Low
	O1-2: Indirect hydrological and geomorphological impacts	Moderately-High	Local	Permanent	Probable	Moderate
	O1-3: Water quality impacts	Moderately-High	Local	Long-term	Possible	Moderately-Low
	O1-4: Fragmentation and ecological disturbance impacts	Moderate	Surrounding Area	Long-term	Possible	Low
'Good' Mitigation Scenario						
Construction	C1-1: Direct ecosystem destruction and modification impacts	Moderate	Site	Permanent	Unlikely	Low
	C1-2: Indirect hydrological and geomorphological impacts	Moderate	Surrounding Area	Short-term	Unlikely	Low
	C1-3: Water quality impacts	Moderately-High	Surrounding Area	Short-term	Possible	Low
	C1-4: Fragmentation and ecological disturbance impacts	Moderate	Site	Long-term	Unlikely	Low
Operation	O1-1: Direct ecosystem destruction and modification impacts	Moderate	Site	Permanent	Unlikely	Low
	O1-2: Indirect hydrological and geomorphological impacts	Moderately-High	Local	Permanent	Possible	Moderately-Low
	O1-3: Water quality impacts	Moderately-High	Local	Long-term	Unlikely	Moderately-Low
	O1-4: Fragmentation and ecological disturbance impacts	Moderate	Surrounding Area	Long-term	Unlikely	Low

7.4. DWS Risk Matrix Assessment

It is our understanding that the purpose of the risk matrix tool developed by the DWS is to give a preliminary indication of the likely impact / degree of change (consequence) of activities (water uses) to local and regional water resource quality. For the purposes of this study, the degree of change is reflected in PES change and/or the change in the supply of regulating ecosystem services associated with wetlands onsite and/or downstream of activities.

The results of the risk assessment for impacts to freshwater ecosystems are shown in Table 22, on the page that follows:

- Construction risks are likely to be of 'Low' significance as there is likely to be a limited probability and low degree of change to the PES and functioning of the wetlands and rivers (located offsite and downstream) if the recommended risk and impact mitigation measures are effectively implemented.
- Operational risks associated with the management of storm water runoff and water quality linked to storm water and wastewater management can be considered 'Moderate' but can be reduced to 'Low' levels also, with appropriate risk and impact mitigation applied.

Given the low risk level overall, **the project could potentially be authorised under a General Authorisation (GA)** in terms of Section 21 c & i[4] water uses, given also that other water uses (such as Section 21 a, b, g, f and k) will not be associated with the development project. This would however require further consultation with the DWS (Department of Water & Sanitation) to confirm this.

[4] NWA Water Uses:

Section 21 a: taking water from a water resource (not applicable to this development application)

Section 21 b: storing water (not applicable to this development application)

Section 21 c: impeding or diverting the flow of water in a watercourse (applicable)

Section 21 i: altering the bed, banks, course or characteristics of a watercourse (applicable)

Section 21 f: discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit (not applicable to this development application)

Section 21 g: disposing of waste in a manner which may detrimentally impact on a water resource (not applicable to this development application)

Section 21 k: using water for recreational purposes (not applicable to this development application)

Table 22. Summary of the DWS 'Risk Assessment Matrix' results under a 'good' mitigation scenario.

Activity	Aspects	Impact	Risk Rating	Borderline LOW / MODERATE Rating Classes
CONSTRUCTION PHASE (C1): Establishment(construction) of all onsite infrastructure, including buildings, roads, parking, storm water and sewer infrastructure	Bulk earthworks, clearing of vegetation, platforming, construction of roads, buildings, trenching for services and water reticulation / sewer pipeline installation	C1-1: Direct ecosystem destruction and modification impacts	**Low**	
	Exposure of bare, sandy soils to the elements, following vegetation clearing and bulk earthworks, excavation of trenches to install pipelines and services	C1-2: Indirect hydrological and geomorphological impacts	**Low**	
	Management of fuels/chemicals, potential spills from vehicles, equipment and containers	C1-3: Water quality impacts	**Low**	
	Bulk earthworks, clearing and disturbance of vegetation and human activities in the vicinity of wetland habitats	C1-4: Fragmentation and ecological disturbance impacts	**Low**	
OPERATIONAL PHASE (O1): Operation of all established residential, recreational and administration facilities, including associated stormwater management and access road infrastructure	Maintenance of storm water and pipeline infrastructure	O1-1: Direct ecosystem destruction and modification impacts	**Low**	
	Storm water management: controlled discharge of 'clean' storm water to wetlands	O1-2: Indirect hydrological and geomorphological impacts	**Moderate**	**Low**
	Storm water management: controlled discharge of 'clean' storm water to wetlands, potential for accidental spills of raw sewage	O1-3: Water quality impacts	**Moderate**	**Low**
	Maintenance of storm water and pipeline infrastructure	O1-4: Impacts to ecological connectivity and/or ecological disturbance impacts	**Low**	

8. License and Permit Requirements

8.1. Environmental Authorisation Requirements

From a purely water resources (wetlands and rivers) perspective, there are no listed activities in terms of the NEMA: Environmental Impact Assessment (EIA) Regulations (of 2014, as amended) associated with the development, due to wetlands and rivers being located outside of the development footprint and no activities are anticipated that will directly impact the identified wetlands and the Slang Spruit River.

There may however be other listed activities from a terrestrial vegetation and biodiversity perspective that could be associated with the development, including the clearance of natural indigenous vegetation for example, that need to be investigated. These have not been identified at this stage as further investigations into the terrestrial habitat and vegetation found on the development site will be required to inform the identification of listed activities and EIA requirements from a terrestrial vegetation and biodiversity perspective.

8.2. Water Use License Requirements

Given that the development is located within 500m of a wetland and there is a risk that the development could indirectly impact on the downslope wetland, this requires the applicant apply for a water use license (WUL) through the Department of Water & Sanitation (DWS) in Durban, for the following water uses in terms of Chapter 4 and Section 21 of the National Water Act No. 36 of 1998:

- Section 21 (c): impeding or diverting the flow of water in a watercourse; and
- Section 21 (i): altering the bed, banks, course or characteristics of a watercourse.

Wetlands:

The nearest wetland is within 50m of the site and is included in the Regulated Area for Section 21 (c) and (i) water uses, as this pertains to wetlands (i.e. a wetlands has been identified within a distance of 500m of the development site). Despite there being no wetlands within the

development footprint, given that there is a risk of indirect impact to the downslope wetland (mostly linked to the management of storm water during site operation), the applicant will need to approach the DWS to enquire as to the water use licensing requirements. Given that risk has been shown to be 'Low' through the application of the DWS Risk Assessment Matrix (*refer specifically to Section 7.4 of the report*), it is likely that the project can avoid having to apply for a full license and can apply for a GA (General Authorisation) in terms of wetland Section 21 (c) and (i) water use.

This will however need to be confirmed during a meeting with the DWS as part of the water use license enquiry required.

Rivers:

The Regulated Area for rivers and streams in terms of Section 21 (c) and (i) water use is 100m from the watercourse, and since the nearest river (Slang Spruit River) downstream of the development site is situated more than 200m from the development boundary, Section 21 (c) and (i) water use, in theory, need not be relevant to the project from a river perspective. It is however recommended that this be confirmed during a meeting with the DWS as part of the water use license enquiry required.

9. Assumptions and Limitations

The following limitations and assumptions apply to this assessment:

- Although all watercourses occurring within 500m of the proposed activities were mapped at a desktop level, field investigations were confined to only those rivers and wetlands where an appreciable 'risk of potential impact' was determined.
- The mapping and classification of the watercourse units outside of the study area but occurring within a 500m radius of activities should be considered preliminary and coarse in resolution. These units were not verified in the field.
- Sampling by its nature means that not all parts of the study area were visited. The assessment findings are thus only applicable to those areas sampled, which were extrapolated to the rest of the study area.

- A Soil Munsell Colour Chart was used to determine the soil matrix colour of the soil sampled. However, it is important to note that the recording of the colours using the soil chart is highly subjective and varies significantly depending on soil moisture and the prevailing light conditions. In this case, all the soils sampled were dry and sampling was undertaken in sunny conditions.
- Soil wetness indicators (i.e. soil mottles, grey soil matrix), which in practice are primary indicators of hydromorphic soils, are not seasonally dependent (wetness indicators are retained in the soil for many years) and therefore seasonality has no influence on the delineation of wetland areas.
- All vegetation information recorded was based on the onsite visual observations of the author and no formal vegetation sampling was undertaken. Furthermore, only dominant and noteworthy plant species were recorded. Thus, the vegetation information provided has limitations for true botanical applications.
- Although every effort was made to correctly identify the plant species encountered onsite, wetland plants, particularly the Cyperaceae (sedge) family, are notoriously difficult to identify to species level. Every effort as made to accurately identify plants species but where identification to species level could not be determined, such species were only identified to genus level.
- Seasonality can also influence the species of flora encountered at the site, with the flowering time of many species often posing a challenge in species identification. Since the wetland vegetation in the study area was found to be largely secondary/degraded with low native plant diversity, seasonality would not be as significant a limitation when compared with a vegetation community that is largely natural or high in native plant diversity.
- The assessment of impacts is predictive and was based on the information and site development provided by the client. The 'realistic good mitigation scenario' impact significance ratings and assessment outcomes assumes that all the mitigation measures recommended in Section 6 will be adhered to.

10. Conclusion

The combined wetland and aquatic ecological assessment identified the following watercourses downstream of the planned Mageza Mall development:

- a **seep wetland unit (W01)** located approximately 45m to the west of the development site; and
- the perennial **Slang Spruit River (R01)** located more than 200m west of the site.

Whilst none of the identified watercourses are not located on the development site and will therefore not be directly affected by the development, due to their location downslope there is the **potential risk that these water resources could be indirectly impacted**.

A suite of planning and design recommendations have been provided to assist in the formulation of a sustainable development plan and concept, as well as ensure that the environmental planning process unfolds according to the internationally accepted mitigation hierarchy. Most importantly, indirect impacts associated with site management during construction and the risk of erosion and sedimentation of downstream watercourses during operation (linked to storm water management mainly) need to be appropriately managed. Where the mitigation measures discussed in Section 6 are appropriately implemented, **impacts can potentially be reduced to relatively 'Low' significance levels**.

Likewise, risk can also be potentially mitigated to 'Low' levels and the project could potentially be authorised under a General Authorisation (GA) in terms of Section 21 c & i water uses, given also that other water uses (such as Section 21 a, b, g, f and k) will not be associated with the development project. **It is therefore recommended that an application for a General Authorisation (GA) in terms of Section 21 c & i water uses** should be pursued, subject to further consultation with the DWS (Department of Water & Sanitation) to confirm this.

From a purely water resources (wetlands and rivers) perspective, there are no listed activities in terms of the NEMA: Environmental Impact Assessment (EIA) Regulations (of 2014, as amended) associated with the development, due to wetlands and rivers being located outside of the development footprint and no activities are anticipated that will directly impact the identified

wetlands and the Slang Spruit River. *Note that other listed activities from a terrestrial vegetation and biodiversity perspective could be associated with the development and these need to be investigated further.*

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Annexure A – Impact Assessment Method

For the purposes of this assessment, the assessment of potential impacts was undertaken using the "Impact Assessment Methodology for EIAs" designed by Eco-Pulse Consulting (2020).

The assessment of impact significance is based on the basic risk formula: **Risk = consequence x probability**. However, the calculation of consequence has been modified to assess significance rather than risk. The basic significance formula utilised is:

Impact significance = impact consequence x impact probability, where
Impact consequence = (impact intensity + impact extent) x impact duration

In order to improve the repeatability of the system, concise descriptions have been developed to assist the user in rating extent and intensity criteria (Table A1). These have been specifically tailored for each of the four ultimate consequences considered as part of the significance assessment. An overall statement of impact significance is then obtained by qualitatively assessing the cumulative effect of all impacts on each aspect of the water resource being assessed.

Table A1. Criteria and numerical values for rating environmental impacts to freshwater ecosystems.

Score	Rating	Description
Extent (E) – relates to the expected extent of the impact in spatial and population terms		
10	**National**	***The effects of an impact are experienced over a very large geographic area. Given the extent of impacts, they are likely to be relevant at a national scale.*** ***Water resource management:*** • Water resources are affected across a very extensive geographic area (e.g. spanning a number of water management areas / crossing international boundaries); and / or • Indirect impacts continue to affect water resources far from the development site (e.g. impacts continue to be experienced > 100km downstream). ***Ecosystem conservation:***

Score	Rating	Description
		• The extent of direct impacts results in extensive impacts to water resources relative to the remaining extent (e.g. affecting >100ha wetlands / >10km watercourses); and / or • The extent of direct impacts is high relative to the extent of affected habitat types (e.g. affecting >10% of a remaining ecosystem type); and / or • The proposed development affects large areas (e.g. > 1000 ha) across a broad geographic area and affecting a range of terrestrial habitat types. ***Species conservation:*** • Impacts affect a large proportion of the population of an important species at a national level (e.g. >10% of species population affected); and / or • The proposed development will affect a wide range of important species populations across a very large geographic area. ***Direct use values***: • Impacts will affect a society at a national scale (e.g. large number of stakeholders across multiple district municipalities / provinces).
8	**Regional**	***The effects of an impact are experienced over a large geographic area. Given the extent of impacts, they are likely to be relevant at a regional scale.*** ***Water resource management:*** • Water resources are affected across a broad geographic area (e.g. extending across a large number of quaternary catchments); and / or • Indirect impacts continue to affect water resources a considerable distance from the development site (e.g. 10 - 100km downstream). ***Ecosystem conservation:*** • The extent of direct impacts results in large-scale impacts to water resources relative to the remaining extent, (10-100ha wetlands / 2-10km watercourses); and / or • The extent of direct impacts is notable relative to the extent of affected habitat types (e.g. affecting 1 - 10% of a remaining ecosystem type); and / or • The proposed development affects *a large area (100 – 1000ha) and typically extends across a range of terrestrial habitat types*. ***Species conservation:*** • Impacts affect a large proportion of the population of an important species at a regional level (e.g. 1 - 10% of species population affected); and / or • The proposed development will affect a wide range of important species populations across a large geographic area. ***Direct use values:*** • Impacts will affect a society at a regional scale (e.g. large number of communities and stakeholders across a number of local municipalities).
5	**Local**	***The effects of an impact are experienced over a limited geographic area. Given the extent of impacts, they are likely to be relevant at a local scale.*** ***Water resource management:*** • Water resources are affected within a localised geographic area (e.g. single quaternary catchment); and / or • Indirect impacts continue to affect water resources some distance from the development site (e.g. 1 - 10km downstream).

Score	Rating	Description
		Ecosystem conservation: • The extent of direct impacts results in localised impacts to water resources relative to the remaining extent, (1 - <10ha wetlands / 200m - <2km watercourses); and / or • The extent of direct impacts is limited relative to the extent of affected habitat types (e.g. affecting <1% of a remaining ecosystem type); and / or • The proposed development affects *a moderately large area (10 – 100ha) but may extend across a wide range of terrestrial habitat types.* ***Species conservation:*** • Impacts affect species populations that are important at a local scale (e.g. < 1% of population affected); and / or • The proposed development will affect a number of important species across a local geographic area. ***Societal impacts***: • Impacts will affect society at a local scale (e.g. a number of communities across a single local municipality).
2	**Surrounding Area**	***The effects of an impact are experienced over a very small area. Given the extent of impacts, they are likely to be relevant at a very localised scale.*** ***Water resource management:*** • Water resources are affected within a small geographic area (e.g. single quinery catchment); and / or • Indirect impacts affect water resources a limited distance downstream of the development site (e.g. <1km downstream). ***Ecosystem conservation:*** • Direct impacts affects a small area proportion of water resources (e.g. 0.1-1ha wetlands / 20 – <200m watercourses); and / or • The proposed development affects a small localised area (1 – 10ha) and is often confined to a very few terrestrial habitat types. ***Species conservation:*** • Impacts affect populations of important species beyond the site level; ***Direct use values:*** • Impacts will affect society at a very local scale (e.g. a number of households within a single community).
0.5	**Site**	***The effects of an impact are confined to a very small footprint. Given the extent of impacts, they are likely to be relevant at a site scale.*** ***Water resource management:*** • Impacts are largely confined to the development footprint with limited downstream impact (<100m downstream effect).

Score	Rating	Description
		Ecosystem conservation: • Direct impacts are typically confined to a single water resource or few water resources within a small focal area (typically <0.1ha wetlands / 20m watercourses); and / or • The proposed development affects a small area (<1ha) and is typically confined to very few terrestrial habitat types. ***Species conservation:*** • Impacts are very localised and are unlikely to affect important species beyond the site level; ***Direct use values:*** • Impacts will affect society at a very local scale (single or few households within a single local community)
Intensity (I) – defines the severity and importance of the impact to water resources / habitats / species or human populations within defined impact extent		
10	**High**	***Water resource management:*** • Loss of regulating and supporting services critical to support effective water resource management (as defined by management objectives / sustainability thresholds / RQOs); and / or • Loss will compromise the ability to meet water resource management objectives. ***Ecosystem conservation:*** • Loss of largely intact critically endangered habitat; and / or • Loss of habitat associated with validated FEPA Rivers & wetlands; and / or • Loss of particularly unique / especially important special habitat features. ***Species conservation:*** • Loss of or seriously compromises persistence of viable populations of critically endangered species; and / or • Loss of or seriously compromises viable landscape-level corridors and longitudinal connectivity (e.g. dams on free-flowing rivers) ***Direct use values:*** • Loss of human life; and / or • Marked deterioration in human health; and / or • Loss of ecosystem services that are critical to support / protect livelihoods of dependant vulnerable communities; and / or
7	**Moderately-High**	***Water resource management:*** • Loss of regulating and supporting services important to support effective water resource management (as defined by management objectives / sustainability thresholds / RQOs) ; and / or • Loss is very likely to compromise the ability to meet water resource management objectives. ***Ecosystem conservation:*** • Serious modification (2 or more classes) of critically endangered habitat; and / or • Loss of largely intact endangered habitat types; and / or • Loss of moderately modified critically endangered habitat types (and with reasonable rehabilitation potential) ; and / or

Score	Rating	Description
		• Loss of habitat that has special habitat attributes (e.g. high habitat diversity / species richness). ***Species conservation:*** • Loss of or seriously compromises persistence of viable populations of endangered species; and / or • Loss of regionally important species populations (e.g. at municipal scale). ***Direct use values:*** • Loss of human livelihoods; and / or • Some deterioration in human health; and / or • Loss of ecosystem services that are important (highly valued but not critical to) supporting / protecting vulnerable communities. Alternative options / resources are not available to meet community needs without incurring significant costs.
4	**Moderate**	***Water resource management:*** • Loss of regulating and supporting services important to support effective water resource management (as defined by management objectives / sustainability thresholds / RQOs); and / or • Loss could compromise the ability to meet water resource management objectives. ***Ecosystem conservation:*** • Moderate modification (1 classes) of critically endangered habitat / serious modification (2 classes) of endangered habitat; and / or • Loss of largely intact vulnerable habitat types; and / or • Loss of moderately modified endangered habitat types (and with reasonable rehabilitation potential). ***Species conservation:*** • Loss of or seriously compromises persistence of viable populations of vulnerable / endemic / specially protected species; and / or • Loss of or seriously compromises viable corridors that are locally important for species movement. ***Direct use values:*** • Notable impact on human livelihoods; and / or • Moderate reduction in the availability of ecosystem services that are important for supporting / protecting vulnerable communities; and / or • Loss of ecosystem services that are moderately valued by local communities. Alternative options / resources are available but limited.
2	**Moderately-Low**	***Water resource management:*** • Loss of regulating and supporting services which are not particularly important for water resource management (as defined by management objectives / sustainability thresholds / RQOs); and / or • Loss is unlikely to compromise the ability to meet water resource management objectives. ***Ecosystem conservation:*** • Moderate modification (1 classes) of endangered habitat / serious modification (2 classes) of vulnerable habitat; and / or • Loss of largely intact least-threatened habitat types; and / or

Score	Rating	Description
		• Loss of moderately modified vulnerable habitat types (and with reasonable rehabilitation potential). ***Species conservation:*** • Reduction in populations of vulnerable / endemic / specially protected species (without compromising viability of locally occurring populations); and / or • Loss of populations of locally important species. ***Direct use values:*** • Limited but identifiable impact on human livelihoods; and / or • Moderate reduction in the availability of ecosystem services with a noticeable but limited impact to livelihoods.
0	**Low**	***Water resource management:*** • Loss of regulating and supporting services which are not particularly important for water resource management (as defined by management objectives / sustainability thresholds / RQOs); and / or • Loss will not compromise the ability to meet water resource management objectives. ***Ecosystem conservation:*** • Loss of highly degraded threatened vegetation types (and with low rehabilitation potential) ; and / or • Moderate modification (1 classes) of vulnerable habitat; and / or • Loss of moderately modified least threatened habitat types. ***Species conservation:*** • Limited impact to any locally important species populations. ***Direct use values:*** • None / very limited impact on human livelihoods; and / or • None / limited reduction in the availability of ecosystem services with very limited impact to livelihoods.
Duration (D) – relates to the duration of the impact in time (consideration should be given to reversibility which may reduce the duration of impact)		
1	**Permanent**	The impact will continue indefinitely (>30 years) and is essentially regarded as irreversible.
0.95	**Long-term**	The impact and its effects will continue over the long-term (10 - 30 years).
0.85	**Medium-term**	The impact and its effects will persist for a number of years (1 – 10).
0.75	**Short-term**	The impact and its effects will persist for a number of months after the impact has occurred (2 -12 months) but is unlikely to persist for more than a year.
0.5	**Immediate**	The impact and its effects will cease within days or weeks after the impact has occurred (0 – 2 months).
Probability (P) – relates to the expected likelihood and frequency of the impact causing event occurring		

Score	Rating	Description
1	**Definite**	More than 80% likelihood of occurrence. The impact is typically recorded under similar conditions and settings.
0.95	**Highly Probable**	The impact has a 50-80% chance of occurring and thus expected to occur. The impact is known to occur regularly in similar conditions and settings.
0.8	**Probable**	The impact has a 20-50% chance of occurring and thus is quite likely to occur. The impact is known to occur quite frequently in similar conditions and settings (less than once in 10 years).
0.6	**Possible**	The impact has a 5-20% chance of occurring. This impact could occur and is known to occur irregularly under the similar conditions and settings (less than once in 20 years).
0.4	**Unlikely**	The possibility of the impact occurring is low with less than 5% chance of occurring. The impact has little chance of materialising (less than once in 50 years).

Table A2. Impact significance categories and definitions.

Impact Significance	Impact Significance Score Range	Definition
High	**14.5 - 20**	**Totally unacceptable** and fatally flawed from an environmental perspective. The proposed activity should only be approved under very special circumstances (i.e. national priorities with large societal benefit). If authorised, residual impacts must be adequately compensated through appropriate offset mechanisms.
Moderately High	**12 – 14.4**	**Generally unacceptable** and should ideally be avoided. The potential impact will affect a decision regarding the proposed activity and require that the need and desirability for the project be clearly substantiated to justify the associated ecological risks. If authorised, residual impacts must be adequately compensated through appropriate offset mechanisms
Moderate	**8.5 – 11.9**	**Potentially unacceptable** and should ideally be reduced to lower significance levels. The potential impact should influence the decision regarding the proposed activity and requires a clear and substantiated need and desirability for the project to justify the risks. If authorised, offsets should be considered to compensate for residual impacts.
Moderately Low	**4.5 - 8.4**	**Acceptable** with low to moderate risks. The potential impact may not have any meaningful influence on the decision regarding the proposed activity.
Low	**0 – 4.4**	**Acceptable**. The potential impact is very small or insignificant and should not have any meaningful influence on the decision regarding the proposed activity.

Annexure B – Risk Assessment Table (complete)

Table A3. DWS Risk Assessment Matrix (complete table).

Project Name	Mageza Mall Development Project
Description	Aquatic risk assessment using the DWS 'Risk Assessment Matrix' (RAM)
Date	17-11-2021
Name	Adam Teixeira-Leite, *MSc*
Professional Registration	Pr.Sci.Nat. (Ecological Science & Environmental Science)
SACNASP Registration No.	400332/13

			Severity																	
Activity	**Aspects**	**Impact**	**Flow Regime**	**Physico & chemical (water Quality)**	**Habitat (Geomogh & Vegetation)**	**Biota**	Severity	**Spatial Scale**	**Duration**	**Consequence**	**Frequency of Activity**	**Frequency of Impact**	**Legal Issues**	**Detection**	**Likelihood**	**Significance**	**Risk Rating**	**Confidence Level**	**Revised Risk Rating**	**Borderline LOW / MODERATE Rating Classes**
CONSTRUCTION PHASE (C1) Establishment(construction) of all onsite infrastructure, including buildings, roads, parking, storm	Bulk earthworks, clearing of vegetation, platforming, construction of roads, buildings, trenching for services and water reticulation / sewer pipeline installation	C1-1: Direct ecosystem destruction and modification impacts	1	1	3	2	1,75	1	2	4,75	1	1	5	1	8	38	Low	80%		
	Exposure of bare, sandy soils to the elements, following vegetation clearing and bulk earthworks, excavation of trenches to install pipelines and services	C1-2: Indirect hydrological and geomorphological impacts	3	2	3	1	2,25	1	2	5,25	1	2	5	1	9	47,25	Low	70%		

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Activity	Aspects	Impact	Severity																	
			Flow Regime	Physico & chemical (water Quality)	Habitat (Geomogh & Vegetation)	Biota	Severity	Spatial Scale	Duration	Consequence	Frequency of Activity	Frequency of Impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Confidence Level	Revised Risk Rating	Borderline LOW / MODERATE Rating Classes
	Management of fuels/chemicals, potential spills from vehicles, equipment and containers	C1-3: Water quality impacts	1	4	1	2	2	2	2	6	1	1	5	2	9	54	Low	80%		
	Bulk earthworks, clearing and disturbance of vegetation and human activities in the vicinity of wetland habitats	C1-4: Fragmentation and ecological disturbance impacts	1	1	3	3	2	1	1	4	1	1	5	2	9	36	Low	70%		
OPERATIONAL PHASE (O1) Operation of all established residential, recreational and administration facilities, including associated stormwater management and access road infrastructure	Maintenance of storm water and pipeline infrastructure	O1-1: Direct ecosystem destruction and modification impacts	1	1	3	2	1,75	1	2	4,75	1	1	5	1	8	38	Low	80%		
	Storm water management: controlled discharge of 'clean' storm water to wetlands	O1-2: Indirect hydrological and geomorphological impacts	3	1	2	1	1,75	2	2	5,75	2	2	5	2	11	63,25	Moderate	70%	46	Low
	Storm water management: controlled discharge of 'clean' storm water to wetlands, potential for accidental spills of raw sewage	O1-3: Water quality impacts	1	3	1	2	1,75	2	2	5,75	2	2	5	3	12	69	Moderate	60%	46	Low
	Maintenance of storm water and pipeline infrastructure	O1-4: Impacts to ecological connectivity and/or ecological disturbance impacts	1	1	2	2	1,5	1	1	3,5	1	1	5	1	8	28	Low	70%		

Thank you. If you have any questions, please contact us via the contact details below.

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