WETLAND DELINEATION & FUNCTIONAL ASSESSMENT

Wetland Delineation & Functional Assessment for the Proposed Formalisation and Proclamation of 2000 sites at Saselamani CBD, Collins Chabane Local and Vhembe District Municipalities, Limpopo

A Project for KV Development Group

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triplo4 sustainable solutions

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EXECUTIVE SUMMARY

Triplo4 Sustainable Solutions (hereafter referred to as Triplo4) was appointed by Mr. Samuel Chauke (on behalf of KV Development Group) to conduct a Wetland Delineation and Functional Assessment (WDFA) for the proposed Formalisation and Proclamation of 2000 site at Saselamani CBD, hereafter known as the proposed development, within the suburb of Saselamani, Collins Chabane Local and Vhembe District Municipalities, Limpop.

The purpose of this Wetland Delineation and Functional Assessment (WD&FA) was to identify sensitivities on site in order to determine the developable land and associated environmental legal requirements. The report provides input to the Water Use License Application (WULA) and Basic Assessment (BA) or full EIA, should it be required, by identifying, classifying and presenting infield delineations of the watercourses within the 500 metre (m) assessment radius of the proposed development. Additionally, the specialist will present and provide quantitative data to justify his recommendations associated with the proposed development.

The proposed development was observed to fall within the Shingwedzi sub-Water Management Areas (WMA), which is situated within the greater Luvuhu and Letuba WMA, within Quaternary Catchment B90B. No Freshwater Ecosystem Priority Areas (FEPA) rivers or wetlands were identified to be at risk as a result of the proposed development, as the closest FEPA wetland is approximately 1.8km away (Nel *et al*., 2011). One vegetation unit was identified within the proposed development site namely; Makuleke Sandy Bushveld which was classified as vulnerable.

Delineated watercourses and watercourses at risk

A total of six riverine systems were delineated as A channel streams (see section 3.2 for explanation of classification of riverine systems). During the initial risk assessment screening, it was determined that Rip01 – Rip06 were all at a **high risk** as a result of the proposed development. Features which calculated a high risk in the initial risk assessment were assessed further using the appropriate assessment tools/methods. The following Table EX1 present the at-risk riverine systems and the Present Ecological State (PES) scores that were calculated for each. The PES of all the at-risk riverine systems were calculated utilising the IHI tool (Kleynhans, 1998, adapted by DWAF, 2008). It must be noted that due to these systems being classified as A channel streams, these systems do not have riparian zones.

Table EX1: Assessed at-risk wetland systems associated with the proposed development

IHI SCORES			
WATERCOURSE	INSTREAM	RIPARIAN	OVERALL
Rip01	54 (D)	N/A	54 (D)
Rip02	60 (C/D)	N/A	60 (C/D)
Rip03	41 (D)	N/A	41 (D)
Rip04	67 (C)	N/A	67 (C)
Rip05	37 (E)	N/A	37 (E)
Rip06	42 (D)	N/A	42 (D)

Riverine Systems Functional Importance

The Ecosystem Services (ESS) supplied by the riverine system includes the binding action of riverine plant roots on the soil which reduces erosion of the stream bed and banks during flooding (Naiman and Decamps, 1997). Furthermore, the riverine system contributes to the aesthetic quality of the overall landscape of the area, certain fauna may utilise the riverine zone during parts of their life cycles, allowing an important corridor for the movement of animals and for the dispersal of plants (Naiman and Decamps, 1997).

Ecological Importance and Sensitivity (EIS)

The EIS of the assessed watercourses were calculated utilising the EIS Tools developed by Rountree *et. al.* (2013) and Kleynhans (1999), respectively. The overall EIS scores calculated for all riverine systems were 0.5, which corresponds to a low EIS.

Impact Statement

The watercourses that have been delineated within the study area have undergone moderate to moderately high disturbance from historic and current land use practices. This has resulted in the overall integrity of the assessed watercourses scoring an average PES D (largely modified). The DWS Risk Assessment Matrix concluded that certain aspects of the proposed development did not have the ability to be mitigated from a moderate to low risk rating. Thus, in line with GN509 of 26 August 2016, which was drafted in accordance with the NWA (No. 36 of 1998), as well as the specialist's opinion, the proposed development will require to undergo **a full WULA process in the form of an IWWMP.**

Specialist's Recommendation

The specialist further recommends that all construction activities of the proposed development can occur but must take into cognizance the surrounding watercourses and their associated buffers (18m for constructional and operational) in which no construction activities should occur. Furthermore, the mitigation measures outlined in this report are to be included in the EMPr and must be followed.

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GLOSSARY OF TERMS

Auger
An auger is a drilling device that usually includes a rotating screw to act as a screw conveyor to remove the drilled out material such as soils. The rotation of the blade causes the material to move out of the hole being drilled. A Dutch (or mud) auger has a unique open design for cutting through boggy, saturated and/or heavily rooted soils such as those found in wetlands.

Biodiversity
The variety of life in an area, including the number of different species, the genetic wealth within each species, and the natural areas which they are found.

Biophysical Environment
All aspects of the natural environment including physical features such as watercourses, groundwater and soils as well as the biological features such as plants and animals.

Buffer
A zone or area around a geographic feature measured in distance. Example: an assessment buffer is an area around a proposed development which needs to be assessed within the report.

Catchment
All the land area from mountaintop to seashore which is drained by a single river and its tributaries.

Chroma (Soil Colour)
The relative purity of the spectral colour, which decreases with increasing greyness.

Competent Authority
The national or provincial governmental department or body responsible for the environmental applications being placed. DWS, DEA, EDTEA and DMR are the most likely competent authorities to be associated with wetland delineations and functional assessments.

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

Ecosystem Services
Benefits people obtain from ecosystems including provisioning services such as food and water; regulating services such as regulation of floods, drought, land degradation, and disease; supporting services such as soil formation and nutrient cycling; and cultural services such as recreational, spiritual, religious and other non-material benefits.

Environment
The environment means the surroundings within which humans exist and that could be made up of water, air, soil, sand, plants and animals.

Environmental Impact
An impact or environmental impact is the change to the environment, whether desirable or undesirable, that will result from the effect of an activity. An impact may be the direct or indirect consequence of a construction, operational or decommissioning activity.

Environmental Consultant
An independent consultant that is appointed by the Client to compile an Environmental Management program and to undertake environmental audits or Control Officer functions.

Environmental Specifications
Instructions and guidelines for specific activities designed to help prevent, reduce and/or control the potential environmental implications of these activities during the operational, construction or decommissioning / closure phases of the facilities.

Estuary
Where the river and sea meet and the fresh water from the river mixes with the sea water.

Fauna
Any and all animals identified within or outside of the operational or project areas. Animals may not be harmed in any way.

Flora
All species of plants that are found in a particular region, habitat, or time period within or outside of the operational or project areas.

Freshwater Systems / Habitats
A subset of Earth's aquatic ecosystems. They include wetlands, rivers, streams, ponds, dams and lakes.

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

Hue (Soil Colour)
The dominant spectral colour (e.g. red).

Hydrogeomorphic (HGM)
A wetland classification/typology system based on the hydrological and landscape (geomorphic) characteristics of wetlands.

Hydrogeomorphic (HGM) Unit
A single "reach", segment or unit of a particular type of HGM wetland type.

Incident
The occurrence of a pollution or degradation event that will have a direct or indirect effect on the environment e.g. surface water, groundwater, soils, ambient air as well as plants, animals and humans.

Invasive Alien Plants (IAP)
An Alien Species is a species that has been intentionally or unintentionally introduced to a location, area, or region where it does not occur naturally. An Invasive Alien Plant is an alien species that causes, or has the potential to cause, harm to the environment, economies, or human health (Global Invasive Species Programme).

Land owner
The individual, company, entity, Tribal Authority, Local Municipality or District Municipality that legally owns the land.

Mitigation measures
Mitigation seeks to address poor or inadequate practices, procedures, systems and/ or management measures by the implementation of preventative and corrective measures to reduce, limit, and eliminate adverse or negative environmental impacts or improve the positive aspects.

Mottle (Soil Characteristic)
Soils with variegated colour patters are described as being mottled, with the "background colour" referred to as the matrix and the spots or blotches of colour referred to as monies.

Permanent (Wetland Zone)
Soil which is flooded or waterlogged to the soil surface throughout the year, in most years.

Proposed Project / Development
The activities, footprint and structures proposed by the client.

Reference State
The natural or pre-impacted condition of the system. The reference state is not a static condition, but refers to the natural dynamics (range and rates of change or flux) prior to development.

Rehabilitation
Rehabilitation is defined as the return of a disturbed area, feature or structure to a state that approximates to the state (where possible) that it was before disruption, or to an improved state.

Remediation
The management of a contaminated site to prevent, minimise, or mitigate harm to human health or the environment

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

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

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

Social Environment
Persons likely to be directly or indirectly affected by the day-to-day operations of the mill.

Solid Waste
Means all solid waste, including domestic and office waste (food, paper, plastic), waste from operations e.g. empty chemical containers, dried sludge as well as waste from the construction and / or decommissioning phases, chemical waste, excess cement/concrete, inert building rubble, packaging, timber, tins and cans.

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

Study Area
The proposed project/development's site and footprint as well as an assessment buffer. Assessment buffers are decided upon by the reports intended use, i.e. 500m for WULAs or 32m for BARs

Sustainable development / sustainability
The integration of social, economic and environmental factors into planning, implementation and decision-making so as to ensure that development serves present and future generations.

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

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

Topsoil
The layer of soil covering the earth which provides a sustainable environment for the germination of seeds, allows water penetration, and is a source of micro-organisms and plant nutrients.

Value (Soil Colour)
The relative lightness or intensity of colour.

Waste
Any substance, material or object, that is unwanted, rejected, abandoned, discarded or disposed of, or that is intended or required to be discarded or disposed of, by the holder of that substance, material or object, whether or not such substance, material or object can be re-used, recycled or recovered.

Watercourse / Water Resource
A river or spring; a natural channel or depression 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.

Watershed
A ridge of land that separates waters flowing to different rivers, basins, or seas. These split areas into different catchments.

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

GLOSSARY OF ACRONYMS

BAR:	Basic Assessment Report
DEA:	Department of Environmental Affairs
(D)EDTEA:	(Department of) Economic Development, Tourism and Environmental Affairs
DMR:	Department of Mineral Resources
DOT:	Department of Transport
DWS:	Department of Water and Sanitation
EA:	Environmental Authorisation
ECA:	Environment Conservation Act
ECO:	Environmental Control Officer
EIA:	Environmental Impact Assessment
EIS:	Ecological Importance and Sensitivity
EMPr:	Environmental Management Programme
GA:	General Authorisation
HGM(U):	HydroGeoMorphic (Unit)
HSE:	Health, Safety and Environment.
IAP(S):	Invasive Alien Plant (Species)
NEMA:	National Environmental Management Act
NEM:BA:	National Environmental Management: Biodiversity Act
NFEPA:	National Freshwater Ecosystem Priority Area
NWA:	National Water Act
PE:	Project Engineer
PES:	Present Ecological State
PM:	Project Manager
PU:	Planning Unit
RAM:	Risk Assessment Matrix (in referral to the DWS RAM)
SEMA:	Specific Environmental Management Acts
(T)SCP:	(Terrestrial) Systematic Conservation Plan
WUL(A):	Water Use License (Application)

1. INTRODUCTION

1.1. BACKGROUND INFORMATION

Triplo4 Sustainable Solutions (hereafter referred to as Triplo4) was appointed by Mr. Samuel Chauke (on behalf of KV Development Group) to conduct a Wetland Delineation and Functional Assessment (WDFA) for the proposed Formalisation and Proclamation of 2000 site at Sasemalani CBD, hereafter known as the proposed development, within the suburb of Saselamani, Collins Chabane Local and Vhembe District Municipalities, Limpopo.

The propose development is expected to cover 566.1612 hectares (ha) of land and yield approximately 2000 erven. The proposed development footprint is situated on a gentle to moderately sloping piece of land cut by watercourses towards the western and central portion of the proposed development footprint. Further to this, a minor business district was present towards the eastern most extremity of the project footprint and sporadic informal settlements towards the north-western extremity of the project footprint.

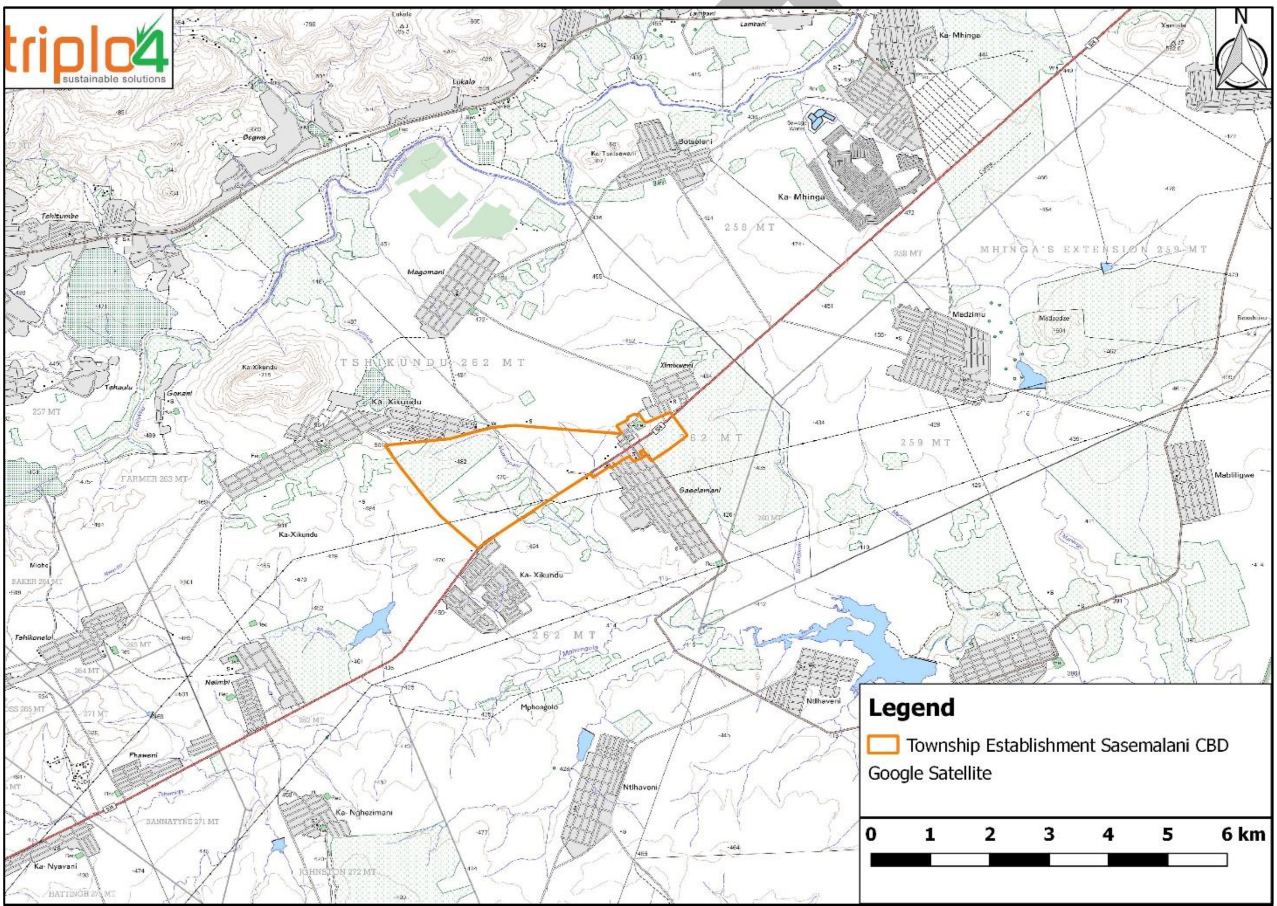

Figure 1: Locality and topographical map of the proposed development

1.2. SCOPE OF THE PROPOSED PROJECT

The proposed development encompasses the following construction activities:

- Mixed use development which may be inclusive of:
    - Low density residential development,
    - Moderate density residential development,
    - Business developments, and
    - Amenity areas for the residential development.
- Sewer lines which will run into an on-site package plant.
- Water lines which will be connected to residential development and amenity areas.

It must be noted that the above scope of proposed project is not finalized and is just a generic scope for similar developments of this magnitude to try to quantify the impact of the development in this report.

1.3. OBJECTIVES OF THE WD&FA

The objective of the WD&FA for the proposed development as adopted from the specific terms of reference presented within the DWS Government Gazette No. 40713 of the 24th of March 2017:

- Desktop delineation and illustration of all watercourses within 500m assessment radius of the proposed development utilising available site-specific data such as aerial photography, elevation data and regional water resource data.
- Risk screening assessment of the delineated watercourses to determine which watercourses will be significantly impacted upon by the proposed development. This was based on professional opinion which may be scientifically substantiated;
- Infield delineation and digital mapping of all watercourses in relation to the proposed development in accordance with the methods contained in the manual 'A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas' (DWAF, 2005);
- Classification of the delineated watercourses in accordance with the 'National Wetland Classification System for Wetlands and other Aquatic Ecosystems in South Africa (Ollis *et al*., 2013), watercourses will be classified in terms of being artificial or natural and wetland or riverine;
- Identification of site-specific biophysical characteristics namely: the hydrological, geomorphological and vegetation modules;
- Assess the current health and functionality of the systems that were identified to be at risk in terms of:
  - Present Ecological State - Level 1 WET-Health Tool (Macfarlane *et al*., 2009)
  - Ecological Importance and Sensitivity (EIS) assessment (Rountree, 2013)
  - Functional Assessment – Level 2 WET-EcoServices (Kotze *et al*., 2009)
- Determine the type and degree of potential impacts which may affect these systems (qualitative assessment);
- Conduct a Risk Assessment Matrix (RAM) (DWS, 2016) analysis to determine whether the proposed development may be authorised under a GA or WULA process or exemption as per General Notice 509 of 2016 in accordance with Section 39 of the NWA (No. 36 of 1998);
- Determine appropriate buffer guidelines by utilising the tool composed by (Marcfarlane and Bredin, 2016);
- Specify mitigation measures to reduce the impacts of the proposed development.

1.4. AUTHORS OF THE WD&FA

This document was compiled and reviewed by:

Mr Suheil Malek Hoosen - Masters in Environmental Science
Suheil Malek Hoosen is a Wetland Specialist with Triplo4 Sustainable Solutions, who holds a Master's Degree in Environmental Science with approximately 5 years of environmental experience in Wetland Ecology. Mr Malek Hoosen has been responsible for conducting wetland delineation & functional assessments, wetland rehabilitation plans, vegetation impact assessments as well as Scoping Environmental Reports. Mr Malek Hoosen has previously worked as a Wetland Specialist at KSEMS Environmental Consulting and Aeon Nexus, being involved in overseeing over 40 specialist projects. Mr Malek Hoosen has also practiced Environmental Assessments and projects which deal with managing specialists under KSEMS Environmental Consulting. Mr Malek Hoosen is a fully registered SACNASP professional (Pr.Sci.Nat.) within the Environmental Science field of practice.

Triplo4 has gained experience on a wide spectrum of projects, spanning from Greenfield Mixed Use developments to industrial (e.g. mining), hazardous waste management operational facilities and linear developments (pipelines, roads, bridges). We have a balanced approach and sustainability perspective on development and operations, understanding not only the need for environmental management, but also the requirements for socio-economic development. It is recognised that socio-economic development may require environmental compromises or trade-offs, as long as these are done responsibly and within the legislative frameworks.

Triplo4 is registered with the Green Building Council of South Africa (GBCSA) allowing us to provide expertise and sustainability measures on Energy (Lighting, Heating & Cooling); Water; Stormwater; Waste; Biodiversity & Materials. Furthermore, Triplo4 is a member of and subscribes to various Codes of Ethics e.g. the International Association for Impact Assessment (IAIAsa), the Institute for Waste Management South Africa (IWMSA) and the Water Institute of South Africa (WISA).

Experience, having been gained in mining and environmental consulting enables Triplo4 to provide a broad range of environmental consulting services, including:

- environmental authorisations and feasibility assessments;
- environmental management systems;
- environmental capacity building / training and awareness;
- waste and water management and pollution control;
- environmental control officer functions and auditing;
- wetland and vegetation assessments;
- carbon footprint analysis and sustainability reporting.

2. APPLICABLE LEGISLATION, GUIDELINES AND DOCUMENTATION

This document describes the role of specialist studies such as wetland and vegetation reports in IEM and planning for environmentally sustainable development within the framework of existing legislation and environmental management policies.

South Africa is a constitutional democracy, which means the constitution and Bill of Rights are the supreme law. Our Constitution guarantees certain human rights, and is one of the most progressive in the world. In line with a constitutional democracy everyone has responsibilities.

In terms of The Constitution of the Republic of South Africa (Act No. 108 of 1996) everyone has the right:

- to clean water;
- to an environment that is not harmful to their health or well-being and to have the environment protected, for benefit of present and future generations, through reasonable legislation and other measures that prevent pollution and ecological degradation, promote conservation and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

The overarching legislative framework that governs all environmental activities is the National Environmental Management Act (No 107 of 1998). NEMA aims to provide for co-operative environmental governance by establishing principles for decision-making on matters affecting the environment, institutions that will promote co-operative governance and procedures for co-ordinating environmental functions exercised by organs of state; to provide for certain aspects of the administration and enforcement of other environmental management laws; and to provide for matters connected therewith. NEMA can help deal with problems at a municipal level and enables one to determine whether proper IEM procedures have been followed.

Accompanying NEMA is a set of Specific Environmental Management Acts (SEMA's). Known by the abbreviation of SEMA's, Specific Environmental Management Acts all fall under the auspices of the overarching National Environmental Management Act (NEMA). To date five SEMA's have been promulgated, with the most recent one being Waste Act in 2008. The full list of SEMA's is:

1. National Environmental Management: Protected Areas Act (57 of 2003), known as the NEM:PAA
2. National Environmental Management: Biodiversity Act (10 of 2004), known as the NEM:BA
3. National Environmental Management: Air Quality Act (39 of 2004), known as the NEM:AQA
4. National Environmental Management: Integrated Coastal Management Act (24 of 2008), known as the NEM:ICM
5. National Environmental Management: Waste Act (59 of 2008), known as the NEM:WA

Section 28 of NEMA (Duty of care and remediation of environmental damage) states that every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment.

2.1. APPLICABLE ENVIRONMENTAL LEGISLATION

The following Environmental legislation was considered, in the evaluation of the activities of the proposed development, as applicable to the WD&FA. It must be noted that only relevant sections of Acts have been listed below, as these were deemed pertinent and specific to the scope of the proposed development. These Acts must be considered and adhered to in their entirety at all times.

The list of applicable legislation and permits provided is intended to serve as a guideline only and is not exhaustive.

Table 1: Applicable Environmental Legislation

Legislation	Section	Relates to
The Constitution (No 108 of 1996)	Chapter 2	Bill of Rights.
	Section 24	Environmental rights.
National Environmental Management Act (NEMA): EIA Regulations (2014, as amended in 2017)	Section 2	Defines the strategic environmental management goals and objectives of the government. Applies through-out the Republic to the actions of all organs of state that may significantly affect the environment.
	Section 24	Provides for the prohibition, restriction and control of activities which are likely to have a detrimental effect on the environment.
	Section 28	The entity has a general duty to care for the environment and to institute such measures as may be needed to demonstrate such care.
	Section 30	Deals with the control of emergency incidents, including the different types of incidents, persons responsible for the incidents and reporting procedures to the relevant authority.
National Environmental Management: Biodiversity Act (No 10 of 2004)		Provides for the management and conservation of biodiversity, protection of species and ecosystems, and sustainable use of indigenous biological resources
National Water Act (No 36 of 1998) and regulations	Section 19	Prevention and remedying the effects of pollution
	Section 20	Control of emergency incidents
	Section 21/40	Licenses for water use – most important of those include discharge & abstraction licenses
Nation Veld & Forest Fire Act (No 101 of 1998)		Provides for a variety of institutions, methods and practices to prevent and combat veld, forest and mountain fires.
National Forests Act (No 84 of 1998)		Protects and controls certain vegetation types as well as specific species.

The potential environmental impacts associated with the current project are required to be considered in compliance with the EIA Regulations (2017) as well as all the SEMA's. It must also be noted that the list of Acts and their associated regulations must be frequently updated to ensure that all assessments are done according to and comply with the most current legislation.

Table 2: Current Environmental Legislation

Regulations and Guidelines
2014 Environmental Impact Assessment Regulations (as amended)
The General Policy on Environmental Conservation (January 1994)

Table 3: Current Provincial Legislation

Legislation
Provincial Conservation Ordinance

3. METHODOLOGY AND DATA

As a necessary part of any specialist impact assessment, the relevant methodologies required to determine and assess the proposed project as well as the data available for the area, must be described. The below section is divided into a methodology subsection, where all methodologies are discussed in relevant detail, and a data subsection, where the data utilised for this assessment are named.

3.1. DESKTOP ASSESSMENT AND DELINEATION

An initial desktop assessment was done utilising all relevant GIS data available for the proposed project's study area. This included, but was not limited to, Google Earth terrain models, contours, NFEPA datasets, vegetation units, and past and present satellite imagery. Utilising these data, a desktop assessment of the study area (500m for NWA WULAs, 32m for NEMA BA or S&EIA) was performed to identify wetlands, rivers, and other watercourses in the area. These were then delineated using the contours, terrain models, and past and present satellite imagery to as high an accuracy as possible. Table 4 below is a list of utilised data and their associated sources which was used for the proposed project.

Table 4: Utilised data, associated sources and significance to the proposed project

DATA	SOURCE	APPLICATION TO PROPOSED DEVELOPMENT
DWS Eco-regions (Geographic Information System (GIS) data)	DWS (2005)	Local eco-region classification.
Google Earth Pro™ Imagery	Google Earth Pro™ (2018)	Up-to-date satellite imagery of the proposed development, area (size) determination, desktop watershed determination, desktop identification of catchment and HGM impacts.
Interactive catchment CD	Frank Sokolic of GISolutions in the WET-Health package by Macfarlane et al. (2009)	Determine primary, secondary, tertiary and quaternary catchments applicable to the study area and their climate.
National Biodiversity Assessment (NBA) Threatened Ecosystems (GIS Coverage)	South African National Biodiversity Institution (SANBI) (2011)	Determine the national threat status of the terrestrial and aquatic vegetation types.
National Freshwater Ecosystem Priority Areas (NFEPA) river and wetland inventories (GIS Coverage)	Council for Scientific and Industrial Research (CSIR) (2011)	Identify potentially important river and wetland systems at a local and regional scale.
NEFPA river, wetland and estuarine FEPAs (GIS Coverage)	CSIR (2011)	Indicates national aquatic ecosystem conservation priorities.
South African Vegetation Map (GIS Coverage)	Mucina & Rutherford (2006/2012)	Determine the national vegetation type of the study area.
South African Geological Map (GIS Coverage)	Geological Survey (1988)	Determine regional and study site geology and soil types.

The desktop assessment allowed for certain watercourses within the study area to be excluded from further investigation based on whether these systems were likely to be impacted upon by the proposed development. Reasons for exclusion will be justified for any system not further assessed within the screening sections (Section 4.2) of this report but some factors (amongst others) which were taken into consideration include:

- Whether the system is found within the same catchment as the proposed development. Systems found in different catchments will be excluded as they will not be impacted.

- The distance and location of system from the proposed development. Systems found at a suitably distant location upstream from the proposed development will be excluded as a result of the low likelihood of being impacted.
- The degree to which natural or currently present infrastructure buffers are present between the system and the proposed development. If these are deemed sufficient to shield the system from impact, they will be excluded from further investigation.

3.2. INFIELD VERIFICATION AND DATA COLLECTION

Following the completion of the desktop assessments, the watercourse delineations had to be verified infield. Infield verification used field work techniques to more accurately determine the limits of the watercourses temporary zones, confirm the wetland type classification according to the Department of Water Affairs delineation manual (DWAF, 2005), and record information to be utilised in the functional assessment of all potentially impacted systems.

Wetland delineation verification requires the use of wetland indicators: measurable parameters that confirm the presence and type of wetland systems.

Four specific wetland indicators were used to confirm the presence of wetlands, including the:

- **Terrain Unit Indicator** which uses topography to identify the landscape features where wetland systems may develop;
- **Vegetation Indicator** (the NWA primary indicator) which takes the vegetation located in the area and determines the likelihood to which they are found in wetland soils (Obligate, Facultative Wetland, Facultative, or Facultative Dryland species);
- **Soil Indicator** that classifies certain soil forms according to the degree and regularity to which these soils are saturated; and
- **Soil Saturation Indicator** where soil features such as mottles and gleying were identified within the soil profile to indicate fluctuating saturation level.

Soil saturation indicators are obtained by observing soil characteristics in samples taken from soil cores using a Dutch soil auger. Samples were taken from depths of 0 -10cm and 30-40cm to determine the degree of saturation of the soils at these levels within potential wetland areas. In cores where indicators are present, and depending on the combination of which indicators are present at which depth, the zonation (permanent, seasonal, and temporary zone) can be determined.

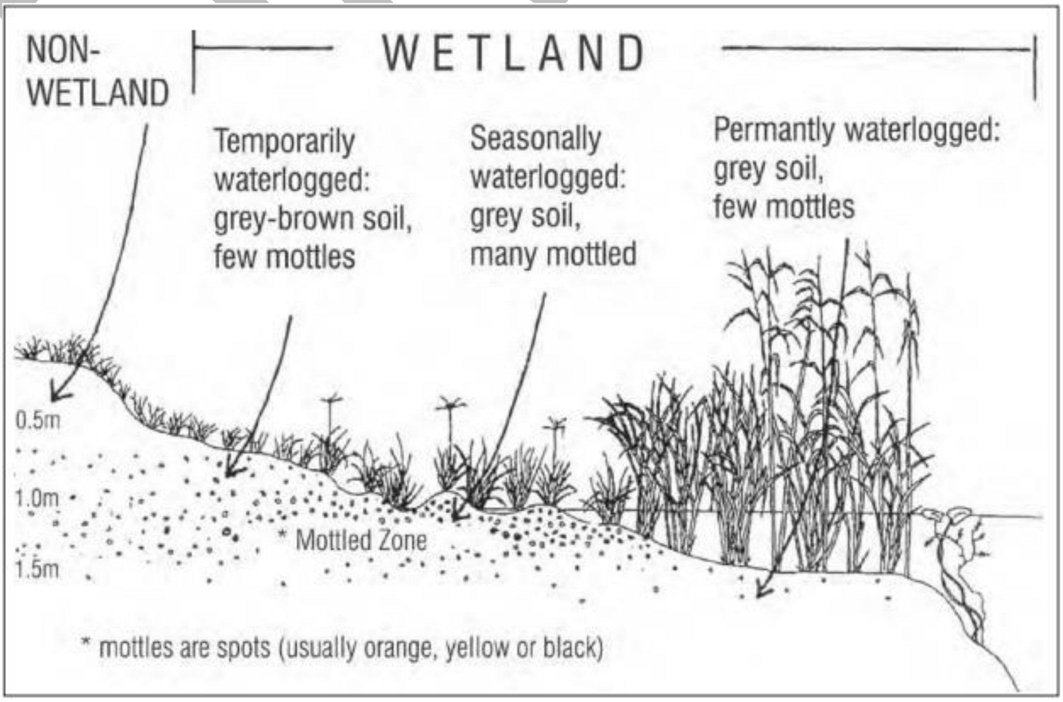

Figure 2: Cross section through a wetland, indicating how the soil wetness and vegetation indicators change as one moves along a gradient of decreasing wetness, from the middle to the edge of the wetland (Kotze et al., 2009).

Similarly, riverine delineation verification has its own set of indicators to confirm the location of the instream and riparian zones. The three indicators include:

- **Topography Indicator** whereby riverine systems will only be present at the lowest point within a valley profile and likely be restricted to being within the macro-channel of the stream;
- **Soil Indicator** in which alluvium and recently deposited soils are likely to be present within the riverine zones;
- **Vegetation Indicator**, as with wetland areas, vegetation species composition can be used to determine and confirm the extent of the riverine zone.

The classification of river channels is associated with the type of channel that is identified within a certain section of the channel network. There are three channel types, namely: "A", "B" and "C" sections and the difference between the three is their position relative to the zone of saturation within the system (DWAF, 2008). Figure 4 below illustrates two levels of the water table; the line marked "wet" depicts the highest level that the water table would reach during a period of heavy rainfall when the zone of saturation has taken place, while the one marked "dry" depicts the level of the water table at its lowest after a dry period (DWAF, 2008). The zone of saturation must be in contact with the channel network for baseflow[1] to take place at any point in the channel.

(A) channel streams are those streams that have presumable flow three months of the year due to rainfall events and do not have baseflow, these are also considered as ephemeral streams.

(B) channel streams are those streams that have presumable flow six – nine months of the year and those that sometimes have baseflow.

(C) channel streams are those streams that have flow throughout the year and always have baseflow (DWAF, 2008).

This classification was adopted because it is based on the changing frequency of saturation of soils in the riparian zone; from very seldom (A), to quite often (B), and to always (C) (DWAF, 2008).

[1] Baseflow: Long-term flow in a river that continues after storm flow has passed (DWAF, 2008).

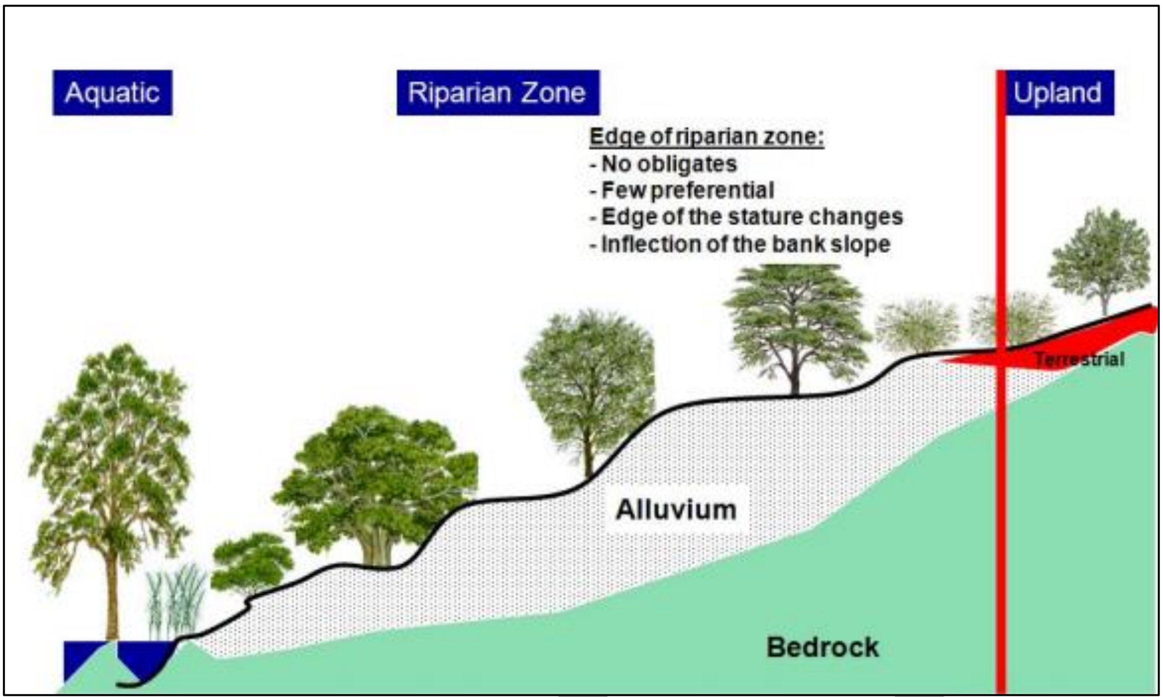

Figure 3: A schematic diagram illustrating the edge of the riparian zone on one bank of a large river. Note the coincidence of the inflection (in slope) on the bank with the change in vegetation structure and composition. The edge of the riparian zone coincides with an inflection point on the bank; where there are not obligates upslope; few preferential. The boundary also coincides with the outer edge of the stature differences (DWAF, 2008)

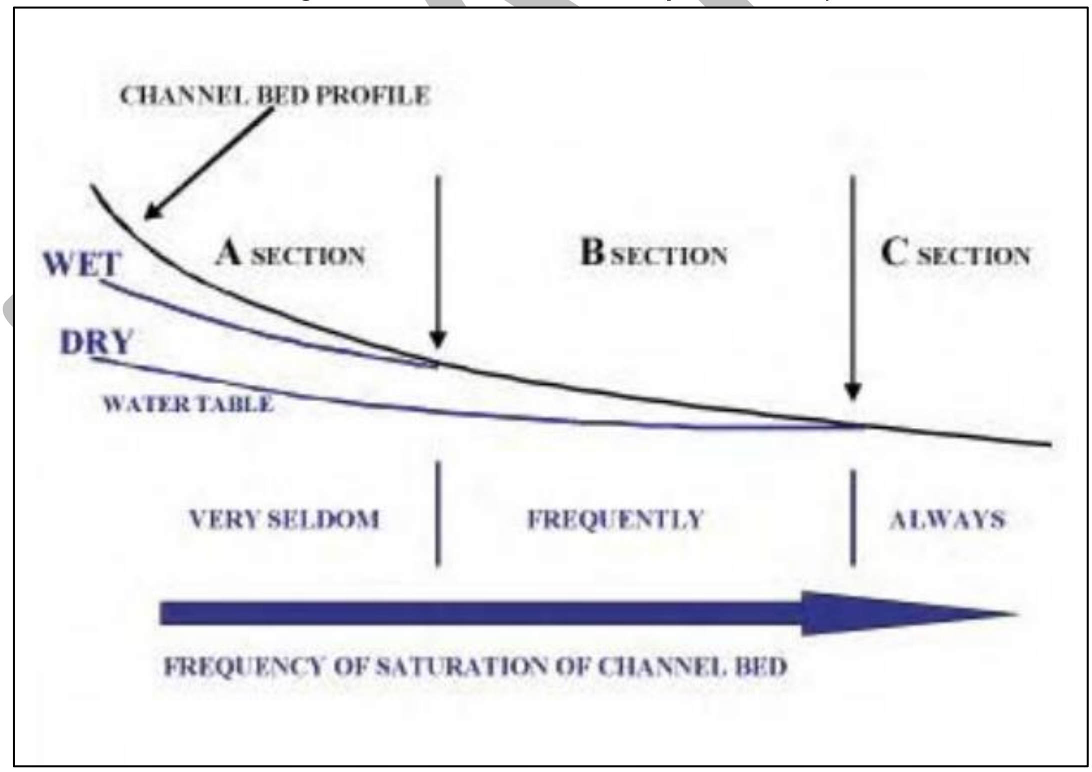

Figure 4: Image illustrating the classification of river channels using the frequency that each channel section contains baseflow (DWAF, 2008).

As per the NWA primary indicator, hydrophytic vegetation species are utilised to guide the delineation of wetness zones within watercourses. The relationship between the wetness zones, vegetation type and classification of occurrence of plants in wetlands can be seen in Table 5 below. Table 6 below presents the frequency of plant species occurrence in wetlands within different wetness zones.

Table 5: Wetness zones, vegetation types and classification of plants occurrence in wetlands based on their relationship (Kotze et al., 2009)

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

Table 6: Frequency of wetland species plant occurrence within different wetness zones (Kotze et al., 2009)

SYMBOL	HYDRIC STATUS	DESCRIPTION/OCCURRENCE
Ow	Obligate wetland species	Almost always grow in wetlands (> 90 % occurrence)
F+	Facultative positive wetland species	Usually grow in wetlands (67-99 % occurrence) but occasionally found in non-wetland areas
F	Facultative wetland species	Equally likely to grow in wetlands (34-66 % occurrence) and non-wetland areas
F-	Facultative negative wetland species	Usually grow in non-wetland areas but sometimes grow in wetlands (1-34 % occurrence)
D	Dryland species	Almost always grow in drylands

3.3. ASSESSMENT METHODOLOGIES

3.3.1.PRESENT ECOLOGICAL STATE (PES)

Wetland Systems

To determine the PES of the systems affected by the proposed development, a WET-Health Level 1 assessment, as developed by Macfarlane et al. (2008), was performed on all potentially impacted systems. WET-Health assessments evaluate the current state of health for 3 main components of wetland systems, namely: Hydrology, Geomorphology, and Vegetation. The assessment involves the evaluation of several measureable aspects of each component in a series of steps to determine that component's current health. The 3 components are then combined in a weighted average (3:2:2) to gain a final state of health score. The overall health score was classified into a health category. Finally, a health projection was assigned to the score to indicate the projected health of the system within the next 5 years, with the proposed development taking place, based on the specialist's opinion.

The impact scores obtained for each of the modules reflect the degree of change from natural reference conditions. Resultant health scores fall into one of six health categories (A-F) on a gradient from "unmodified/natural" (Category A) to "severe/complete deviation from natural" (Category F) as depicted in Table 7 below. This classification is consistent with DWAF categories used to evaluate the present ecological state of aquatic systems.

Table 7: Health categories used by the WET-Health for describing the integrity of wetlands (Macfarlane et al., 2009)

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

Riverine Systems

Evaluations of the riverine systems utilised a different methodology which was developed in 1999 by the then Department of Water Affairs and Forestry (DWAF), the previous incarnation of the DWS and DAFF. The methodology, known as the Index of Habitat Integrity (IHI), breaks down riverine systems into instream and riparian zone areas. It then breaks these down further into various aspects associated with the instream and riparian zone habitat which are rated infield on an increasing scale of severity from 0 (no impact) to 25 (highest impact). The instream and riparian zone final scores are classified into Habitat Integrity categories.

The Index of Habitat Integrity, 1996, version 2 (Kleynhans, 2012) was used to obtain a habitat integrity class for the instream habitat and riparian zone. This tool compares the current state of the in-stream and riparian habitats (with existing impacts) relative to the estimated reference state (in the absence of anthropogenic impacts). This involved the assessment and rating of a range of criteria for instream and riparian habitat (Table 20.2a) scored individually (from 0-25) using Table 8 as a guide.

This assessment was informed by (i) a site visit (as conducted on the23rd March 2020) where potential impacts to each metric were assessed and evaluated and (ii) an understanding of the catchment feeding the river and land-uses/activities that could have a detrimental impact on river ecosystems.

Table 8: Category of score for the Present Ecological State (PES)

Rating Score	Impact Score	Description
0	A: Natural	No discernible impact or the modification is located in such a way that it has no impact on habitat quality, diversity, size and variability.
1-5	B: Good	The modification is limited to very few localities and the impact on habitat quality, diversity, size and variability are also very small.
6-10	C: Fair	The modifications are present at a small number of localities and the impact on habitat quality, diversity, size and variability are also limited.
11-15	D: Poor	The modification is generally present with a clearly detrimental impact on habitat quality, diversity size and variability. Large areas are, however, not influenced.
16-20	E: Seriously Modified	The modification is frequently present and the habitat quality, diversity, size and variability in almost the whole of the defined area are affected. Only small areas are not influenced.
21-25	F: Critically Modified	The modification is present overall with a high intensity. The habitat quality, diversity, size and variability in almost the whole of the defined section are influenced detrimentally.

3.3.2.ECOLOGICAL IMPORTANCE AND SENSITIVITY

Wetland Systems

The Ecological Importance and Sensitivity was determined by utilising a rapid scoring system. The system has been developed to provide a scoring approach for assessing the Ecological, Hydrological Functions; and Direct Human Benefits of importance and sensitivity of wetlands. These scoring assessments for these three aspects of wetland importance and sensitivity have been based on the requirements of the NWA, the original Ecological Importance and Sensitivity assessments developed for riverine assessments (DWAF, 1999), and the work conducted by Kotze et al (2008) on the assessment of wetland ecological goods and services from the WET-EcoServices tool (Rountree, 2013). The scores are then placed into a category of very low, low, moderate, high and very high as shown in Table 9 below.

Table 9: Category of score for the Ecological Importance and Sensitivity (Rountree, 2013)

Ecological Importance and Sensitivity categories	Range of EIS score
Very High: Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these systems is usually very sensitive to flow and habitat modification. They play a major role in moderating the quantity and quality of water of major rivers	>3 and <= 4
High: Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these system may be sensitive to flow and habitat modification. They play a role in moderating the quantity and quality of water of major rivers	>2 and <= 3
Moderate: Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these systems is not usually sensitive to flow and habitat modification. They play a small role in moderating the quantity and quality of water of major rivers	>1 and <= 2
Low/marginal: Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these systems is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of major rivers	>0 and <= 1

Riverine Systems

The ecological importance of a river is an expression of its importance to the maintenance of biological diversity and ecological functioning on local and wider scales. Ecological sensitivity (or fragility) refers to the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (resilience) (Kleynhans & Louw, 2007; Resh, *et. al*., 1988; Milner, 1994). Both abiotic and biotic components of the system are taken into consideration in the assessment of ecological importance and sensitivity. The scores assigned to the criteria of the assessment are used to rate the overall EIS of each mapped unit according to Table 10 below, which was based on the criteria used by DWS for river eco-classification (Kleynhans & Louw, 2007) and the WET-Health wetland integrity assessment method (Macfarlane *et al*., 2008).

Table 10: The ratings associated with the assessment of the Ecological Importance and Sensitivity of the riverine areas

RATING	EXPLANATION
None, Rating = 0	Rarely sensitive to changes in water quality/hydrological regime
Low, Rating =1	One or a few elements sensitive to changes in water quality/hydrological regime
Moderate, Rating =2	Some elements sensitive to changes in water quality/hydrological regime
High, Rating =3	Many elements sensitive to changes in water quality/ hydrological regime
Very high, Rating =4	Very many elements sensitive to changes in water quality/ hydrological regime

3.3.3.Ecosystem Services (EcoServices)

Wetland systems are subjected to a further assessment which measures the types and levels of ecosystem services each wetland provides to the area. Ecosystem services are evaluated using the Level 2 WET-EcoServices assessment tool (Kotze *et al.,* 2009). This tool quantitatively scores both physical and socio-cultural aspects of the wetland system and produces a score and graph for several services provided by the wetland. The services which are scored can be seen below in Table 11.

Table 11: Physical and socio-cultural ecosystem services

Category	Service
Physical	Flood attenuation Stream flow regulation Sediment trapping Phosphate assimilation Nitrate assimilation Toxicant assimilation Erosion control Carbon storage
Socio-Cultural	Biodiversity maintenance Provision of water for human use Provision of cultural floods Cultural significance Tourism and recreation Education and research

3.3.4. BUFFER ASSESSMENT

A buffer zone assessment was performed using the DWS Buffer Zone Tool developed by MacFarlane and Bredin (2016). This tool takes into account the type of water resources, its condition and ecological importance and determines an appropriate buffer to prevent it from being significantly impacted upon. Within the buffer zone, no construction, movement, waste or ablutions may occur or be situated, either temporarily or permanently.

3.3.5. RISK ASSESSMENT MATRIX

Assessing the risk of all the proposed development impacts, and associated consequences on watercourses was performed utilising the DWS's Aspects and Impact Register/Risk Assessment for Watercourses including Rivers, Pans, Wetlands, Springs, and Drainage Lines tool, otherwise known as the Risk Assessment Matrix or RAM. The RAM assessed different activities and aspects of the development and scores were determined for factors, such as magnitude of the impact, length of time of the activity, length of time for the impact to persist, and geographical scale, to determine an overall risk rating of each impact. Table 7 illustrates the different risk ratings, their classes, and the management descriptions.

Table 12: Freshwater habitat screening

Rating	Class	Management Description
1 – 55	*Low Risk*	Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated. Wetlands may be excluded.
56 – 169	*Moderate Risk*	Risk and impact on watercourses are notably and require mitigation measures on a higher level, which costs more and require specialist input. Wetlands are excluded.
170 – 300	*High Risk*	Always involves wetlands. Watercourse(s) impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve.

4. ASSUMPTIONS AND LIMITATIONS

- According to the SANBI guidelines, specialist assessments should be performed during the rainfall season of assessed area. In this case, Limpopo is a summer rainfall area and therefore assessments should be performed between October and February. Fieldwork for this project was done in March 2020, thus does not fall within the rainfall season but is only a month after the rainfall season.

- Accessibility to certain portions of the landscape where watercourses were present was difficult due to the dense thicket vegetation and fences erected by certain members of the community.
- A construction method statement was not provided by the engineer and therefore the potential impacts on the watercourses that may arise as a result of the construction activities were determined using the specialist's knowledge and experience with similar projects.
- No data and information were provided by the client on the specific design of the proposed development and thus could not be assessed against the sensitivities identified on site.
- Only those wetland/riverine habitats which will be significantly impacted by the proposed development were accurately delineated in the field. The remaining watercourses within a 500m assessment radius were delineated at a desktop level and broadly verified in the field to obtain an extent of the wetland/riverine areas, and to facilitate an understanding of the dynamics of the systems.
- This is a once off assessment which can only take into consideration the current condition with some speculation of historical events based on evidence observed in the area and satellite imagery. As vegetation and habitats may vary both temporally and spatially, there must be recognition of fact that certain aspects or features may be missed if they do not present themselves on the day.
- All delineation verification is done using a GPS system. The precision of such systems is generally limited to 5m and therefore this error must be taken into account when utilising the GPS coordinates.
- Only vegetation which was present within at risk watercourses were assessed in the field, all other systems were assessed at desktop level and visually confirmed on site.
- While the assessment techniques utilised in this report are used in order to standardise and 'objectify' the assessment of the systems' function, potential impacts and services, it must be noted that much of the information is subjectively collected based on the assessor's previous experience and training. The assessor will, if additional information or counter arguments are provided and verified, hold the right to amend the report if need be.
- The site had been disturbed by dirt roads, sporadic informal settlements, ad hoc dumping and minor business district. Surrounding vegetation, Google Earth and Google Street View were all utilised to estimate approximate historical vegetation present. The site had been pioneered by grassland, thornveld vegetation type and alien invasive plants (AIP) within certain watercourses.
- The assessment of impacts and recommendation of mitigation measures was informed by the site-specific ecological issues identified during the infield assessment and based on the assessor's working knowledge and experience with similar development projects.
- Evaluation of the significance of impacts with mitigation takes into account mitigation measures provided in this report and standard mitigation measures are to be included in the project-specific Environmental Management Programme report (EMPr).

5. DESKTOP ASSESSMENT AND DELINEATION

5.1. STUDY AREA

5.1.1.ECOREGION

According to DWS (previously DWA), the proposed development falls into the Lowveld (03) Level 1 Ecoregion (Kleynhans *et al.*, 2005). Level 1 ecoregions are derived primarily from terrain and vegetation, along with altitude, rainfall, runoff variability, air temperature, geology and soil. This region can predominantly be broken down into the following characteristics:

- Mean annual precipitation: Tends to be moderate towards the west, but low over most of the region.
- Coefficient of variation of annual precipitation: Mostly moderate.
- Drainage density: Mostly low, but high in some of the central areas.
- Stream frequency: Mostly low to medium but high in some of the central areas.
- Slopes <5%: >80% of the area.
- Median annual simulated runoff: Mostly low/moderate, but moderate in areas.
- Mean annual temperature: High to very high.

Table 13: Main attributes of the Lowveld Eco-region (Kleynhans et al., 2005)

Main Attributes	Description
Terrain Morphology: Broad division (dominant types in bold) (Primary)	Plains; Low Relief; **Plains; Moderate Relief**; Lowlands, Hills and Mountains; Moderate and High Relief (limited) Open Hills, Lowlands; Mountains; Moderate to High Relief; (limited) Closed Hills; Mountains; Moderate and High Relief (Limited)
Vegetation types (dominant types in bold) (Primary)	**Mopane Bushveld;** Mopane Shrubveld; **Mixed Lowveld Bushveld;** Sour Lowveld Bushveld; Sweet Lowveld Bushveld; Natal Lowveld Bushveld; Lebombo Arid Mountain Bushveld; Mixed Bushveld North Eastern Mountain Grassland;
Altitude (above mean sea level – a.m.s.l)	0-700; 700-1300 limited
MAP (mm)	200 to 1000
Coefficient of Variation (% of annual precipitation)	<20 to 35
Rainfall concentration index	30 to >65
Rainfall seasonality	Early to late summer
Mean annual temp. (°C)	16 to >22
Mean daily max. temp. (°C): February	24 - 32
Mean daily max. temp. (°C): July	18 - 24
Mean daily min. temp. (°C): February	14 - >20
Mean daily min temp. (°C): July	4 - >10
Median annual simulated runoff (mm) for quaternary catchment	10 to >250

5.1.2.GEOLOGY

The proposed development is located on one dominat lithostratigraphic group, namely Soutpasberg Group which falls under the Karoo Super Group as per Figure 5. Table 14 is an explanation of the underlying lithostratigraphy.

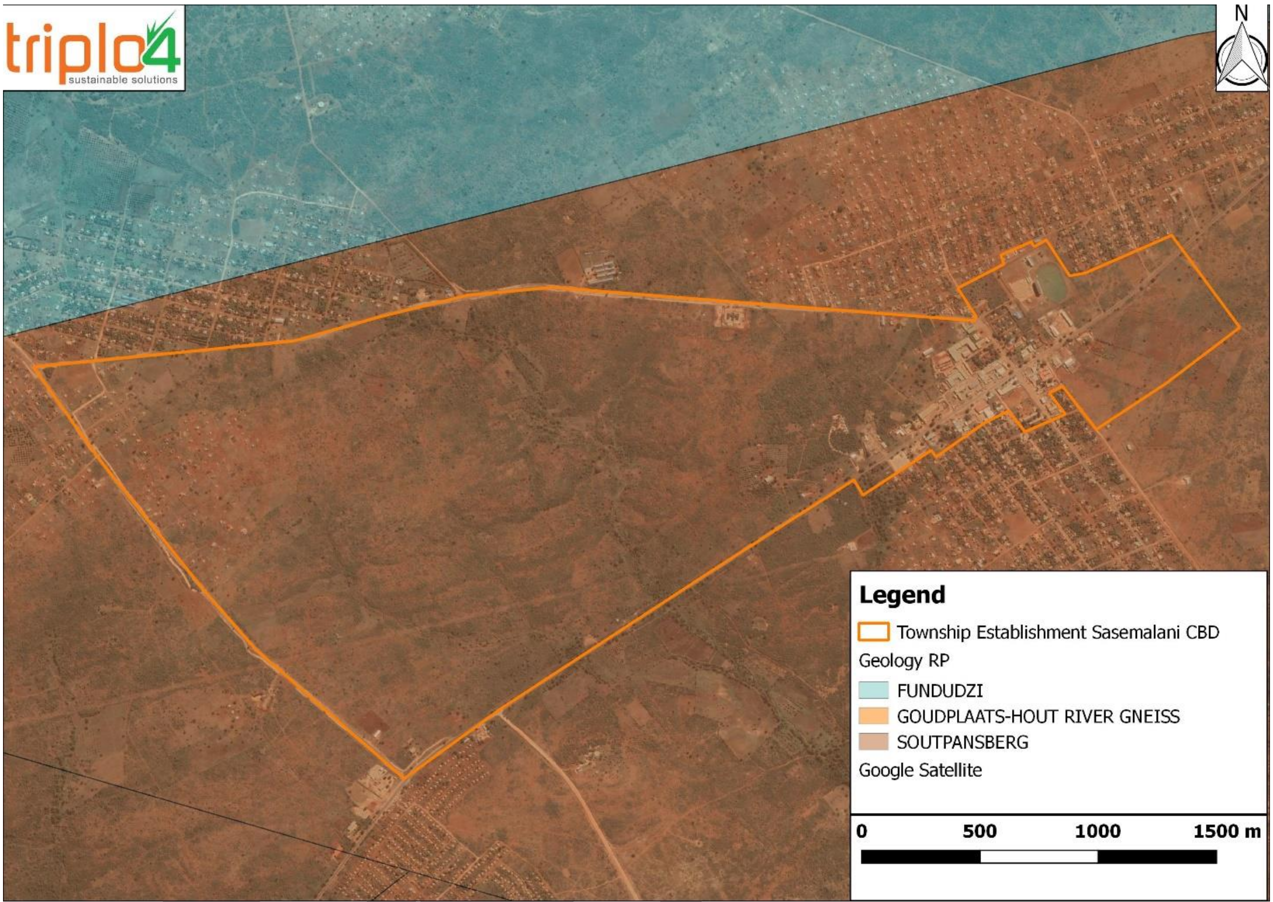

Figure 5: Dominant lithostratigraphic group of the proposed development

Table 14: Lithostratigraphy attributes of the proposed development

No.	Estimates % of Proposed Development	Lithostratigraphy	Description
1	100%	Southpansberg	The Soutpansberg rocks rest unconformably on gneisses of the Limpopo Belt and Bandelierkop Complex. Along the eastern and most of the northern margin the Soutpansberg outcrops are unconformably overlain by, or tectonically juxtaposed against, rocks of the Karoo Supergroup (Council for Geosciences, 2011). The contact relationship between the Soutpansberg and Waterberg Group rocks is a tectonic one, though the latter rocks are believed to be younger. The Group is best developed in the eastern part of Soutpansberg, where the maximum preserved thickness is about 5 000 m (Council for Geosciences, 2011). Dykes and sills of diabase are plentiful in the Soutpansberg rocks. The former

			intruded often along fault planes, whereas the sills were mainly emplaced along the interface of shale and competent quartzite. Some of the diabase intrusions are probably synchronous with the Soutpansberg volcanism (Council for Geosciences, 2011).

5.1.3. VEGETATION TYPES

Mucina and Rutherford (2006/2012) delineated vegetation units throughout southern Africa. The purpose of this exercise was to map the extent of various vegetation types across the country and to identify their conservation status. Utilising the Mucina and Rutherford (2006 & 2012) data, Scott-Shaw and Escott (2011) subsequently refined the dataset according to the extent of the vegetation units, as well as their relevant conservation status, within the province of Limpopo. Both datasets were utilised in conjunction to determine the natural state of the vegetation units that were recorded within the study area associated with the proposed development and upgrade. In doing so, a comparison could be conducted between the current state and recorded natural state of the vegetation units to divulge what the primary impacts may have been on the floral habitats. This will allow for more refined analysis of the floral composition within each of the at-risk watercourses.

The proposed development extends over one vegetation unit at a desktop level namely the Makuleke Sandy Bushveld (Figure 6). The conservation status this vegetation type is vulnerable (SANBI, 2011). The identified vegetation type remains mainly intact throughout the site, besides for the eastern and north western extremities, which were inclusive of a minor business district and informal settlements, respectively. Furthermore, disturbed areas of the site were noted to be inclusive of alien invasive plants (AIPs).

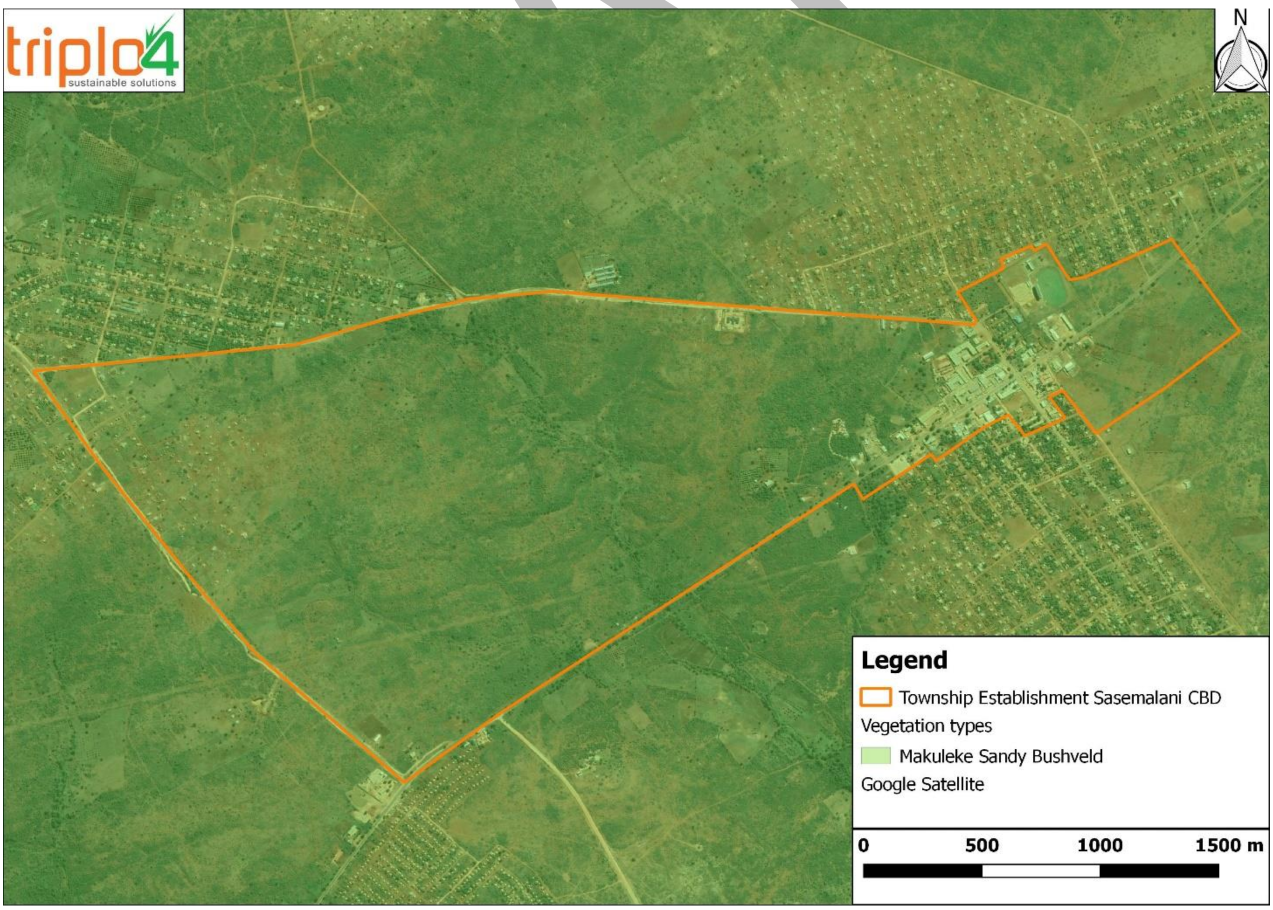

Figure 6: Map of the vegetation types within the proposed development

5.1.4.CRITICAL BIODIVERSITY AREA

Limpopo Province is subdivided into a number of Planning Units (PUs) based on biodiversity characteristics, spatial configuration and requirement for meeting targets for both biodiversity pattern and ecological processes. The Pus are subdivided into 7 units namely; Critical Biodiversity Area 1, Critical Biodiversity Area 2, Ecological Support Area 1, Ecological Support Area 2, Other Natural Area, Protected Area and No Natural Remaining Area (EKZNW, 2013).

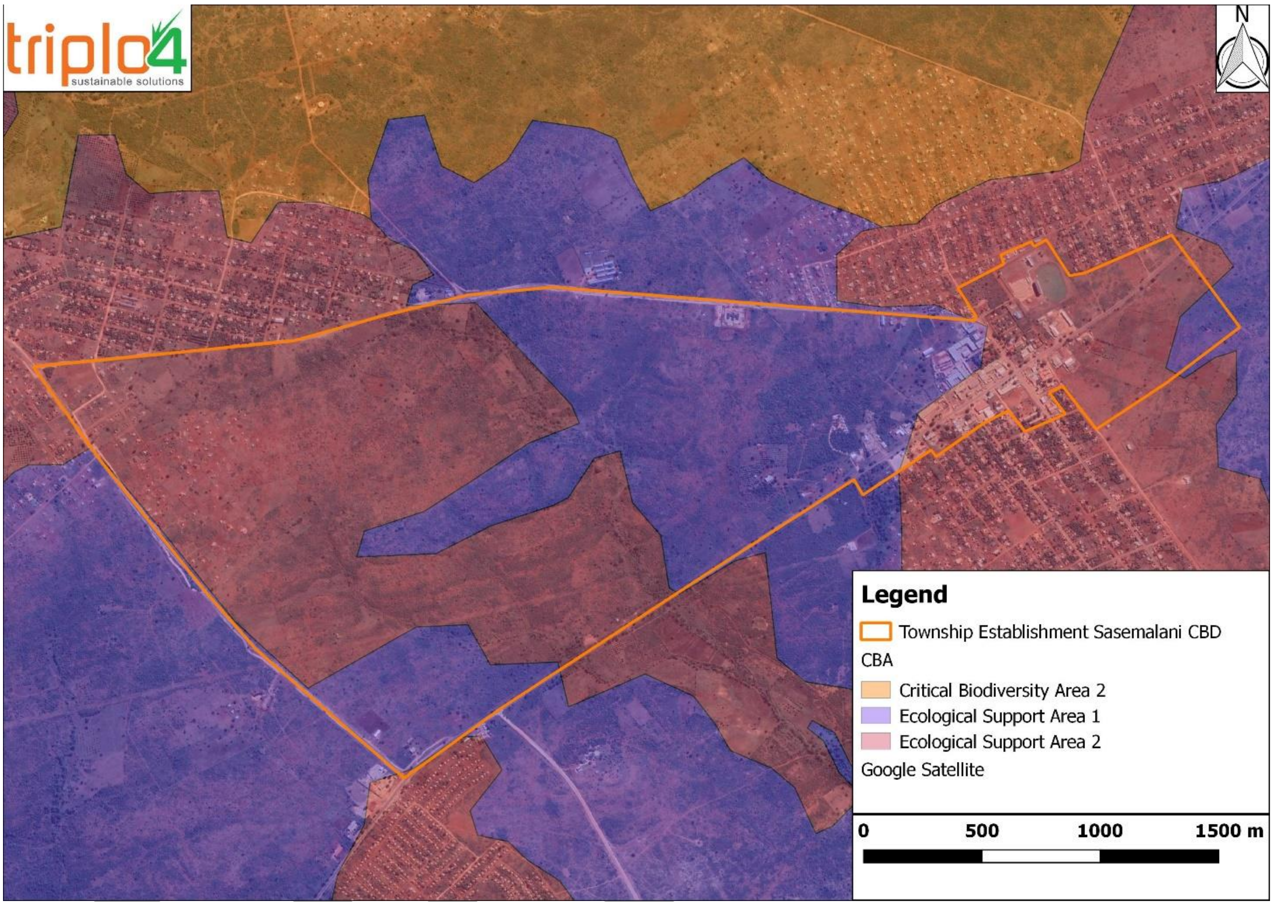

Figure 7: Critical Biodiversity Area within the proposed development

The CBA associated with the proposed development is ESA 1 and ESA 2, thus the proposed development falls within an Ecological Support Area 1 and 2, respectively, at a desktop level. Thus, no CBAs were present on site, however the ESAs on site still provide important ecological functions and services. Furthermore, it must be noted that the ESA were not entirely on site, as a portion of the proposed development footprint has been transformed by a minor business district and informal settlements.

Table 15: CBA Descriptions for the Limpopo Province

CBA	Description
Critical Biodiversity Area 1	The CBA 1 areas are based on areas which are identified as having irreplaceable features. These PUs represent the only localities for which the conservation targets for one or more of the biodiversity features contained within can be achieved, therefore there are no alternative sites available. .
Critical Biodiversity Area 2	CBA 2 areas represent areas of significantly high biodiversity value. In practical terms, this means that there are alternate sites within which the targets can be met for the biodiversity features contained within, but there aren't many. This site was chosen because it represents the most optimal area for choice in the systematic planning process, meeting both the conservation target goals for the features concerned as well as a number of other guiding criteria as defined by the Decision Support Layers.

Ecological Support Area 1	ESA 1 represents areas that is not entirely essential for meeting biodiversity targets for a CBA, but play a critical role in supporting ecological functioning and ecosystem services for CBAs
Ecological Support Area 2	ESA 2 represents areas that are also not entirely essential for meeting biodiversity targets for a CBA, but can play a role to support the ecology and services for CBAs.
Other Natural Area	Represents areas that have not been disturbed by human induced changes.
Protected Area	A specifically delineated area that is both designated and managed to achieve the conservation of the indigenous state and the maintenance of associated ecosystem services and cultural values, through legal or other effective means
No Natural Remaining Areas	Areas in which no biodiversity features remain due to existing development or land use.

5.1.5.WATER MANAGEMENT AREAS

The proposed development was observed to fall within the Water Management Area (WMA): Luvuvhu and Letaba, which falls under the lesser sub-WMA's: Shingwedzi and the quaternary catchment B90B. The aforementioned WMA is drained by several parallel rivers which flow in a south-easterly direction and eventually discharge into the Indian Ocean. The rivers which contribute to the highest flow within this WMA is the Mutale, Luvuvhu and Letaba rivers with several smaller tributaries that feed the aforementioned larger rivers (DWA, 2003a).

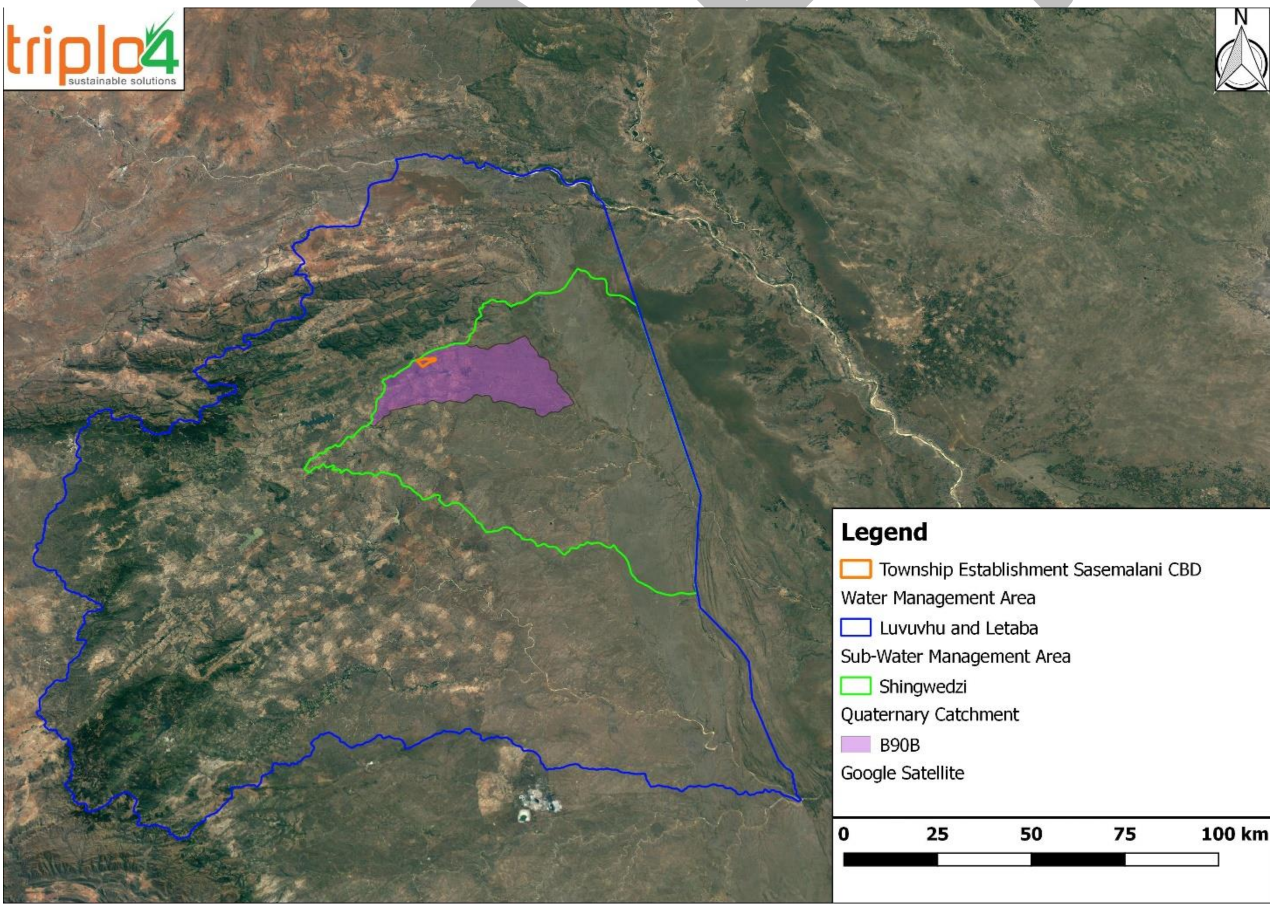

Figure 8: Map of the WMA, sub-WMA and Quaternary Catchment that falls within the proposed development

5.1.6.NFEPA

The National Freshwater Ecosystem Priority Areas (or NFEPA), are a selection of rivers, wetlands and estuaries which have been identified as systems of strategic importance to the hydrological functioning of South Africa. These systems have been identified using scientific methodologies as well as consensus amongst researchers, government entities and the general public (Nel *et al*., 2011).

According to the NFEPA dataset, no FEPA rivers or wetlands will be at risk as a result of the development. Further to this, the closest FEPA wetland is approximately 1.8 kilometres away.

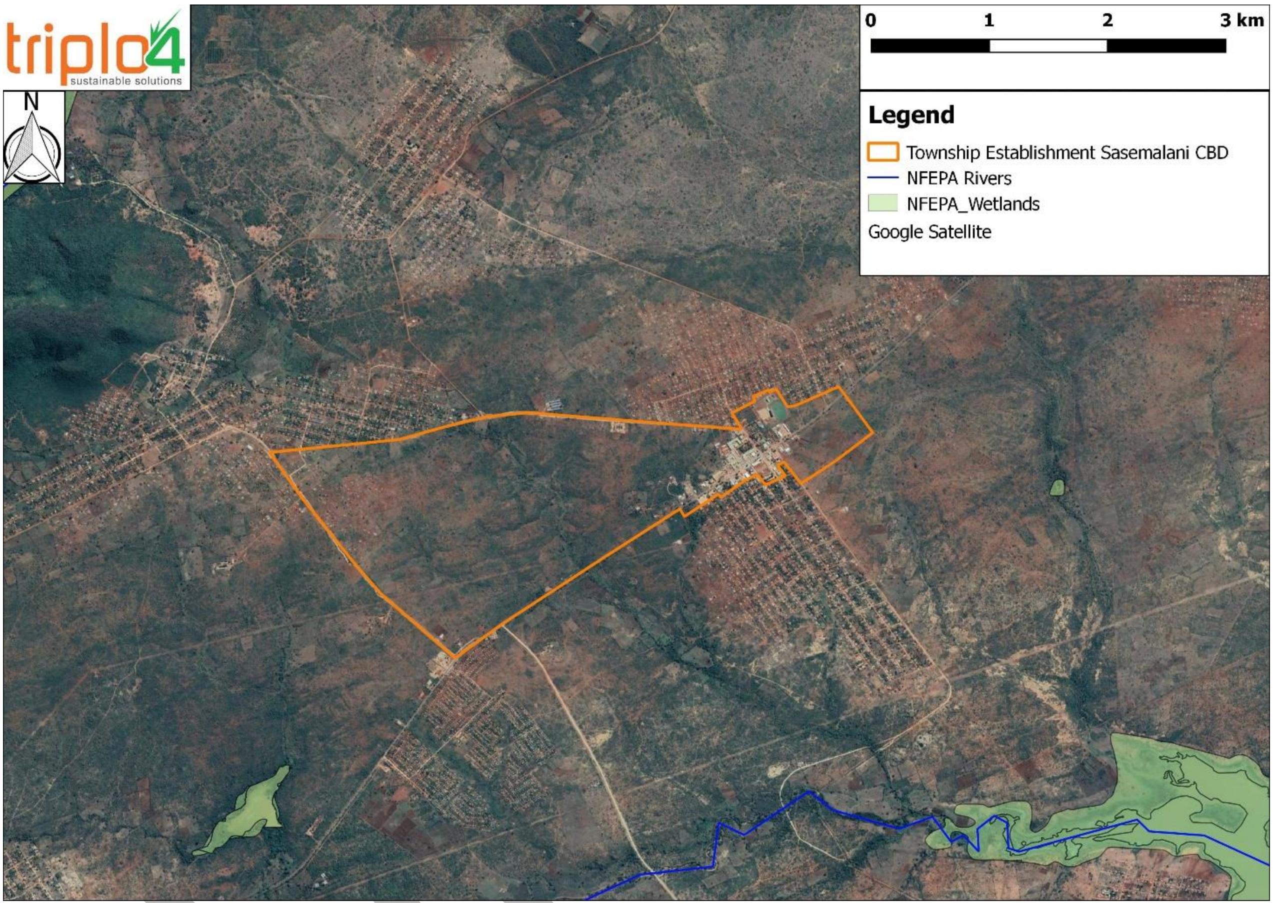

Figure 9: Map of the FEPA Rivers and Wetland in relation to the proposed development, from the NFEPA dataset

5.2. DESKTOP DELINEATIONS & SCREENING

5.2.1.WETLAND DELINEATIONS

The watercourses within the study area were identified on a desktop level, classified and delineated in-field and subsequently mapped utilising GIS (QGIS 2.14 and Google™ Earth Pro) and available spatial data. Figure 10 below demonstrate the delineated watercourses identified within the study area during the field assessment.

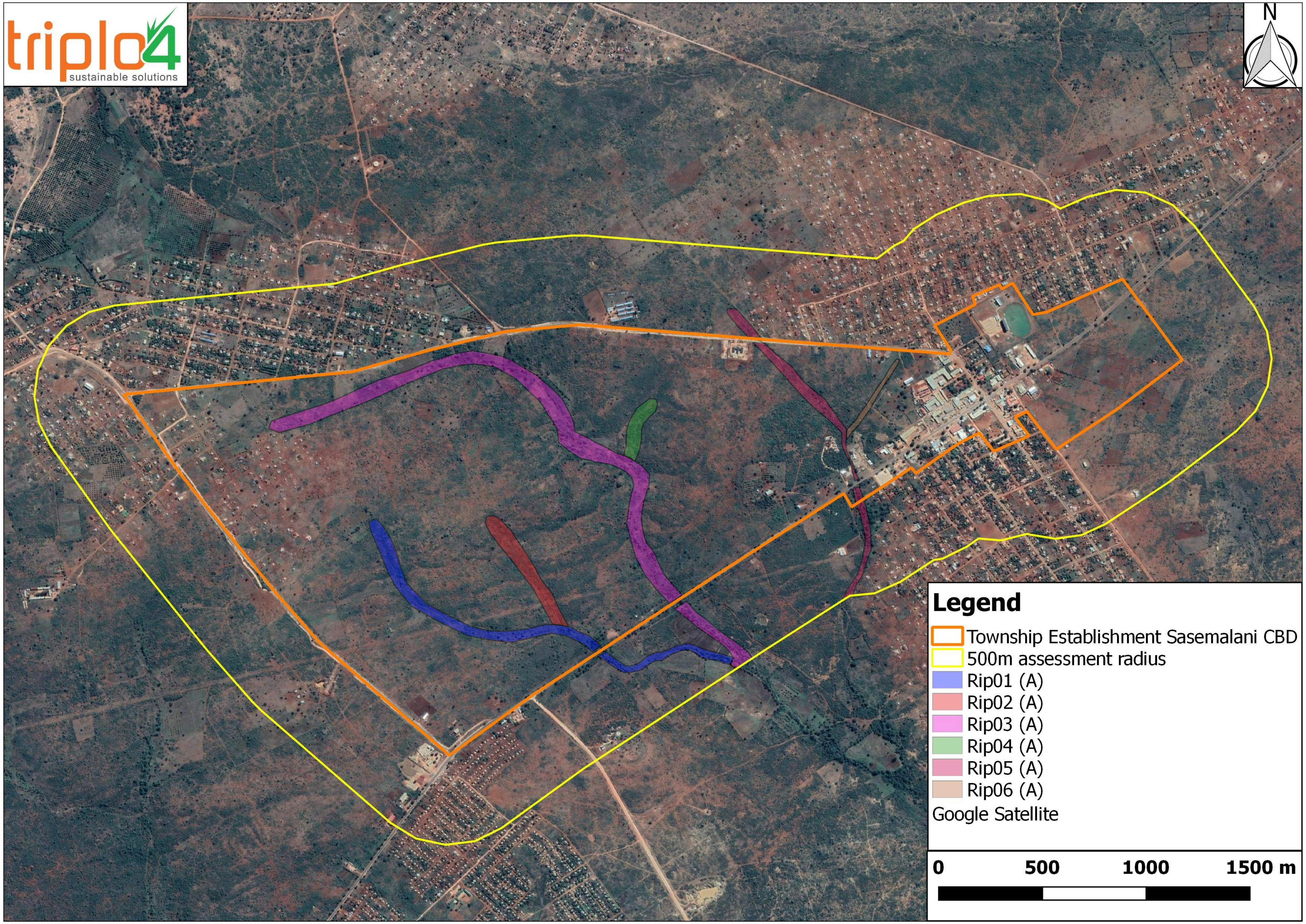

Figure 10 : Map of the in-field delineations of the watercourses identified at the proposed development and study area.

5.2.2. INITIAL IMPACT SCREENING

The infield field assessment phase confirmed the location and extent of the watercourses and subsequent screening provided an indication of which of the watercourses that may potentially be impacted upon by the proposed development. There are several factors which influence the level a watercourse will be impacted upon such as; type of system, position of the system in relation to the construction and position in which the system is located in the landscape. Table 16 below presents the criteria that was used to rank the various watercourses in terms of risk. It must be noted that the criteria provided in Table 16 is utilised as a guideline to identify at risk watercourses and is not indefinite in terms of risk status of watercourses. Table 17 presents the watercourses delineated within the 500m assessment radius and their respective risk status.

Table 16: Criteria utilised to rank the delineated watercourses and wetlands within the 500m assessment radius around the proposed development

RISK RATING	CRITERIA/DESCRIPTION
High	The watercourse/wetland is situated directly within or in close proximity to, or within the same minor catchment area as, the proposed development footprint. Therefore, the aquatic habitat, biota present within, water quality of and/or the hydrological regime through the watercourse/wetland are highly likely to be impacted on by aspects of the proposed development.
Moderate	The watercourse/wetland is situated directly upstream, or within a medium distance (32m to 54m) downstream of the proposed development within the same minor catchment area. This may result in the aquatic habitat, biota present within, water quality of and/or the hydrological regime through the watercourse/wetland being indirectly impacted on by aspects pertaining to the proposed development (e.g. sedimentation, pollution and/or a change in the hydrological characteristics of the system).
No Risk	The watercourse/wetland is situated a significant distance (>54m) upstream or downstream of the proposed development and upgrade, or within a landscape that prevents any direct/indirect impacts that have been determined to originate from the activity from reaching it, and thus is not likely to be impacted on by the proposed development.
	The watercourse/wetland is situated within a completed different minor catchment area to the proposed development, and thus is highly unlikely to be affected by direct or indirect impacts that have been determined to originate from the proposed development.

Table 17: Watercourse Risk Screening

Code	System Type	At risk status	Impacted (High, Moderate, Low, Very)	Reasoning
Rip01 Rip02 Rip03 Rip04 Rip05 Rip06	A Channel Streams	Yes	High	The following riverine systems occur within the proposed development footprint. At this point, the client has not provided a layout of the development, thus it is assumed that all of the footprint is utilised for development. Thus, the riverine systems will be at a high risk as a result of the development and will require further assessment.

6. RIVERINE SYSTEM

The riverine system was assessed individually utilising the Rapid Index of Habitat Integrity (IHI) tool (Kleynhans, 1996, modified by the Department of Water and Forestry (DWAF), 2008). The scores obtained from the Rapid IHI tool (Kleynhans, 1996, modified by the Department of Water and Forestry (DWAF), 2008) form the base-line condition of the assessed systems and provide input into the project-specific mitigation measures pertaining to the impacts associated with the proposed development.

It must, however, be noted that this assessment only provides the condition of the assessed systems at a specific point in time and does not account for seasonal variation. The assessment of the condition or PES of the habitats is based on an understanding of both catchment and on-site impacts and the impact that these aspects have on system hydrology, geomorphology and the structure and composition of riverine vegetation.

The riverine systems description section are grouped together as they occur in the same quaternary catchment with similar impacts to their functionality. It must be noted that all of the systems were identified as A channel streams, A channel streams (ephemeral streams) are streams that do not contain a riparian habitat, thus there is no scoring and description for the riparian aspect.

6.1. A Channel Stream: Rip01, Rip02, Rip03, Rip04, Rip05, Rip06

Table 18: Description of at risk Rip01, which will be impacted upon by the proposed development.

CHARACTERISTIC	B CHANNEL STREAM		
Watercourse Details	Level 1 ecoregion: Lowveld, Quaternary catchments: B90B		
Average longitudinal gradient (~2 km upstream)	1.2%		
Sinuosity	Low		
Flow type	A channel stream		
Reach of system assessed	Rip01 = 2.13km, Rip02 = 0.63, Rip03 = 3.2km, Rip04 = 0.28km, Rip05 = 1.67km, Rip06 = 0.4km		
Channel Dimensions	Riverine system	Width (Active)	Depth
	Rip01	1-4m	1-2m
	Rip02	1-2m	1-2m
	Rip03	1-4m	1-2m
	Rip04	1-2m	1-2m
	Rip05	1-3m	1-2m
	Rip06	1-2m	1-2m
Instream Habitat	Morphology: These systems experience moderate level of sedimentation as a result of historically and current land use practices in the catchment and within these systems. Further to this, transportation of sediment from the instream habitat only occurs during rainfall events as is the nature of ephemeral streams.	Vegetation: The instream zone of these system consist of hydrophilic grasses, indigenous tree species and alien invasive plants (AIPs) due to historically changes in the	

		landscape. The vegetation identified are but not limited to: *Cyperus spp.*, *cymbopogon spp.*, *Vachellia karoo* and degraded grassland.
Riparian Habitat	There are no riparian habitats in A channel streams.	There are no riparian habitats in A channel streams.

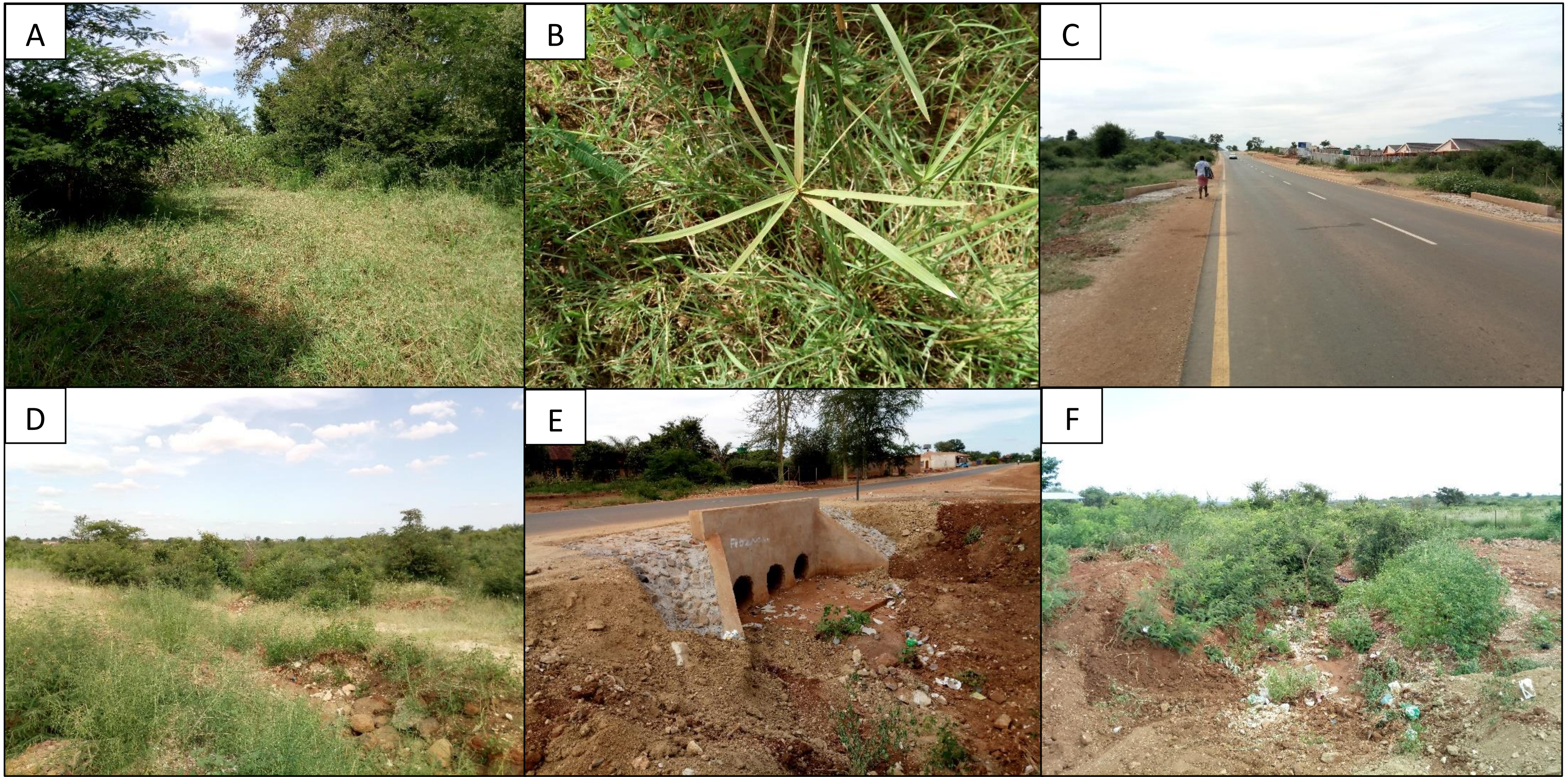

Figure 11: A – Vegetation within instream of Rip03 consisting of AIPs, *Vechillia karoo* and degraded grassland, B - Cyperus spp. found within all riverine systems, C - the typical roads constructed across Rip01, Rip03 and Rip05, D & E - Secondary vegetation, constructed culvert, eroded instream zone and ad hoc waste observed in Rip05, F – Ad hoc waste, alien vegetation and eroded instream zone within Rip06.

Table 19: Rip01 PES Score and rationale

Resource	Study site	IHI (Intact Score %)	Integrity Class	Class	Rationale
A Channel Stream	Instream	54	D	**54 (D) -** (Largely Modified)	The assessed Rip01 A channel stream associated with the proposed development was observed to be situated in a largely modified landscape historically and with current land-use practices. This system is also known as an ephemeral drainage line whose flow occurs during periods of rainfall or 0 – 3 months of the year. The functionality and health of this system has been compromised by activities within the catchment such as informal settlements, footpaths, bare hardened soil surfaces, ad hoc dumping and tar road networks. The aforementioned impacts has modified the system in several aspects such as uptake of water my proliferation of AIPs within the instream environment, the quality of water in the system has been compromised, increase in nutrient levels within the instream environment due to ad hoc dumping and excess transportation of sediment as a result of exposed bare soils, construction of dirt tar road and culverts through system and reduction in diversity of riverine system as a result of anthropogenic changes.
	Riparian	N/A	N/A		

Table 20: Rip02 PES score and rationale

Resource	Study site	IHI (Intact Score %)	Integrity Class	Class	Rationale
A Channel Stream	Instream	60	C/D	**60 (C/D) –** (Moderate to Largely Modified)	The assessed Rip02 A channel stream associated with the proposed development was observed to be situated in a largely modified landscape historically and with current land-use practices. This system is also known as an ephemeral drainage line whose flow occurs during periods of rainfall or 0 – 3 months of the year. The functionality and health of this system has been compromised by activities within the catchment such as informal settlements, footpaths, bare hardened soil surfaces, ad hoc dumping and tar road networks. The aforementioned impacts has modified the system in several aspects such as uptake of water my proliferation of AIPs within the instream environment, the quality of water in the system has been compromised, increase in nutrient levels within the instream environment due to excess transportation of sediment as a result of exposed bare soils and reduction in diversity of riverine system as a result of anthropogenic changes.
	Riparian	N/A	N/A		

Table 21: Rip03 PES and rationale

Resource	Study site	IHI (Intact Score %)	Integrity Class	Class	Rationale
A Channel Stream	Instream	41	D	**41 (D) -** (Largely Modified)	The assessed Rip03 A channel stream associated with the proposed development was observed to be situated in a largely modified landscape historically and with current land-use practices. This system is also known as an ephemeral drainage line whose flow occurs during periods of rainfall or 0 – 3 months of the year and was the largest system on site. The functionality and health of this system has been compromised by activities within the catchment such as informal settlements, footpaths, bare hardened soil surfaces, ad hoc dumping and tar road networks. The aforementioned impacts has modified the system in several aspects such as uptake of water my proliferation of AIPs within the instream environment, the quality of water in the system has been compromised, increase in nutrient levels within the instream environment due to excess transportation of sediment as a result of exposed bare soils, construction of tar road and culvert through the system and reduction in diversity of riverine system as a result of anthropogenic changes.
	Riparian	N/A	N/A		

Table 22: Rip04 PES and rationale

Resource	Study site	IHI (Intact Score %)	Integrity Class	Class	Rationale
A Channel Stream	Instream	67	C	**67 (C) -** (Largely Modified)	The assessed Rip04 A channel stream associated with the proposed development was observed to be situated in a largely modified landscape historically and with current land-use practices. This system is also known as an ephemeral drainage line whose flow occurs during periods of rainfall or 0 – 3 months of the year and was the smallest system on site. The functionality and health of this system has been compromised by activities within the catchment such as informal settlements, footpaths, bare hardened soil surfaces, ad hoc dumping and tar road networks. The aforementioned impacts has modified the system in several aspects such as uptake of water my proliferation of AIPs within the instream environment, the quality of water in the system has been compromised, increase in nutrient levels within the instream environment due to excess transportation of sediment as a result of exposed bare soils and reduction in diversity of riverine system as a result of anthropogenic changes.
	Riparian	N/A	N/A		

Table 23: Rip05 PES and rationale

Resource	Study site	IHI (Intact Score %)	Integrity Class	Class	Rationale
A Channel Stream	Instream	37	E	**37 (E) -** (Seriously Modified)	The assessed Rip05 A channel stream associated with the proposed development was observed to be situated in a largely modified landscape historically and with current land-use practices. This system is also known as an ephemeral drainage line whose flow occurs during periods of rainfall or 0 – 3 months of the year and was traversed by the construction of two tar road networks and culverts. The functionality and health of this system has been compromised by activities within the catchment such as informal settlements, footpaths, bare hardened soil surfaces, ad hoc dumping and tar road networks. The aforementioned impacts has modified the system in several aspects such as uptake of water my proliferation of AIPs within the instream environment, the quality of water in the system has been compromised, increase in nutrient levels within the instream environment due to excess transportation of sediment as a result of exposed bare soils, especially near construction tar roads and culverts and reduction in diversity of riverine system as a result of anthropogenic changes.
	Riparian	N/A	N/A		

Table 24: Rip06 PES and rationale

Resource	Study site	IHI (Intact Score %)	Integrity Class	Class	Rationale
A Channel Stream	Instream	42	D	**42 (D) -** (Largely Modified)	The assessed Rip06 A channel stream associated with the proposed development was observed to be situated in a largely modified landscape historically and with current land-use practices. This system is also known as an ephemeral drainage line whose flow occurs during periods of rainfall or 0 – 3 months of the year and was traversed by the construction of a tar road network, culvert and informal settlements. The functionality and health of this system has been compromised by activities within the catchment such as informal settlements, footpaths, bare hardened soil surfaces, ad hoc dumping and tar road networks. The aforementioned impacts has modified the system in several aspects such as uptake of water my proliferation of AIPs within the instream environment, the quality of water in the system has been compromised, increase in nutrient levels within the instream environment due to excess transportation of sediment as a result of exposed bare soils, especially near construction tar roads, culverts and informal settlements; and reduction in diversity of riverine system as a result of anthropogenic changes.
	Riparian	N/A	N/A		

6.2. Riverine System: Functional Importance

To ensure informed planning and decision-making, which considers the value of the numerous ecosystems and their ecosystem services, the functions of the systems need to be outlined. The typical role of riverine habitats is discussed below.

The riverine zone has specific important biotic and abiotic characteristics which are important for the continued functioning of the riverine system and ensuring the provision of goods and services. According to Rogers (1995) the riverine zone must be considered and managed not in isolation but with full awareness of its roles and functions in the landscape as a whole. There are numerous functions associated with riverine zones including (but not limited to):

- The binding action of riverine plant roots on the soil would reduce erosion of the stream bed and banks during flooding and elevated flows;
- Similarly, the changes in flow characteristics caused by the vegetation results in increased deposition of both organic and inorganic suspended materials within the macro-channel which in turn results in a decrease in flood energy;
- Certain fauna may utilise the riverine zone during parts of their life cycles and others may be confined solely to the system;
- Despite the presence of some alien invasive species occurring in the riverine zone, it nevertheless forms a centre of species biodiversity within the surrounding landscape;
- More generally, the riverine zone provides an aesthetic quality to the overall landscape of the area; and
- The riverine zone is commonly considered a corridor for the movement of animals and it is also important for the dispersal of plants (Naiman and Decamps, 1997).

6.3. Riverine System: Ecological Importance and Sensitivity (EIS)

The EIS of riverine systems is an expression of the importance of the water resource for the maintenance of biological diversity and ecological functioning on local and wider scales; whilst Ecological Sensitivity (or fragility) refers to a system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (Kleynhans & Louw, 2007).

Table 25 below illustrates the EIS which are calculated for Rip01 – Rip06. According to Kleynhans (2007) streams with a High EIS usually consist of many variables which may be sensitive to flow modifications and often have a substantial capacity for use. Systems with a Moderate EIS are observed to have a relatively high number of aspects which can be influenced by alterations to the hydrological regime, or changes to water quality. Alternatively, the Low EIS systems may have one or a few elements which may be sensitive to changes in water quality and the hydrological regime (Kleynhans & Louw, 2007).

There were no rare/endangered species/biota identified on site for all the riverine systems and no potential habitat for rare/endangered species/biota. It must be noted that within a landscape which has been greatly modified, especially the catchment, the stream networks and associated riverine systems maintain ecological linkages between upstream sites and the broader river valley downstream. There is also a lateral linkage between adjacent terrestrial vegetation and the riverine vegetation in terms of ecological functions (e.g. reducing runoff energy, soil stability) in all riverine systems.

Table 25: Table illustrating the overall Ecological Sensitivity and Importance (EIS) of the high risk Riverine Systems (EC= Ecological Category).

High Risk Riverine Systems		
Resource	**Overall EIS Score**	**Category**
Perennial (Rip01 – Rip06)	0.50 (EC=D)	**Low**

7. BUFFER ZONE DETERMINATION

It is recommended that the buffer zone, which was calculated for the at-risk riverine systems which may potentially be impacted on by the proposed development utilising the DWS buffer zone tool (Macfarlane *& Bredin*, 2016) be applied. The following activities and the proposed development footprint should not be conducted within the calculated buffer zones: no ablution facilities, washing of vehicles, stockpiling, waste dumping (organic or artificial), access roads, haulage roads, site camps and any other activities which may be detrimental to the health and functionality of the watercourse. Additionally, any unauthorised, or potentially detrimental activities, which occur in the direct vicinity, or upstream, of the watercourse should be rehabilitated according to the site EMPr, and preventative or mitigation strategies Table 26 and Figure 12 below provide the recommended buffer zone relative to the study area.

Table 26: Recommended buffer zones for the watercourse that will be impacted on by the proposed development (Macfarlane & Bredin, 2016).

Watercourse	Construction Phase (m)	Operational Phase (m)
Riverine systems (Rip01 – Rip06	18	18

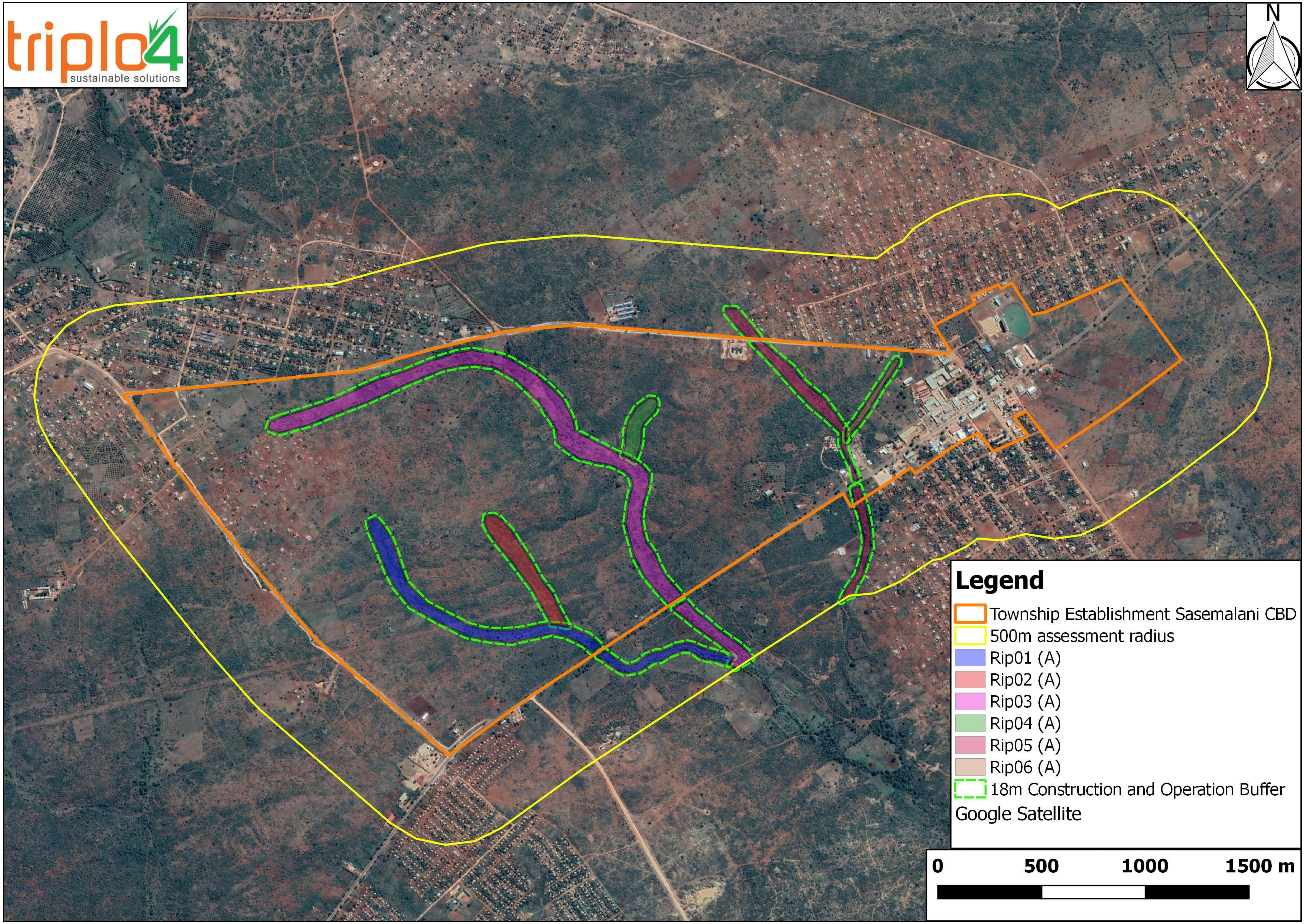

Figure 12: Map illustrating the calculated buffer segments for the watercourses delineated within the 500m assessment radius.

8. IMPACT AND RISK ASSESSMENT

8.1. Impact Assessment and DWS Risk Assessment Matrix (RAM)

An understanding of the relationship between the landscape and the dynamic characteristics of watercourse is vital for the accurate assessment of the watercourses functions and values. Watercourses are adjusting to disturbance occurring within them and within the greater landscape, on a continuous basis. The recognition to what extent these various disturbances have on watercourse and their associated PES and EIS is vital when assessing disturbance and impact and when considering mitigative measures.

The types of impacts on watercourses can be categorised into three (3) broad categories, namely; direct, indirect and cumulative impacts. Direct impacts are associated with disturbances occurring within the system such as canalisation, infilling, removal of indigenous vegetation and infrastructure development. Indirect impacts include disturbances outside the system, such as increased surface water and sediment runoff, loss of recharge area and changes in local drainage patterns. Cumulative impacts include disturbances resulting from combined direct and/or indirect impacts to the system over time.

The direct and indirect impacts associated with the proposed development are grouped into three (3) encapsulating impact categories where associated or interlinked impacts are grouped. Impacts have been separated into construction and operational phases of the development within these categories. The various aspects of the proposed construction activities have been assessed and are presented in the below Section 8.2.

8.2. DWS Risk Assessment Matrix (RAM)

The DWS has published an amendment of the GN 509 Section 21 (c) and (i) activities in terms of the NWA (No. 36 of 1998). The purpose of the authorisation is as follows:

> *"This General Authorisation replaces the need for a water user to apply for a license in terms of the National Water Act (No.36 of 1998) ("the Act") provided that the water use is within the limits and conditions of this General Authorisation."*

The reason for this amendment is to streamline the WULA process by allowing projects that are calculated to pose a low risk of impacting on the surrounding aquatic environment to be granted under a GA instead of having to undergo a full WULA process. The risk rating of each aspect pertaining to all the construction activities associated with the proposed development is calculated using the DWS RAM (DWS, 2016). Any aspect that is assessed to pose a moderate or high risk of impacting on the surrounding freshwater environment will trigger the need for the proposed development to undergo a full WULA process. However, if all the aspects are calculated to be of negligible-to-low risk the proposed development may be authorised under a GA, as per GN509 (26 August 2016), which was drafted under the NWA (No. 36 of 1998).

The strength of the revised DWS RAM is that the critical components of each impact, namely duration, extent, magnitude, probability and significance, are carefully considered, allowing for a balanced perspective of each impact to be gained. Subsequent to conducting the RAM for the proposed development it was determined that the certain aspect did not have the ability to be mitigated from a moderate to low risk rating. Therefore, in line with GN509 of 26 August 2016, which was drafted in accordance with the NWA (No. 36 of 1998), as well as the specialist's opinion, the proposed development will require to undergo a full WULA process through the Department of Water and Sanitation (DWS).

Table 27: Evaluation of potential impacts of the proposed development and upgrade on the surround watercourses (Presented in a summarised DWS RAM).

Phases	Activity	Aspect	Impacts	Type of Impact	Severity	Consequence	Likelihood	Significance	Risk Rating Pre-mitigation	Control measures	Risk Rating Post-Mitigation
Pre C	Establishment of the site camp and the erection of temporary stores, offices, workshops and ablution facilities on precast yards within a previously disturbed area at least 50m away from any watercourse	Increase in surface-area of hardened surfaces.	Potential encroachment by invasive and alien plant species; Potential destruction of native and/or indigenous plant species; Disruption to soil profile and consequent creation of excess sediment; Compaction of the soil profile; Potential alteration to the physcio-chemical properties of the downstream watercourses; Potential pollution of groundwater and surrounding watercourses if erected ablution facilities are poorly maintained.	Direct	1.25	3.25	8	26	Low		N/A
Pre C		Clearing and grubbing.		Direct	1	3	8	24	Low		N/A
Pre C & C		Potential application of herbicide to clear land.		Direct and Indirect	1.5	3.5	8	28	Low		N/A
Pre C	Demarcation of buffer zones and no-go areas and the allocation/preparation of spoil sites (topsoil separate from subsoil), waste dump sites and construction vehicle routes.	Erection of silt fencing around all spoil sites and waste dumps (including coverage).	Disruption of the soil profile and thus creation of excess sediment; Potential noise and air pollution as a result of on-site waste dump sites; The potential increase of preferential drainage parts as a result of construction vehicles creating unauthorised pathways; Compaction of topsoil as a result of construction vehicles baring excess weight on soil. Removed topsoil and subsoil which will be utilised for rehabilitation purposes contaminated by alien invasive plant species and loss due to natural wind mechanism.	Direct and Indirect	1	3	8	24	Low		N/A
Pre C & C		The dumping of waste and spoil at the designated sites using haulage routes.		Direct and Indirect	1.5	3.5	8	28	Low		N/A
Pre C & C		Input of dropper, or wooden poles to extend danger tape on, or paint poles.		Indirect	1	3	8	24	Low		N/A
Pre C & C	Construction vehicle movement during the lifespan of the proposed development.	Movement of construction vehicles over loose soil particles.	Disruption of the soil profile, and thus potential sedimentation of downstream systems; Concentrated flow entering the adjacent environment; Increased frequency, velocity and volume of stormwater flow into the downstream watercourses.	Direct and Indirect	1.75	3.75	10	37.5	Low		N/A
Pre & C		Different soil structures baring excess weight.		Direct and Indirect	1.5	3.5	8	28	Low		N/A
Pre C & C		Accidental spillage of harmful pathogens (e.g. hydrocarbons, oil, cement, asphalt).		Direct and Indirect	1.75	3.75	11	41.25	Low		N/A

C	Construction of the mixed-use development (i.e. apartments, business hubs, amenities and open spaces).	Setup a concrete batch plant onsite (if contractor does not utilise a commercial ready mix concrete supplier).	Contamination of the surrounding terrestrial and aquatic environments by concrete mix or hydrocarbons; Sedimentation of downstream resources; Increased hardened surfaces and thus higher energy surface and stormwater runoff into the downstream resources; loss of habitat for species within the area; Potential contamination of sediment and groundwater due to continuous cement spills and poor construction ethics.	Direct and Indirect	1.5	3.5	10	35	Low		N/A
C		Piling and construction of concrete footings.		Direct and Indirect	1.5	3.5	10	35	Low		N/A
C		Construction of new sewage lines.		Indirect	1.25	5.25	10	52.5	Low		N/A
C		Construction of new water mains.		Indirect	1.5	5.5	9	49.5	Low		N/A
C		Construction of apartments, amenities and package plant/septic tanks in close proximity to the buffer of the watercourses		Direct and Indirect	1.75	6.75	10	67.5	Moderate	Avoidance of entering wetland environments and their associated buffers. Wetland areas and associated buffers should be clearly demarcated as no go areas. Silt fences should be erected to ensure that no excess sediment enters nearby sensitive watercourses. No construction and foreign construction material should enter nearby sensitive watercourses.	Low
C	Construction of new stormwater infrastructure.	Trenching for stormwater infrastructure	Disruption of the soil profile, and thus potential sedimentation of downstream systems; Concentrated flow entering the adjacent environment; Increased frequency, velocity and volume of stormwater flow into the downstream watercourses.	Direct and Indirect	1.25	5.25	9	47.25	Low		N/A
C		Concrete batching.		Indirect	1.75	3.75	9	33.75	Low		N/A
C		Construction of the relevant stormwater attenuation area		Direct and Indirect	1.5	5.5	9	49.5	Low		Low
R	De-establishment of the site camp, spoil sites, waste dumps etc. and the rehabilitation of the temporary access/haulage roads.	Tillage of areas of bare-soil and revegetation using a mixture of indigenous grass species.	**Positive impacts**: Increase surface roughness and reduce the velocity of the surface runoff; Decrease erosion potential; Increase biodiversity; Remove all potential contaminants; Reinstate natural topography.	N/A	1	3	8	24	Low		N/A
R		Reshape local topography to natural slope if necessary.		N/A	1	3	8	24	Low		N/A
O	Use of the proposed mixed-use development by residents, business owners and surrounding community	Increased risk of pollution (e.g. litter, hydrocarbons and utilisation of package plant/septic tanks).	Removal of vegetation cover and loss of biodiversity; Destruction of aquatic and terrestrial habitats and loss of faunal species; Soil compaction and thus increased surface runoff and decreased	Direct and Indirect	2.5	7.5	14	105	Moderate	Ensure that all sewage infrastructure are constructed outside all delineated watercourses and their associated buffer zones. If leaks occur, these should be immediately reported to the body cooperate agency and	Moderate

			infiltration/permeability; Increased friction against rainfall and surface runoff with the addition of vegetation; Increased opportunity for groundwater and watercourse contamination as a result of leaks from sewer lines and leakages from residentially vehicles; Increased potential of erosional features if stormwater is not managed in terms of discharge velocity and discharge area.							repaired in rapid succession before sewer pollutes nearby watercourses and groundwater. All discharged sewer waters into watercourses must be treated to the South African Water Quality standards for aquatic ecosystems before discharged. The discharged point must be well vegetated with wetland vegetation and gabion walls to reduce scouring of watercourse. If septic tanks are utilised over package plant, honey-sucker must utilization must be scheduled and ensure no spillage of effluent occur. The effluent collected by the honey-sucker must be disposed of at a registered WWTW's which has a WULA license.	
O		Increased risk of the regional population harvesting local fauna and flora from the surrounding environment.		Direct and Indirect	1	3	8	24	Low		N/A
O		Increased risk of vehicles creating unauthorised tracks.		Direct and Indirect	1	3	8	24	Low		N/A

9. MITIGATION MEASURES

9.1. GENERAL MITIGATION MEASURES

9.1.1.Pre- Construction Phase

Drainage and runoff control should utilise the following mitigation measures:

- Runoff from disturbed areas to be directed to silt traps (silt fences and sandbags to remove sediment and reduce the sedimentation of the water bodies).
- Ensuring that a suitable drainage system is in place before construction on a site takes place is important to keep the area as dry as possible and thereby reducing the amount of erosion.
- The area where water disperses out of a drain must be suitable for such and must not be susceptible to erosion.
- A grass-lined channel conveys storm water runoff through a stable conduit. Vegetation lining the channel slows down concentrated runoff.
- Direct discharges of runoff from developed/ disturbed areas to receiving waters should be avoided wherever possible. This involves the use of collection/conveyance through closed conduits. Runoff should be routed through one or a combination of runoff treatment practices.
- Water discharged into the environment (e.g.: from trench dewatering) must be done so in a manner that is not conducive to erosion and does not result in heavily silt-, nutrient-, toxic and pathogen-laden water flowing into any water resource/river. In this regard, storm water divert through dense vegetation (to act as a filter) before re-entering the river.

9.1.2.Construction Phase

During site clearing, the following mitigation measures must be observed:

- Construction clearing must be phased, the entire footprint of the proposed development must not be cleared and left exposed.
- By minimising the area of soil disturbance and the amount of earthworks required the impact of construction and operations (especially the sedimentation of water bodies) can be greatly reduced.
- Clearing and grading should occur only where absolutely necessary to build and provide access to structures and infrastructure. Clearing should be done immediately before construction, rather than leaving soils exposed for months or years.
- Where possible, plants should be cut down to ground level instead of being removed completely to stabilise the soil during land-clearing operations.
- Site fingerprinting involves clearing only those areas essential for conducting construction activities, leaving other areas undisturbed. The proposed limits of land disturbance should be physically marked off to ensure that only the land area required for buildings, roads, and other infrastructure is cleared.
- Vegetation on steep slopes should be avoided and preserved through fencing, signage, and site plan notations.
- When excavated areas are backfilled the surface must be level with the surrounding land surface, to minimise soil erosion from the areas when the excavation is complete.
- To prevent unnecessary sediment loading of waterbodies, the construction of infrastructure should be carried out in the months without high rainfall (April – August), thus during winter preferably as soil stockpiles can be washed into watercourses during heavy rainfall events.
- Excavators should be used instead of bulldozers in areas sensitive to erosion (e.g. steep areas and unstable soils).
- Topsoil conservation should be conserved through the following ways:
    - Storing topsoil separately from subsoil in a bunded area,
    - Covered with hessian mats, and
    - Ensure no proliferation of AIP occur within the exposed soil layers.

- During excavation, soil should be excavated one layer at a time and stored in separate stockpiles so they can be returned in their natural order when the area is backfilled. This improves soil functions and improves the template for plant growth.
- Topsoil should be removed from sites that will be disturbed (e.g. by construction) and stored in a secure bunded area outside of the 1:100 year flood line if there is any on site and separate from overburden and construction material.
- Unprotected stockpiles are very prone to erosion and therefore must be protected. Small stockpiles can be covered with a tarp to prevent erosion. Large stockpiles should be stabilized by erosion blankets, seeding, and/or mulching.

Construction management to include the following mitigation measures:

- No mixed concrete shall be deposited directly onto the ground. A batter board or other suitable platform/mixing tray is to be provided onto which any mixed concrete can be deposited whilst it awaits placing.
- Concrete spilled outside of the demarcated area must be promptly removed and taken to a permitted waste disposal site.
- Wash water from cement is not to be released into the environment. This water must be collected, stored and disposed of at an approved site.
- Concrete wash water are typically alkaline substance and contains high levels of chromium, which must be disposed of by installing concrete washout facilities not only prevents pollution but also is a matter of good housekeeping.
- Concrete and cement-related mortars can be toxic to aquatic life. Proper handling and disposal should minimize or eliminate discharges into watercourses. Fresh concrete and cement mortar should not be mixed on-site, and both dry and wet materials should be stored away from water bodies and storm drains. These materials should be covered and contained to prevent contact with rainfall or runoff.

Soil stabilisation to include the following mitigation measures:

- Gullies and other areas of active erosion should be stabilised (using catch water drains, raising headwalls or providing protective measures including grassing, stone pitching, concrete paving or gabions/ mattresses) and rehabilitated to minimise sediment entering the aquatic resource from these sources.
- Stabilization practices (e.g. re-vegetation) should occur as soon as possible after grading and construction occurs within a portion of the proposed development, especially those areas that are prone to erosion.
- Slope stabilisation involves covering the exposed slope with stockpiled topsoil, then using mats, pegs, mesh and grass to stabilise the topsoil and allow re-vegetation, which should be facilitated using indigenous plants. Effective stabilisation practices should be utilised, this could include:
    - Mulching is an erosion control practice that uses materials such as grass, hay, wood chips, wood fibres, straw, or gravel to stabilize exposed or recently planted soil surfaces. In addition to stabilizing soils, mulching can reduce stormwater velocity, improve the infiltration of runoff and add nutrients to the soil (instead as using fertilizer). Specific types of mulching also mentioned are hydro-mulching and straw mulching (below).
    - Hydro-mulching is a process by which wood fibre mulch, processed grass, hay or straw mulch is applied with a tacking agent in a slurry with water to provide temporary stabilization of bare soils. This mulching method provides uniform, economical slope protection. It may be combined with hydroseeding as a revegetation method.
    - Critical area planting is the planting of grasses, legumes, or other vegetation to permanently stabilize slopes in small, severely eroding areas. The vegetation stabilizes areas such as gullies, over-grazed hillsides and terraced backslopes. Although the primary goal is erosion control, the vegetation can also provide nesting cover for birds and small animals.

- Sodding is a permanent erosion control practice and involves laying a continuous cover of grass sod on exposed soils. Sodding stabilizes disturbed areas and reduces the velocity of stormwater runoff. It provides immediate vegetative cover for critical areas and stabilize areas that cannot be readily vegetated by seed and during the vegetation establishment period when there is high erosion potential. It also can stabilize channels that convey concentrated flows and reduce flow velocities.64,
- A compost blanket is a layer of loosely applied compost or composted material that is placed on the soil in disturbed areas to control erosion and retain sediment resulting from sheet-flow runoff. When properly applied, the erosion control compost forms a blanket that completely covers the ground surface. This blanket prevents stormwater erosion by (1) presenting a more permeable surface to the oncoming sheet flow, thus facilitating infiltration; (2) filling in small rills and voids to limit channelized flow; and (3) promoting establishment of vegetation on the surface. Composts used in compost blankets are made from a variety of feedstocks, including municipal yard trimmings, food residuals, separated municipal solid waste, bio solids, and manure.
- Geotextiles are porous fabrics that can be used in various ways (usually just covering the soil) for erosion control.
- Brush barriers are perimeter sediment control structures constructed of material such as small tree branches, root mats, stone, or other debris left over from site clearing and grubbing. Brush barriers can be covered with a filter cloth to stabilize the structure and improve barrier efficiency.

Sedimentation and erosion control measures are to be implemented to prevent slope destabilisation and increased sediment loads entering freshwater systems. Mitigation measures may include:

- Exposed slopes are highly prone to erosion, so drainage control features such as earth dikes, perimeter dikes/swales, and diversions can be used to intercept and convey runoff from above disturbed areas to suitable dispersal areas or drainage systems. This helps to reduce the sedimentation from exposed areas.
- Sediment traps detain sediments in stormwater runoff to protect receiving water bodies, and the surrounding area. The traps are formed by excavating an area or by placing an earthen embankment across a low area or drainage swale. An outlet or spillway is often constructed using large stones or aggregate to slow the release of runoff.
- A gravel or stone filter berm is a temporary ridge made up of loose gravel, stone, or crushed rock that acts as an efficient form of sediment control.
- Silt fences (or filter fabric fences) are lengths of filter fabric entrenched in the ground and stretched between anchoring posts spaced at regular intervals along the lower side of a site. They are available in several mesh sizes from many manufacturers. Sediment is filtered out as runoff flows through the fabric. Such fences should be used only where there is sheet flow (no concentrated flow).
- The use of live stakes involves inserting and tamping live, rootable vegetative cuttings into the ground to create a living root mat that stabilizes the soil by reinforcing and binding soil particles together and extracting excess soil moisture. Live stakes are appropriate for repairing small earth slips and slumps caused by excessively wet soil and should be used only at sites with relatively uncomplicated conditions. They are especially useful when construction time is limited and an inexpensive method is desired. They can be used to secure erosion control measures and can be used in combination with other bioengineering techniques. Finally, they facilitate plant colonization by providing a favourable microclimate for plant growth. Native species that are appropriate for the soil conditions onsite should be used where possible.
- Fascines are long bundles of branch cuttings bound together into sausage-like structures. They are installed in contoured or angled trenches and are secured to the slope with both live and dead stakes. They reduce surface erosion and rilling, protect slopes from shallow slides, and reduce long slopes into a series of shorter slopes that trap and hold soil. They also enhance vegetative growth by creating a microclimate conducive to plant growth.

- Brush layering is much like the fascine technique except branches are placed perpendicular to the slope contour. This method is more effective than fascines with respect to earth reinforcement and mass stability. Brush layers break up the slope length, preventing surface erosion, and reinforce the soil with branch stems and roots, providing resistance to sliding or shear displacement. Brush layers also trap debris, aid infiltration on dry slopes, dry excessively wet sites, and mitigate slope seepage by acting as horizontal drains. Brush layers facilitate vegetation establishment by providing a stable slope and a favourable microclimate for growth of vegetation.
- Live gully repair is a technique that is similar to branch packing but is used to repair rills and gullies. Live gully repairs offer immediate reinforcement and reduce the velocity of concentrated flows. They also provide a filter barrier that reduces further rill and gully erosion
- A live cribwall is a hollow, boxlike structure of interlocking untreated logs or timber members installed with backfill material and layers of live branch cuttings. The live cuttings eventually take over the structural functions of the wall once the roots have become established. Live cribwalls are appropriate for stabilizing the toe of a slope and reducing its steepness. They should not be used in areas that are subject to large lateral stresses. Cribwalls provide both immediate and long-term stabilization and are useful where space is limited. They should be tilted if the system is built on a smoothly sloped surface, or they can be constructed in a stair-step fashion.
- Vegetated rock gabions consist of wire mesh or chain-link baskets layered with live branch cuttings that take root inside the gabions and bind the structure to the slope. These structures are appropriate for stabilizing the toe of a slope and reducing its steepness, especially in areas where space is limited. They should not be used in areas that are subject to large lateral stresses and should not be more than 5 feet tall.
- Vegetated rock walls consist of a combination of rocks and live branch cuttings used to stabilize the toe of steep slopes. These structures are appropriate for stabilizing areas where space is limited and natural rock is available. The wall should not exceed 1.5 m in height.
- Joint planting stabilizes slope faces by planting live cuttings in spaces between the stones of riprap. The plantings improve drainage, bind rock materials to the slope, and help prevent washout of fine materials. Joint planting can be used where riprap has already been installed, or it can be part of a new riprap installation.
- Retaining walls can be used to decrease the steepness of a slope. If the steepness of a slope can be reduced, the runoff velocity and erosion potential can be decreased. They also hold soil in place preventing steep banks from failing.
- Sediment capturing involves the utilisation of structural and vegetative practices to reduce sediment loads in runoff through capture as well as settling due to the reduced velocity of the runoff.
- Sediment basins and rock dams can be used to capture sediment from stormwater runoff before it leaves a site. Both structures allow a pool to form in an excavated or natural depression, where sediment can settle. The pool is dewatered through a single riser and drainage hole leading to a suitable outlet on the downstream side of the embankment or through the gravel of the rock dam. The water is released more slowly than it would be without the control structure.

Pollution controls such as the following should be utilised at all times:

- General pollution control mitigation measures may include:
    - If soil contamination occurs (such as due to a spill) the soil should be removed from the site and disposed of appropriately.
    - Prevention of spills eliminates or minimizes the discharge of pollutants to water bodies. Water bodies adjacent to sites utilising chemicals (e.g. construction sites) are at highest risk of contamination from an uncontained spill. Several steps can be taken to reduce the risks: handle hazardous and non-hazardous materials, such as concrete, solvents, asphalt, sealants, and fuels, as infrequently as possible and observe all federal, state, and local regulations when using, handling, or disposing of these materials.
    - An effective response plan must be in place and personnel must be ready to mobilise in the event of a spillage to reduce the environmental effects of an oil or chemical spill.

- Spill control devices such as absorbent snakes and mats should be placed around chemical storage areas, and they can be used in an emergency to contain a spill.
- Paints should be mixed where spills can be recovered or cleaned easily, and an impermeable ground cloth should be used while painting. Paint chips and scrapings might contain lead and should be managed properly to prevent contamination of water or soil. Paint buckets and barrels of materials should be stored away from contact with runoff.

- Work vehicles must be maintained as follows:
    - Implement preventative maintenance system to ensure that work vehicles are maintained in an acceptable condition. This would involve routinely checking vehicles for leaks before construction begins; and not allowing vehicles with significant leaks to operate or be repaired within the construction site. Ideally, vehicle maintenance and washing occurs in garages and wash facilities, not on active construction sites.
    - Old engine oil must NOT be thrown on the ground or down a stormwater drain but rather collected in containers and recycled.
    - Before an operation occurs near a waterbody vehicles should be checked for leaks, to reduce soil and water contamination from vehicle fluids.
    - Re-fuelling areas for vehicles should be bunded and located away from water resources and sensitive environments to prevent any accidental spillage contaminating soil or seeping into groundwater aquifers. All servicing area runoff should be directed towards a fully contained collection sump for recovery and appropriate disposal.
    - It is important when washing and maintaining equipment (i.e. construction vehicles and equipment) to adhere to certain pollution prevention measures. The flow of water resulting from cleaning construction vehicles and equipment, must be discharged to the sanitary sewer and is not allowed in storm drains.
    - When cleaning greasy equipment or trucks, a special cleaning area should be designated and equipment installed to capture, pre-treat, and discharge the wash water to the sanitary sewer. In addition, instructional signs that prohibit changing vehicle oil, washing with solvents, and other activities should be posted in non-wash areas.
    - Sumps or drain lines should be installed to collect wash water for treatment and discharge to the sanitary sewer.
- Stockpiles and solid waste must follow the below mitigation measures:
    - Ensure that appropriate solid waste disposal facilities are provided and adequate signage is provided for all solid, liquid and hazardous waste types. These should contain waste products in a weatherproof manner and to prevent any airborne litter, access to scavengers or loss of food residues that may be washed into surface or ground waters. Collected waste needs to be disposed of at a registered landfill site/hazardous waste facility.
    - One of the best and least-expensive ways to reduce pollutants in runoff is to limit the exposure and contact of materials to rainfall and runoff. The contractor should be advised to keep dumpsters and other containers securely closed, store containers under cover, and cover stockpiled materials, such as gravel and wood chips with plastic sheeting.
    - Pooling of water must be minimised to reduce erosion.

Site management during construction to include the following mitigation measures:

- Velocity abatement should be used to reduce sedimentation where necessary.
- Dust must be controlled by spraying with water or other non-toxic dust allaying agents, reducing drop distances, covering equipment and storage piles as well as reducing the speed of vehicles.
- Seeding is a method used to re-vegetate exposed areas to provide long-term erosion control. It can also be used to re-vegetate contaminated areas and areas susceptible to erosion.
- Grass and legume seeding is a form of re-vegetation of bare soils used to prevent erosion. Native plants, domesticated native plants and introduced agronomic species are all useful for re-vegetation.

- Although indigenous grasses are most favourable, various types of grass can be used to speed up the re-vegetation of disturbed sites that take long to recover. This provides greater soil stability and reduces erosion in the interim, until the native vegetation takes over.
- All natural waterways within a development site should be clearly identified before construction activities begin.
- Alien and invasive vegetation have a number of detrimental effects on water quality, from nutrient enrichment to increased erosion and excessive water use, which is especially relevant in dry areas or in important catchments. Invasive species are highly likely to colonise disturbed areas, even after rehabilitation and follow-up clearing must be done until healthy vegetation returns to the site.
- Areas (away from surface water bodies and outside of the riparian zone) should be designated for the storage of materials (e.g. building sand/ stockpiled topsoil or manure) and mixing of materials (such as concrete or chemicals). This reduces contamination of water resources from these materials/ activities.
- Develop and implement proper environmental management and auditing systems to ensure that pollution prevention and impact minimisation plans and measures are implemented.
- Inspections of new on-site systems during and immediately following construction/installation should be undertaken to ensure that design and siting criteria are applied appropriately in the field.
- Effective training and awareness must be created in not only English but languages that are understandable for construction workers.
- Within a construction/ operations site vehicle access should be strictly controlled.
- Cleared vegetation should be stockpiled (away from surface waters) and redistributed over the topsoil when the operation/ construction is complete.

10. CONCLUSION

After the application of the initial risk screening assessment, it was determined that the proposed development consist of a total of six watercourses, classified as A channel streams. It was determined that all of the six riverine systems will be impacted upon by the proposed development. The watercourses that will be impacted upon by the proposed development are Rip01, Rip02, Rip03, Rip04, Rip05 and Rip06 were determined to be **of a high risk** as a result of their position in the landscape in relation to the proposed development. It must be noted that the risk rating was provided on the basis that the watercourses occurred within the development footprint which will be used in its entirety. No development plan was provided at this point.

The overall PES scores for the riverine systems was largely modified (D) for Rip01, Rip03 and Rip06, moderately to largely modified (C/D) for Rip02, moderately modified (C) for Rip04 and seriously modified for Rip05 (E). The aforementioned scores for the at-risk riverine systems were primarily as a result of anthropogenic pressures in the catchment and instream habitat extent namely; creation of footpaths, informal settlements, livestock grazing, ad hoc dumping and proliferation of AIPs within the catchment, whereas instream habitat was observed to be modified by footpaths, ad hoc dumping, construction of roads and culverts through systems, sedimentation as a result of poor conditions in catchment and no rehabilitation practices after construction of road and culverts; and proliferation of AIPs. This indicated that modifications have moderately, largely and seriously impacted riverine systems, respectively within the study area which has subsequently impacted on the habitat quality, diversity, and size.

The ESS supplied by the riverine system was the binding action of riverine plant roots on the soil would reduce erosion of the stream bed and banks during flooding, certain fauna may utilise the riverine zone during parts of their life cycles, aesthetic quality to the overall landscape of the area and a corridor for the movement of animals and it is also important for the dispersal of plants (Naiman and Decamps, 1997).

It was identified utilising the RAM (DWS, 2016) in Section 8.2 of this report that certain aspects of the construction activities associated with the proposed development scored a moderate risk rating, however these aspects did not have the potential to be mitigated from a moderate to low risk rating. Thus, it is the specialist's opinion, in line with GN 509 (South Africa: DEA, 2016), **that the proposed development be subject to undergo a full WULA process in the form of an IWWMP.**

The specialist further recommends that all construction activities of the proposed development can occur but must take into cognizance the surrounding riverine systems and their associated buffers in which no construction activities should occur. Furthermore, the mitigation measures outlined in this report are to be included in the EMPr, and must be followed.

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