Proposed Housing developments on Erf 25537, Kraaibosch, George, Western Cape.

Aquatic Biodiversity Specialist Assessment.

Prepared For: Hilland Environmental

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EXECUTIVE SUMMARY

Confluent Environmental Pty (Ltd) was appointed by HilLand Environmental to provide aquatic specialist inputs for a proposed mixed-use development on Erf 25537 Kraaibosch, George, Western Cape. The proposed development site is located adjacent to the N2 approximately 5.5 km southeast of George's town centre. Several site visits were carried out during May and June 2024 during which time the entire extent of the proposed development footprint on the property was traversed by foot. Erf 25537 is characterised by low undulating hills that slope steeply down to watercourses (mapped as non-perennial streams). All mapped watercourses within the property boundaries were associated with wetland habitat.

The development involves the construction of Meulenzicht Landgoed residential estate (~36.9 ha in extent), which will comprise primarily of full title residential erven and a sewage package plant. Multiple roads, stormwater, sewage and water supply infrastructure will also need to be constructed. The treatment plant will discharge treated wastewater into a channelled valley-bottom wetland (W2). The development layout has been adapted to accommodate recommended 15 m buffers throughout, and apart from road crossings, all infrastructure will remain outside of the delineated area of wetlands.

The scale of the planned development covers a large area and presents several risks to aquatic biodiversity both within the development area and downstream towards the Kaaimans Estuary. Many of these risks can be mitigated to an appropriate level of impact subject to the implementation of prescribed mitigation measures. Sewage contamination and increased stormwater volumes pose the greatest risk to aquatic biodiversity for this development and is the prevailing threat to urban watercourses in and around the city of George. With respect to wastewater, the most serious impacts are generally associated with leaks due to blocked pipelines, malfunctioning pump stations or operational problems at the package plant. Maintenance and operation of the package plant must therefore be strictly enforced, monitored and routinely audited. Irrigation using treated wastewater must be prioritised over discharge into the watercourse whenever possible. Monitoring the impact of effluent discharge on the Swart River is challenging due to limited options to access the river. It is likely that the volume and quality of water flowing down the Swart River will be sufficient to dilute effluent discharged from the package plant – provided that effluent water quality falls within the General Limit. A more detailed analysis of flow volumes released from the Garden Route Dam is however required to assess this impact with higher confidence. Assimilation of pollutants (especially nutrients) is also expected to occur along W2 and is an important ecosystem service provided by wetlands. The ability of the wetland to assimilate pollutants is however dependent on maintaining the hydro-functional attributes of the wetland (e.g. a well vegetated channel that slows flow, allowing for assimilation of pollutants through absorption, adsorption and microbial decomposition). In this respect watercourses must be protected from erosion and incision caused by high stormwater flows. For this reason, it is recommended that additional attenuation of stormwater is accommodated onsite prior to discharge into watercourses, particularly for W2 and W3 which are confined, channelled systems located along steeper gradients.

A sewage package plant will be constructed as part of the development. According to GN 4167 of 2023, any Section 21 (c) and (i) water use associate with the operation of a sewage package plant (i.e. discharge of wastewater into a watercourse) is excluded from a General Authorisation. In addition, main sewage pipelines crossing watercourses are also excluded from a General Authorisation. A Water Use License (WUL) will therefore be required for the development.

DECLARATION OF SPECIALIST INDEPENDENCE

- I consider myself bound to the rules and ethics of the South African Council for Natural Scientific Professions (SACNASP);
- At the time of conducting the study and compiling this report I did not have any interest, hidden or otherwise, in the proposed development that this study has reference to, except for financial compensation for work done in a professional capacity;
- Work performed for this study was done in an objective manner. Even if this study results in views and findings that are not favourable to the client/applicant, I will not be affected in any manner by the outcome of any environmental process of which this report may form a part, other than being members of the general public;
- I declare that there are no circumstances that may compromise my objectivity in performing this specialist investigation. I do not necessarily object to or endorse any proposed developments, but aim to present facts, findings and recommendations based on relevant professional experience and scientific data;
- I do not have any influence over decisions made by the governing authorities;
- I undertake to disclose all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by a competent authority to such a relevant authority and the applicant;
- I have the necessary qualifications and guidance from professional experts in conducting specialist reports relevant to this application, including knowledge of the relevant Act, regulations and any guidelines that have relevance to the proposed activity;
- This document and all information contained herein is and will remain the intellectual property of Confluent Environmental. This document, in its entirety or any portion thereof, may not be altered in any manner or form, for any purpose without the specific and written consent of the specialist investigators.
- All the particulars furnished by me in this document are true and correct.

Dr. James Dabrowski (Ph.D., Pr.Sci.Nat. Water Resources; SACNASP Reg. No: 114084)

June 2025

Mr. Franco de Ridder (MSc., Candidate Natural Scientist. Aquatic Science – 166398)

June 2025

TABLE OF CONTENTS

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LIST OF TABLES

LIST OF FIGURES

GLOSSARY

Aquatic Biodiversity	The variety of plant and animal life in water ecosystems, relevant to the study due to the site's proximity to potential water bodies.
Desktop Review	Preliminary assessment based on existing data and information, conducted prior to on-site investigations.
Erosion Control Methods	Techniques employed to prevent or minimize soil erosion, such as haybale check dams or silt fencing, crucial in areas with high inherent erosion potential.
Freshwater Ecosystem Priority Area (FEPA)	Designated areas of high importance for freshwater ecosystem conservation, identified as a sensitivity feature in the DFFE screening tool.
Site Assessment	Comprehensive evaluation of the proposed development site, including the identification of wetlands, watercourses, and soil characteristics.
Sensitivity	The degree to which a particular area or ecosystem is susceptible to disturbance or impact, crucial in determining potential environmental consequences.
Terrestrial Critical Biodiversity Area (CBA1)	A designation indicating the significance of the area's biodiversity on land.
Topography	The physical features of the land surface, considered for its potential influence on drainage and ecological features.
Wetland	An area where water covers the soil, or is present either at or near the surface, contributing to biodiversity and ecological significance.
Western Cape Biodiversity Spatial Plan (WCBSP)	A plan indicating categorized areas based on their ecological importance in the Western Cape region.

ABBREVIATIONS

CBA:	Critical Biodiversity Area
CD:NGI:	Chief Directorate: National Geo-spatial Information
DFFE:	Department of Environment, Forestry and Fisheries
DWAF:	Department of Water Affairs and Forestry
DWS:	Department of Water & Sanitation
EIS:	Ecological Importance and Sensitivity
ESA:	Ecological Support Area
FEPA:	Freshwater Ecosystem Priority Area
GA:	General Authorisation
GPS:	Global Positioning System
NEMA:	National Environmental Management Act
NFEPA:	National Freshwater Ecosystem Priority Areas
NWA:	National Water Act
NWM5:	National Wetland Map 5
SACNASP:	South African Council for Natural Scientific Professions
WCBSP:	Western Cape Biodiversity Spatial Plan
WUL:	Water Use License

1. INTRODUCTION

Confluent Environmental Pty (Ltd) was appointed by HilLand Environmental to provide aquatic specialist inputs for a proposed mixed-use development on Erf 25537 Kraaibosch, George, Western Cape. The proposed development site is located adjacent to the N2 approximately 5.5 km southeast of George's town centre. The closest perennial river to the property is the Swart River which is located adjacent to the north-eastern corner of the property and flows in a south-easterly direction before meeting the Kaaimans River, which flow into the Kaaimans Estuary (Figure 1). The scope of work for this report is guided by the legislative requirements of the National Environmental Management Act (NEMA) as well as the National Water Act (NWA).

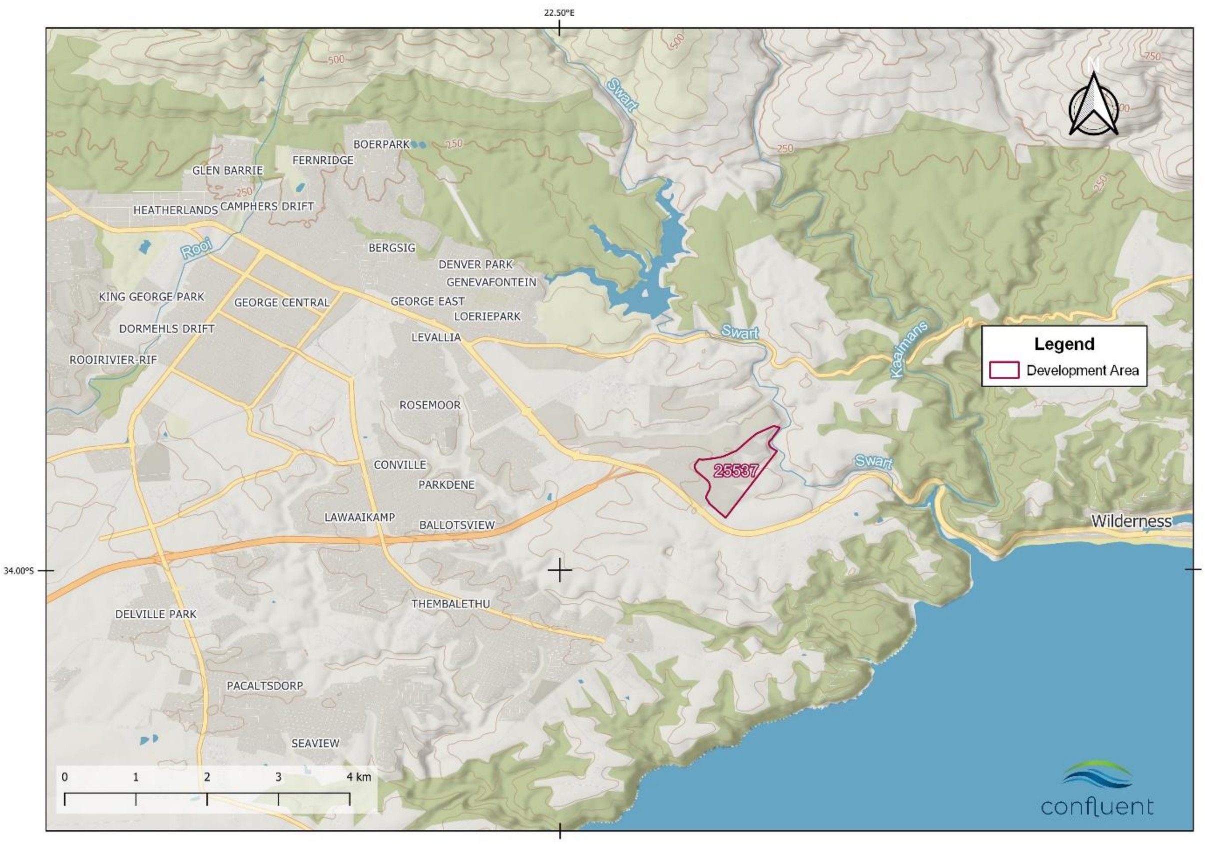

Figure 1. Map indicating the development area east of George, Western Cape.

1.1 Key Legislative Requirements

1.1.1 National Environmental Management Act

According to the protocols specified in GN 1540 (Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in Terms of Sections 24(5)(A) and (H) and 44 of the National Environmental Management Act, 1998, when Applying for Environmental Authorisation), assessment and reporting requirements for aquatic biodiversity are associated with a level of environmental sensitivity identified by the national web-based environmental screening tool. An applicant intending to undertake an activity identified in the scope of this protocol on a site identified by the screening tool as being of:

- **Very High** sensitivity for aquatic biodiversity, must submit an Aquatic Biodiversity Specialist Assessment; or

- **Low** sensitivity for aquatic biodiversity, must submit an Aquatic Biodiversity Compliance Statement.

According to the DFFE Screening Tool Erf 25537 has a **Very High** aquatic biodiversity sensitivity for the following reasons:

- The properties fall within a Strategic Water Source Area (SWSA).
- One or more aquatic Critical Biodiversity Areas (CBA) are mapped to occur within the property boundaries.
- Aquatic habitat (river) has been mapped to occur within or in close proximity to the properties.

1.1.2 National Water Act

The Department of Water & Sanitation (DWS) is the custodian of South Africa's water resources and therefore assumes public trusteeship of water resources, which includes watercourses, surface water, or aquifers. A watercourse means:

- A river or spring;
- A natural channel in which water flows regularly or intermittently;
- A wetland, lake or dam into which, or from which, water flows; and
- Any collection of water which the Minister may, by notice in the Gazette, declare to be watercourse, and

For the purposes of this assessment, a wetland area is defined according to the NWA (Act No. 36 of 1998):

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

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

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

No activity may take place within a watercourse unless it is authorised by the Department of Water and Sanitation (DWS). According to Section 21 (c) and (i) of the National Water Act, an authorization (Water Use License or General Authorisation) is required for any activities that impede or divert the flow of water in a watercourse or alter the bed, banks, course or characteristics of a watercourse. The regulated area of a watercourse for section 21(c) or (i) of the Act water uses means:

a) The outer edge of the 1 in 100-year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam;

b) In the absence of a determined 1 in 100-year flood line or riparian area the area within 100m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench (subject to compliance to section 144 of the Act); or

c) A 500 m radius from the delineated boundary (extent) of any wetland or pan.

According to Section 21 (c) and (i) of the NWA, any water use activities that do occur within the regulated area of a watercourse must be assessed using the DWS Risk Assessment Matrix (GN4167) to determine the impact of construction and operational activities on the flow, water quality, habitat and biotic characteristics of the watercourse. Low-Risk activities require a General Authorisation (GA), while Medium or High-Risk activities require a Water Use License (WUL).

1.2 Assumptions and Exclusions

- A series of site visits were conducted in May and June 2024 which falls in the winter season. It is possible that sensitive features such as rare or unique biota (e.g. amphibians), plants or habitat were not observed during the site visit, but are influenced by season, time of day, flow level or vegetation cover. However, recent good rainfall would have meant that any wetland features would have been quite evident and easy to identify.
- Most of the site was mowed, making it difficult to accurately determine the edge of the wetland areas using vegetation indicators. Delineation therefore relied heavily on soil augering.

2. METHODS

2.1 Wetland Delineation

Wetlands are described by the National Water Act (Act 36 of 1998) as:

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

According to DWAF (2005) wetlands must have one or more of the following attributes:

- Wetland (hydromorphic) soils that display characteristics resulting from prolonged saturation;
- The presence, at least occasionally, of plants that grow in water saturated conditions (hyrdophytes or obligate wetland plants);
- A high water table that results in saturation at or near the surface, leading to anaerobic conditions developing in the top 50cm of the soil.

The boundary of the wetland was delineated in accordance with DWAF (2005) guidelines which considers the following four specific indicators:

- The Terrain Unit Indicator: Identifies those parts of the landscape where wetlands are more likely to occur;
- The Soil Form Indicator: Identifies the soil forms, as defined by the Soil Classification Working Group (1991), which are associated with prolonged and frequent saturation;

- The Soil Wetness Indicator: Identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation (i.e. mottling and gleying within 50 cm of the soil surface); and
- The Vegetation Indicator: Identifies hydrophilic vegetation associated with frequently saturated soils.

The boundary of the wetland was determined by identifying the presence or absence of the combination of indicators mentioned above at selected points in the field. The location of soil augering points used to assess soil wetness were marked on a hand-held GPS and saturation zones were classified according to the soil wetness indicators as follows:

- Temporary Zone: Short periods of saturation (less than three months per annum) characterised by few high chroma mottles and minimal grey matrix (< 10 %).
- Seasonal Zone: Significant periods of wetness (at least three months per annum) characterised by many low chroma mottles and a grey matrix.
- Permanent Zone: Wetness all year round characterised by a prominent grey matrix and few to no high chroma mottles.

Auger points that showed no sign of saturation were classified as 'Dry'. All augering points were imported into GIS software and, in combination with aerial imagery and other site observations of vegetation indicators, were used to plot the boundary of the wetland.

2.2 Present Ecological State (PES)

2.2.1 Wetlands

WET-Health 2.0 is designed to assess the PES of a wetland by scoring the perceived deviation from a theoretical reference condition, where the reference condition is defined as the un-impacted condition in which ecosystems show little or no influence of human actions. In thinking about wetland health or PES, it is thus appropriate to consider 'deviation' from the natural or reference condition, with the ecological state of a wetland taken as a measure of the extent to which human impacts have caused the wetland to differ from the natural reference condition. Whilst wetland features vary considerably from one wetland to the next, wetlands are all broadly influenced/ by their climatic and geological setting and by three core inter-related drivers, namely hydrology, geomorphology and water quality. The biology of the wetland (in which vegetation generally plays a central role) responds to changes in these drivers, and to activities within and around the wetland. The interrelatedness of these four components forms the basis of the modular-based approach adopted in WET-Health Version 2. Desktop and field data were captured in GIS software and used to populate the Level 1 WET-Health tool (Macfarlane et al., 2020) which was used to derive the PES of the wetland HGM units. The magnitude of observed impacts on the hydrological, geomorphological, water quality and vegetation components of the wetland were calculated and combined as per the tool to provide a measure of the overall condition of the wetland on a scale from 1-10. Resultant scores were then used to assign the wetland into one of six PES categories as shown in Table 1 below.

Table 1: Wetland Present Ecological State (PES) categories and impact descriptions.

ECOLOGICAL CATEGORY	DESCRIPTION	IMPACT SCORE*	PES SCORE (%)*
A	Unmodified, natural.	0-0.9	90-00
B	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	80-89
C	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	60-79
D	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4-5.9	40-59
E	Seriously modified. The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6-7.9	20-39
F	Critically modified. 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	0-19

2.3 Ecological Importance and Sensitivity

2.3.1 Wetlands

The ecological importance of a water resource is an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales (Duthie, 1999). Ecological sensitivity refers to the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (Duthie, 1999). The Ecological Importance and Sensitivity (EIS) provides a guideline for determination of the Ecological Management Class (EMC). The revised method for the determination of the EIS of a wetland considers the three following ecological aspects (Rountree et al., 2013):

- **Ecological importance and sensitivity**
  - Biodiversity support including rare species and feeding/breeding/migration;
  - Protection status, size and rarity in the landscape context;
  - Sensitivity of the wetland to floods, droughts and water quality fluctuations.
- **Hydro-functional importance**
  - Flood attenuation;
  - Streamflow regulation;
  - Water quality enhance through sediment trapping and nutrient assimilation;
  - Carbon storage
- **Direct human benefits**
  - Water for human use and harvestable resources;
  - Cultivated foods;
  - Cultural heritage;
  - Tourism, recreation, education and research.

Each criterion is scored between 0 and 4, and the average of each subset of scores is used to derive a score for each of the three components listed above. The highest score is used to determine the overall Importance and Sensitivity category of the wetland system.

Table 2: Ecological importance and sensitivity categories. Interpretation of average scores for biotic and habitat determinants.

Ecological Importance and Sensitivity Category (EIS)	Range of Median	Recommended Ecological Management Class
Very high: Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these floodplains is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water of major rivers.	>3 and <=4	A
High: Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these floodplains may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers.	>2 and <=3	B
Moderate: Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these floodplains is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers.	>1 and <=2	C
Low/marginal: Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these floodplains 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	D

2.4 Wetland and Buffer Determination

Buffer zones have been defined as a strip of land with a use, function or zoning specifically designed to act as barriers between human activities and sensitive water resources with the aim of protecting these water resources them from adverse negative impacts. Appropriate buffers were estimated based on buffer zone guidelines developed by Macfarlane and Bredin (2017). These guidelines estimate required buffer zone widths based on a combination of input parameters which include, *inter alia*, the nature of the activity and associated impacts, basic climatic and soil conditions, the PES and EIS of potentially affected watercourses and the implementation of appropriate mitigation measures.

3. CATCHMENT CONTEXT

3.1 Catchment Features

The property is located in the quaternary catchment K30C in the catchment of the Swart River (Figure 2). The main rivers draining this catchment are the Swart and Kaaimans, both of which originate in the Outeniqua Mountains to the north. The Swart River feeds the Garden Route Dam and terminates in the Kaaimans River Estuary. The project area falls within the South-Eastern Coastal Belt (20) Level 1 ecoregion (20.02 Level 2 Ecoregion), which is characterized by moderately undulating plains and low mountains with altitude ranging from 0 to 1 300 m above mean sea level. Watercourses are typically located at the base of relatively steep slopes. Mean annual precipitation for the catchment area is approximately 800 mm per year and occurs all year-round, with peaks in October to November and March to April. Dominant natural vegetation in the vegetation comprises broadly of fynbos, renosterveld, dune thicket, and afro-montane forest. Three non-perennial watercourses are indicated to drain the properties, each of which join the Swart River upstream of its confluence with the Kaaimans Estuary (Figure 3).

Soils in the catchment area are relatively shallow consisting of a diagnostic pedocutanic duplex soil, with a clear textural contrast between the A and B horizon. The B horizon is however heavily enriched with clay, which serves as a barrier to both root growth and water movement. Sub-surface water therefore tends to flow laterally over the top of the B horizon, through the more coarsely textured A horizon. In addition, the area falls within a very high rainfall and high rainfall intensity zone, which, in urban areas with a high proportion of impervious surfaces, results in the production of very large volumes of high energy stormwater (Table 3). For these reasons, soils are highly erodible and is undoubtedly the main cause of relatively widespread bank erosion and channel incision of urban watercourse in and around George.

Table 3. Summary of relevant catchment features for the proposed development area.

Feature	Description
Quaternary catchment	K30C
Mean Annual Runoff	186.61 mm
Mean Annual Precipitation	834.00 mm
Inherent erosion potential of soils (K-factor)	0.74, Very High
Rainfall intensity	Very High
Ecoregion Level II	20.02, Southeastern coastal belt
Geomorphological Zone	Upper Foothill
NFEPA area	Sub-quaternary reach 9093 and 9144, no FEPA.
Mapped Vegetation Type	FFg 5: Garden Route Granite Fynbos (CR: Critically Endangered)
Conservation	None

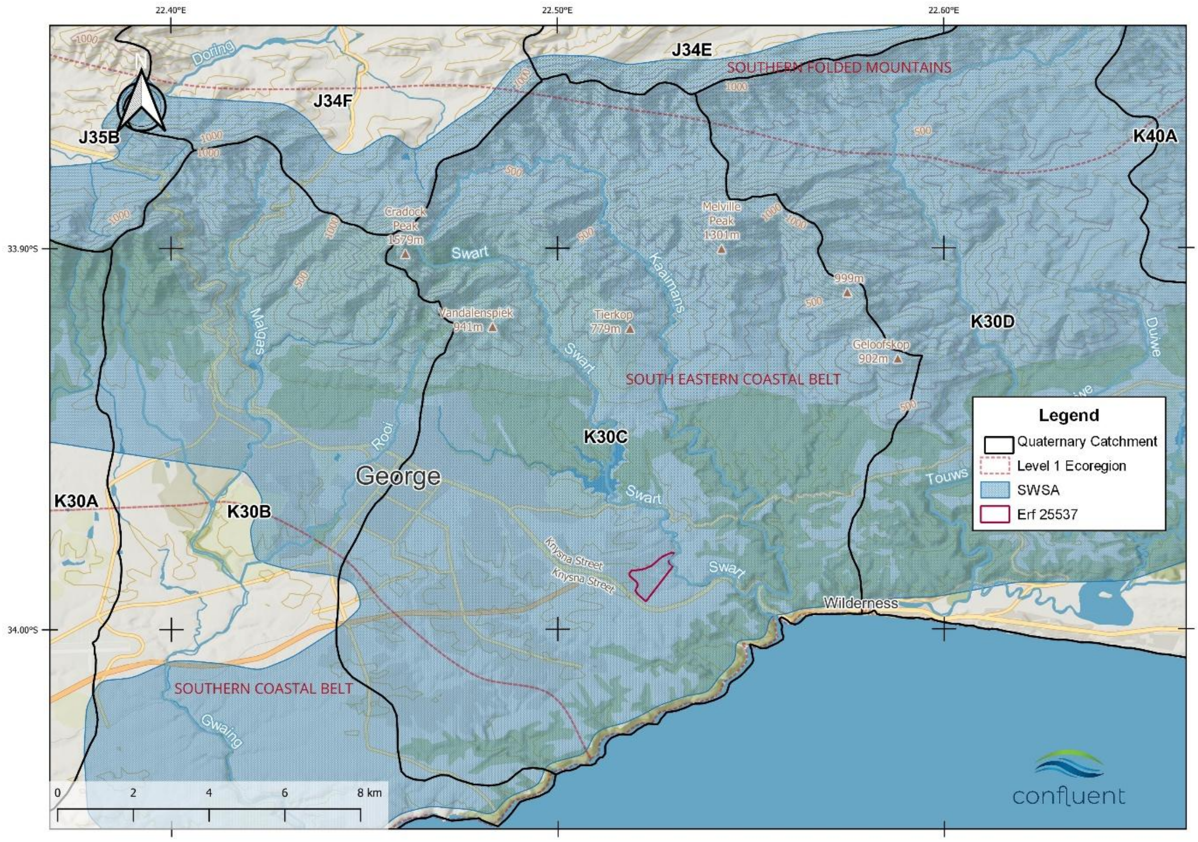

Figure 2. Erf 25537 in the quaternary catchment K30C.

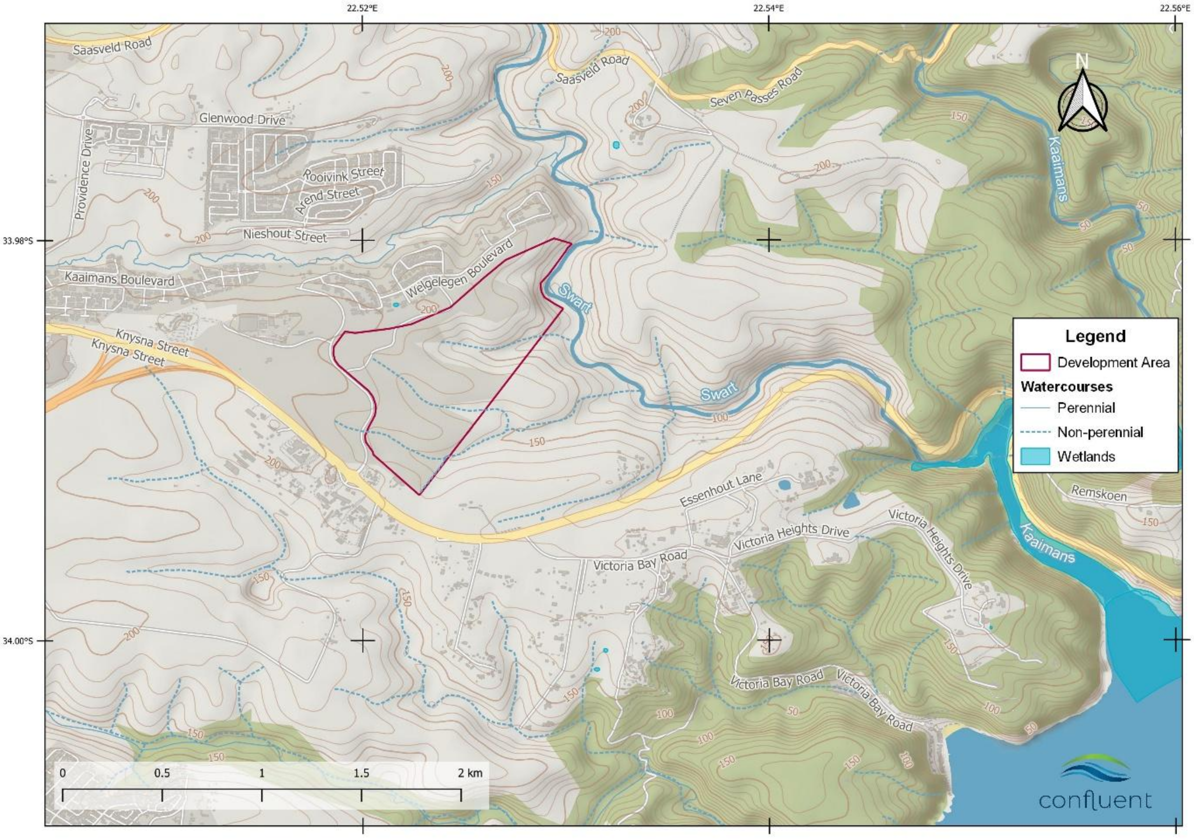

Figure 3: The proposed development area in relation to mapped watercourses.

3.2 Conservation and Catchment Management

3.2.1 Western Cape Biodiversity Spatial Plan

The main purpose of a biodiversity spatial plan is to ensure that the most recent and best quality spatial biodiversity information can be accessed and used to inform land use and development planning, environmental assessments and authorisations, natural resource management and other multi-sectoral planning processes. The WCBSP plan achieves this by providing a map of terrestrial and freshwater areas that are important for conserving biodiversity pattern and ecological processes – these areas are called Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs).

No aquatic CBAs or ESAs are mapped within the boundaries of any of the three properties. The three non-perennial rivers drain into the Swart River which has been designated as CBA2, indicating that it is modified system, but is still important for meeting biodiversity targets. The lower reaches of the Swart River and the Kaaimans River and Estuary are more natural CBA1 areas. Management objectives associated with these biodiversity categories are provided in (Table 4).

Figure 4. The proposed development area to mapped conservation features of the Western Cape Biodiversity Spatial Plan (2017).

Table 4. Definitions and objectives for conservation categories identified in the Western Cape Biodiversity Spatial Plan (WCBSP, 2017).

WCBSP Category	Definition	Management Objective
Critical Biodiversity Area 1 (CBA1)	Areas in a natural condition that are required to meet biodiversity targets, for species, ecosystems or ecological processes and infrastructure.	Maintain in a natural or near-natural state, with no further loss of habitat. Degraded areas should be rehabilitated. Only low-impact, biodiversity-sensitive land uses are appropriate.
Critical Biodiversity Area 2 (CBA2)	Areas in a degraded or secondary condition that are required to meet biodiversity targets, for species, ecosystems or ecological processes and infrastructure.	Maintain in a natural or near-natural state, with no further loss of habitat. Degraded areas should be rehabilitated. Only low-impact, biodiversity-sensitive land uses are appropriate.

2.3.3 Strategic Water Source Area

The project area falls within the Outeniqua Strategic Water Source Area (SWSA) (Figure 2), which is considered to be of national importance. SWSAs are defined as areas of land that either:

a) Supply a disproportionate (i.e. relatively large) quantity of mean annual surface water runoff in relation to their size and so are considered nationally important; or

b) Have high groundwater recharge and where the groundwater forms a nationally important resource; or

c) Areas that meet both criteria (a) and (b).

SWSAs are vital for water and food security in South Africa and also provide the water used to sustain the economy. Given this context, management and implementation guidelines have been developed with the objective of facilitating and supporting well-informed and proactive land management, land-use and development planning in these nationally important and critical areas (Le Maitre, et al., 2018). The primary principle behind this objective is to protect the quantity and quality of the water they produce by maintaining or improving their condition. The proposed development footprint falls within an urban 'working landscape' and in this context the management objectives are:

- To maintain at least the present condition and ecological functioning of these landscapes;
- To restore where necessary; and
- To limit or avoid further adverse impacts on the sustained production of high-quality water.

A key objective in the management of SWSAs is to ensure the quantity and quality of water within and flowing from SWSAs is protected from developments that cause unacceptable and irreparable impacts. Development of roads, parking areas and other impervious surfaces, along with wetland draining or infilling has the potential to change quantities of water in watercourses by intercepting, increasing, reducing or diverting flows from their normal path. Water quality can be impacted by flow-related alterations, particularly increased flows as this usually results in altered sediment transport causing scouring, sedimentation and increased turbidity due to suspended sediments. Especially during the construction phase. The operational phase of urban developments increases the risk of toxic hydrocarbons and other road-based pollutants as well as sewage from leaking or blocked drains or pump stations impacting on water quality.

3.3 Desktop Present Ecological State

The property are located in the catchment of the Swart River which feeds into the Kaaimans Estuary. According to DWS (2014), the PES of the Swart River is D (Largely Modified), which is largely attributable to the Garden Route Dam which significantly reduces natural flows in the lower reaches of the river (Table 5). Other contributing factors include encroachment of alien invasive vegetation (primarily *Acacia mearnsii* and *Eucalyptus*) and manipulation of the river channel associated with the construction of road crossings. The Kaaimans Estuary is fed by the Kaaimans and Swart rivers. Due largely to the contribution from the Kaaimans River (which is not flow regulated and in a Largely Natural condition), the PES of the Kaaimans Estuary is B (Largey Natural) and is considered a priority estuary in terms of biodiversity importance (Van Niekerk et al., 2019a). The Kaaimans Estuary is classified as a warm temperate – predominantly open system, which are poorly protected in South Africa and have a Vulnerable ecosystem threat status (Van Niekerk et al., 2019b).

It is therefore essential that development in the catchment area of the estuary is managed with the aim of maintaining and improving water quality in the estuary. In this respect, developments must not cause an increase in the concentrations of pollutants, nutrients and sediment loads into the estuary. Considering the intention to discharge treated wastewater into the Swart River, water quality Resource Quality Objectives (RQOs) that have been gazetted for the estuary are of relevance and included in Table 6.

Table 5: Present Ecological State, Ecological Sensitivity and Eecological Importance for the Swart and Kaaimans rivers.

River	Present Ecological State	Ecological Importance	Ecological Sensitivity
Swart River	D (Seriously Modified)	Moderate	High
Kaaimans River	B (Largely Natural)	Very High	Very High

Table 6: Resource quality objectives (RQOs) set for the Kaaimans River Estuary (Government Notice 1298 – Proposed Classes of Water Resource and Resource Quality Objectives for the Breede-Gouritz Water Management Area).

Indicator	RQO Narrative	RQO Numeric
Dissolved Inorganic Nitrogen (DIP)	Inorganic nutrient concentrations not to exceed TPCs for macrophytes and microalgae	< 100 µg/L
Dissolved Inorganic Phosphorus (DIN)		< 20 µg/L
Turbidity	System variables not to exceed TPCs for biota	< 10 NTU (low flow season)
Dissolved Oxygen		> 5 mg/L
Enterococci	Concentrations of waterborne pathogens should be maintained in an Acceptable category for full contact recreation	≤ 185 Enterococci/100 ml) (90th percentile)
Escherichia coli		≤ 500 E. coli/100 ml (90th percentile)

3.4 Historical Assessment

Erf 25537 has undergone noticeable changes throughout the past 20 years (2000 to 2020 - Figure 5). Historically, the property was under pine plantations in the years leading up to 2005. In the years leading up to 2011, the pine plantations were cleared on all properties and the land has remained fallow since then. Noticeable revegetation of drainage areas with wetland and riparian vegetation has occurred since the removal of forestry plantations. An instream dam and two smaller offstream dams were constructed on the property between 2009 and 2010.

Figure 5. Historical photos showing Erf 25537 through notable changes between 2005 and 2025 (Google Earth imagery) – red circles indicate dams.

4. SITE ASSESSMENT

Several site visits were carried out during May and June 2024 during which time the entire extent of the proposed development footprint on the property was traversed by foot (Figure 6). At the time of the site visits the weather varied from overcast to clear. The topography of Erf 25537 is characterised by low undulating hills that slope steeply down to watercourses (mapped as non-perennial streams). All mapped watercourses within the property boundaries were associated with wetland habitat (mapped as W2 to W4 – Figure 7). The soil on the properties varies from sandy loam with a hard clay layer (found at a depth 30 to 40 + cm) below the surface, to clay that is associated with the wetland areas on the property. Most of the vegetation on the site was mowed, making it difficult to accurately determine the edge of the wetland areas through use of vegetation indicators.

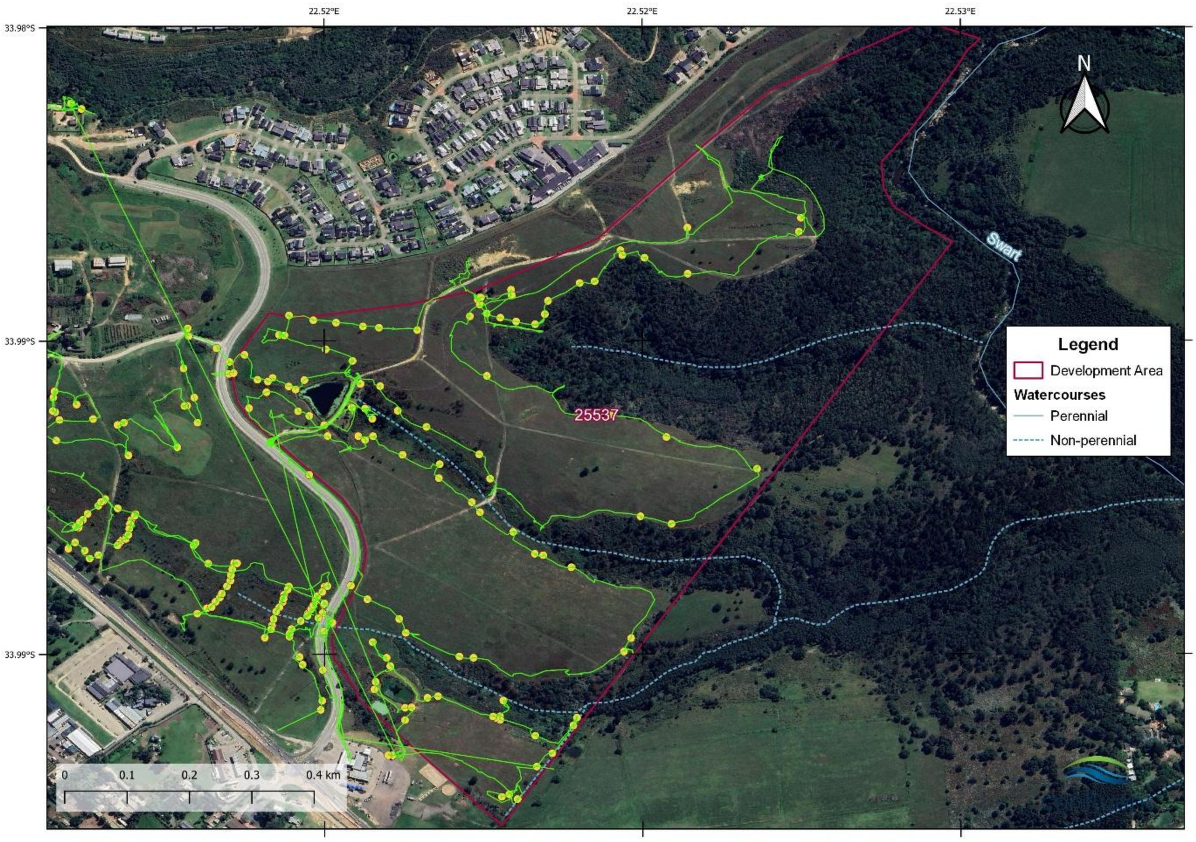

Figure 6: GPS track walked in relation to the proposed development site.

Figure 7: Watercourses mapped within the development area.

4.1 Watercourse Classification

The wetland systems are not obviously visible in historical imagery but generally followed distinct linear areas that were either sparsely planted with pine trees or were not planted at all (Figure 5). Given the distinct soil characteristics of the area (i.e. a coarsely textured A horizon overlying a clay enriched B horizon) lateral sub-surface flows down slopes is expected to be an important source of water to these wetlands. Pines consume high volumes of water and their presence on the adjacent slopes would have deprived the wetlands of lateral sub-surface flows, reducing the extent (i.e. width) and visible footprint of the wetland systems. These wetland systems have become more visible since the pine plantations have been cleared.

4.1.1 W2

W2 is situated near the southern corner of Erf 25537. The wetland is classified as a Channelled Valley Bottom (CVB) and is situated at the bottom of a very confined, steep valley which, together with the steeper gradient of the valley bottom, favours the formation of a clearly defined channel (approximately 3 m in width). The wetland receives stormwater flows from a culvert beneath Urbans Boulevard (Figure 8). A narrow band of wetland vegetation lines either side of the channel dominated by species that include *Cyperus textilus*. Flow through the channel is seasonal following heavy downpours or periods of sustained rainfall. Lateral seepage from surrounding catchment area will sustain soil saturation along the banks for prolonged periods of time. Mottling observed in the auger samples indicates that the wetland is permanent to seasonal.

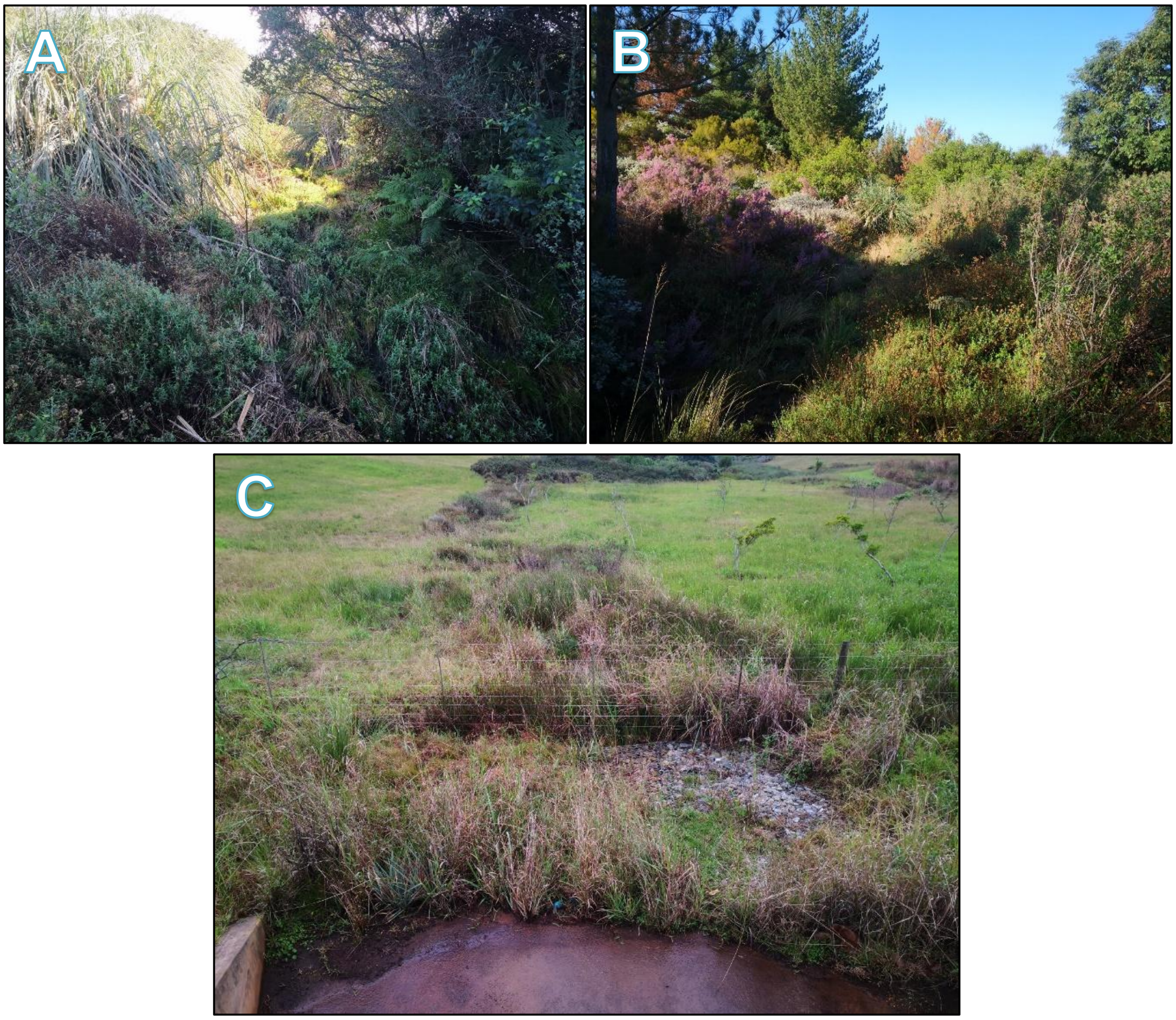

Figure 8: Photographs of W2 illustrating well vegetated channel (A and B) and a culvert from Urbans Boulevard discharging towards W2 (C).

4.1.2 W3

W3 is situated below an instream dam that captures stormwater runoff from a culvert beneath Urbans Boulevard and surface runoff from the sloped catchment area. The wetland receives concentrated surface flows when the dam overflows (via spillways located on either end of the dam wall) but is also sustained by lateral sub-surface flows from the adjacent steep slopes – as indicated by distinct mottling in the soil profile where vegetation is currently mowed. Dominant wetland plant species include *Cliffortia odorata* while the outer, seasonal margins of the wetland were characterised by *Centellas sp*, *Juncus effusus, Hypoxis sp., Fuirena hirsuta* (Figure 9). Of notable concern is a significant headcut erosion gulley towards the lower end of the wetland which has resulted in an eroded channel, approximately 3 m lower than the elevation of the bed of the wetland. The erosion has revealed a clear profile of the soil and it is evident that the wetland was historically infilled with waste from the sawmill (e.g. planks, saw dust, metal bars etc.). Increased stormwater flows originating from Urbans Boulevard could have caused the initial erosion of the channel, which over time is likely to have deepened and moved further upstream in the direction of the dam. The channelled wetland area upstream of the dam is artificial and is sustained by stormwater flows from Urbans Boulevard.

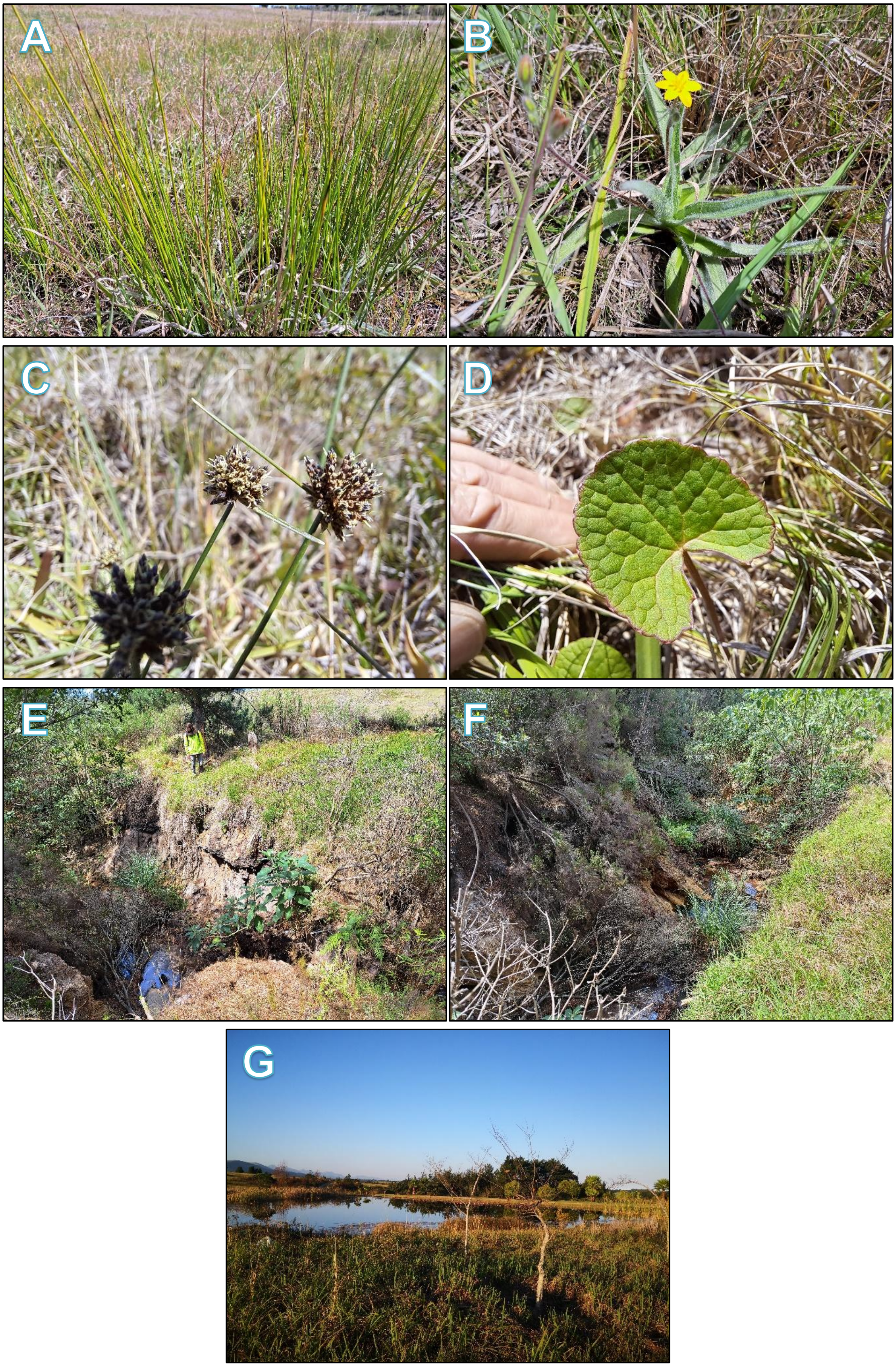

Figure 9: Wetland vegetation along the margins of W4 including Juncus effusus (A); Hypoxis sp. (B); Fuirena hirsuta (C); Centellas sp. (D); severely eroded channel (E & F); dam in upper reaches (G).

4.1.3 W4

W4 is a hillslope seep wetland situated in the upper slopes of the northern most watercourse. It extends from a mowed section of the slope and as the gradient flattens out slightly it broadens at the head of a valley, with a distinct zone of seasonally saturated soils dominated by *H. cymosum*, and *N. ivifolia* and a small patch of *Phragmites australis.* The gradient drops steeply down into the valley where a more well defined non-perennial stream channel develops. The seep wetland extends along the northern slopes of the valley and was characterised by saturated soils and a noticeable change in vegetation from typical fynbos species to wetland species where *H. cymosum* and *Schoenus sp.* were prominent. The entire extent of the seep was not mapped in detail, but it is expected that it will stretch further east along the valley, following along the line of the steep south-facing slopes.

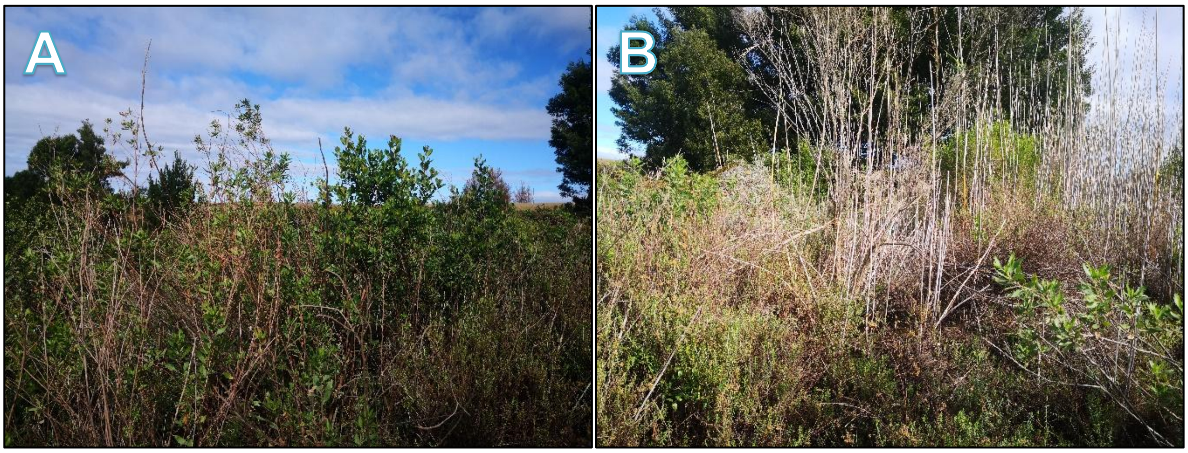

Figure 10: Wetland vegetation associated with the seep, including Nidorella ivifolia (A); and Phragmites australis (B).

5. AQUATIC ASSESSMENT

5.1 Present Ecological State

5.1.1 W2

- Receives stormwater runoff from Urbans Boulevard and from the Sasol petrol station, which has most likely contributed to a transition from an unchannelled to a channelled valley bottom wetland.
- Infilling has occurred along the southern bank of the wetland which has resulted in a more confined valley and has reduced the width of the wetland.
- Minor invasion by invasives along the length of the wetland (most notably by Pampas grass – *Cortaderia selloana* – further downstream)
- **PES: D (Largely Modified) –** Table 7

Table 7: Present Ecological State (PES) of W2.

Final (adjusted) Scores				
PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	6.3	5.2	1.2	4.0
PES Score (%)	37%	48%	88%	60%
Ecological Category	E	D	B	D
Trajectory of change	↑	↑	↑	
Confidence (revised results)	Medium	Not rated	Not rated	Not rated
Combined Impact Score	4.9			
Combined PES Score (%)	51%			
Combined Ecological Category	D			

5.1.2 W3

- The dam captures stormwater runoff from Urbans Boulevard which on the one hand protects the wetland from an increase in hydrological energy. On the other hand, the dam also captures natural surface runoff that would ordinarily have flowed into the wetland and base flow through the wetland will most likely have reduced.
- Flood peaks through the wetland have increased due to overflows from the dam which result in the transmission of high volume, high energy flows into the channel. This has caused channel incision in the upper reaches of the wetland (immediately below the dam wall). These flood peaks have also contributed to the severe headcut erosion gulley further downstream which has resulted in a transition to a severely eroded, incised channel with no wetland features.
- Historical infilling of the wetland with sawmill waste has occurred.
- Vegetation within the seasonal zone has been mowed (resulting in reduced surface roughness within the delineated wetland area and dominance of grassy species). There is minor invasion by alien invasives (e.g. *Pinus sp. A. melanoxylon and A. mearnsii*).
- **PES: D (Largely Modified) –** Table 8**.**

Table 8: Present Ecological State (PES) of W3.

Unadjusted (modelled) Scores				
PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	6.1	3.2	1.0	5.0
PES Score (%)	39%	68%	90%	50%
Ecological Category	E	C	A	D
Combined Impact Score	4.6			
Combined PES Score (%)	54%			
Combined Ecological Category	D			

5.1.3 W4

- Minor impacts related to increased water inputs from adjacent roads and reduction in catchment roughness due to mowed vegetation.
- Minor levels of invasion by alien invasives (most notably *A. mearnsii*).

- **PES: C (Moderately Modified) –** Table 9**.**

Table 9: Present Ecological State (PES) of W4.

Unadjusted (modelled) Scores				
PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	2.9	2.3	0.9	2.3
PES Score (%)	71%	77%	91%	77%
Ecological Category	C	C	A	C
Combined Impact Score	2.2			
Combined PES Score (%)	78%			
Combined Ecological Category	C			

5.2 Ecological Importance and Sensitivity

5.2.1 W2

Small size, intermittent flows and low habitat diversity offers limited biodiversity support and landscape scale features. The wetland is sensitive to changes in water quality and flow (

- Table 10);
- Channelled valley bottom characteristics provide moderate pollutant assimilation capabilities (Table 11);
- No direct human benefits in terms of resources (i.e. water for abstraction, harvestable materials, tourism etc.) (Table 12).
- **EIS is Moderate.**

5.2.2 W3

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- Channelled valley bottom characteristics provide moderate pollutant assimilation capabilities (Table 11);
- No direct human benefits in terms of resources (i.e. water for abstraction , harvestable materials, tourism etc.) (Table 12).
- **EIS is Moderate**

5.2.3 W4

Small size, intermittent flows and low habitat diversity offers limited biodiversity support land landscape (

- Table 10).
- Channelled flow characteristics results in comparatively fast flows through the system and together with the narrow extent of wetland habitat, attenuation, regulation and assimilation capacity is low (Table 11).
- No direct human benefits in terms of resources (i.e. water for abstraction, harvestable materials, tourism etc.) (Table 12).
- **EIS is Moderate.**

Table 10. Ecological Importance and Sensitivity criteria for the wetland.

Ecological Importance and Sensitivity	W2	W3	W4
Biodiversity Support			
Presence of Red Data species	0	0	0
Populations of unique species	0	0	0
Migration/feeding/breeding sites	0	0	1
Average	**0**	**0**	**0.33**
Landscape Space			
Protection status of wetland	0	0	0
Protection status of vegetation type	0	0	4
Regional context of the ecological integrity	1	1	1
Size and rarity of the wetland types present	1	1	1
Diversity of habitat types	1	1	1
Average	**0.6**	**0.6**	**1.4**
Sensitivity of Wetland			
Sensitivity to changes in floods	3	3	1
Sensitivity to changes in low flows	2	2	1
Sensitivity to changes in water quality	1	1	1
Average	**2**	**2**	**1**
ECOLOGICAL IMPORTANCE AND SENSITIVITY	**2 (Moderate)**	**2 (Moderate)**	**1.4 (Moderate)**

Table 11: Hydro-functional importance of the wetland.

Hydro-functional Importance			W2	W3	W4
Regulating & supporting benefits	Flood attenuation		1	1	2
	Streamflow regulation		1	1	2
	Water quality enhancement	Sediment trapping	2	2	2
		Phosphate assimilation	2	2	2
		Nitrate assimilation	2	2	2
		Toxicant assimilation	2	2	2
		Erosion control	1	1	2
	Carbon storage		1	1	2
HYDRO-FUNCTIONAL IMPORTANCE			**1.5 (Moderate)**	**1.5 (Moderate)**	**2 (Moderate)**

Table 12: Direct human benefit importance of the wetland.

Direct Human Benefits		W2	W3	W4
Subsistence benefits	Water for human use	0	0	0
	Harvestable resources/cultivated foods	0	0	0
Cultural benefits	Cultural heritage	0	0	0
	Tourism and recreation Education and research	0	0	1
DIRECT HUMAN BENEFITS		**0 (Low)**	**0 (Low)**	**0.25 (Low)**

6. BUFFER

Buffer determination considered the implementation of mitigation measures specified in the impact assessment below and was determined based on catchment and buffer characteristics listed in Table 13. Based on these inputs the buffer for the wetland is set to 15 m (Figure 11). The development has been adapted to accommodate the buffer throughout.

Table 13: Input paramaters used to determine buffer widths for watercourses.

Parameter	Value
MAP	Up to 1000
Rainfall Intensity	70.9 – Zone 4 (Very High)
Soil SCS	A/B
Slope of Catchment	Gentle (2 – 10 %)
Slope of Buffer	Moderate (10 -20 %)
Soil erosion potential	0.74 (Very High)
Vegetation Characteristics	Fair
Soil Permeability	Low
Buffer Width	15 m

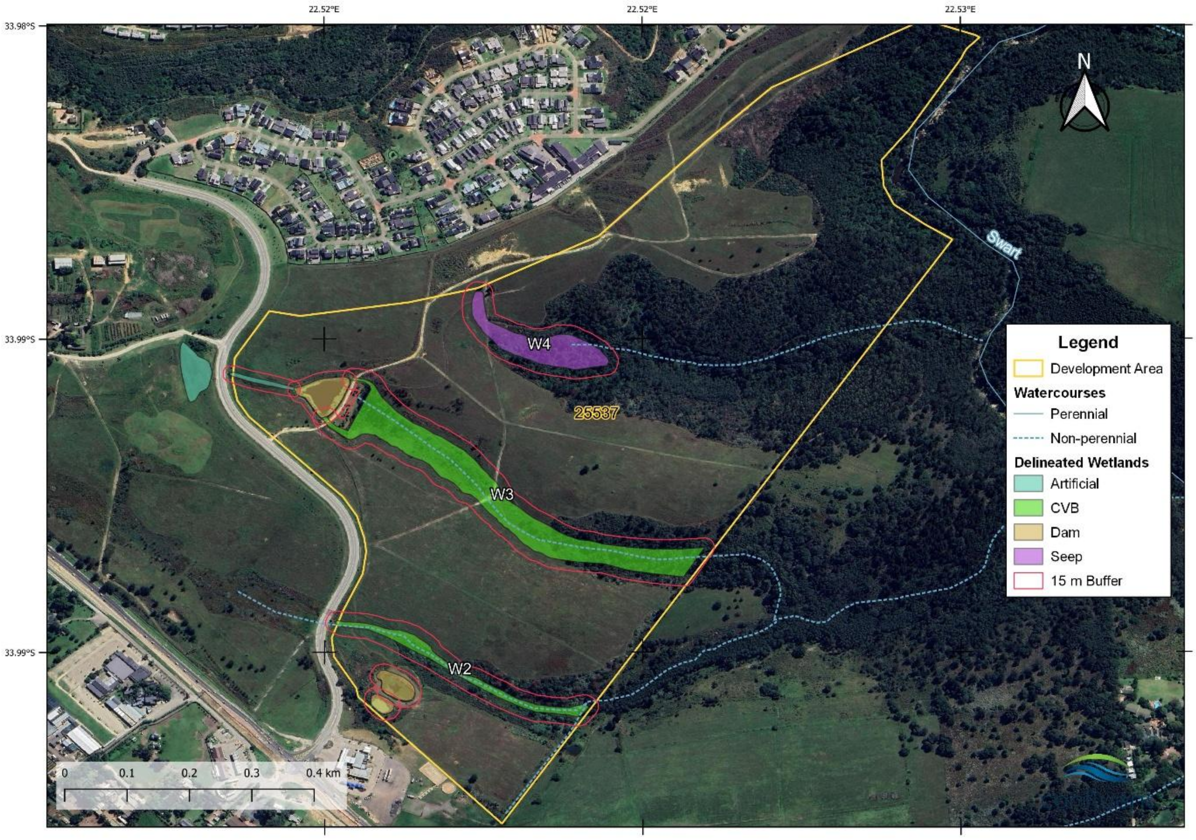

Figure 11: Map showing wetlands and recommended 15 m buffer area.

7. THE PROPOSED DEVELOPMENT

The development involves the construction of the Meulenzicht Landgoed bordered by Urbans Boulevard along the north-wet (Figure 12). Meulenzicht Landgoed will comprise primarily of full title residential erven and a wastewater treatment plant that will service Meulenzicht as well as Oumeulen Village (west of Urbans Boulevard). Multiple roads, stormwater, sewage and water supply infrastructure will also need to be constructed. The treatment plant will discharge treated wastewater into W2.

Figure 12: The latest site development plan (SDP) for Meulenzicht Landgoed.

7.1.1 Stormwater

- Limited stormwater detention/attenuation has been incorporated into the stormwater management plan and post-development flows for both estates will increase relative to pre-development flows (Table 14).

Table 14: Pre- and post-development runoff (m^3/s) for Meulenzicht Landgoed (Lyners, 2025).

Return Interval	Meulenzicht	
	Pre	Post
2	0.94	1.58
5	1.36	2.02
10	1.98	2.89
20	2.52	3.40
50	4.20	5.09
100	6.47	6.15

- Discharge headwalls at the ends of pipes will be equipped with stilling basins and erosion protection to decrease storm water velocities, spread the flows and prevent erosion at the outlets (Figure 13). These headwall outlets discharge into the buffer of wetland areas and will not be constructed within the delineated area of any wetland.

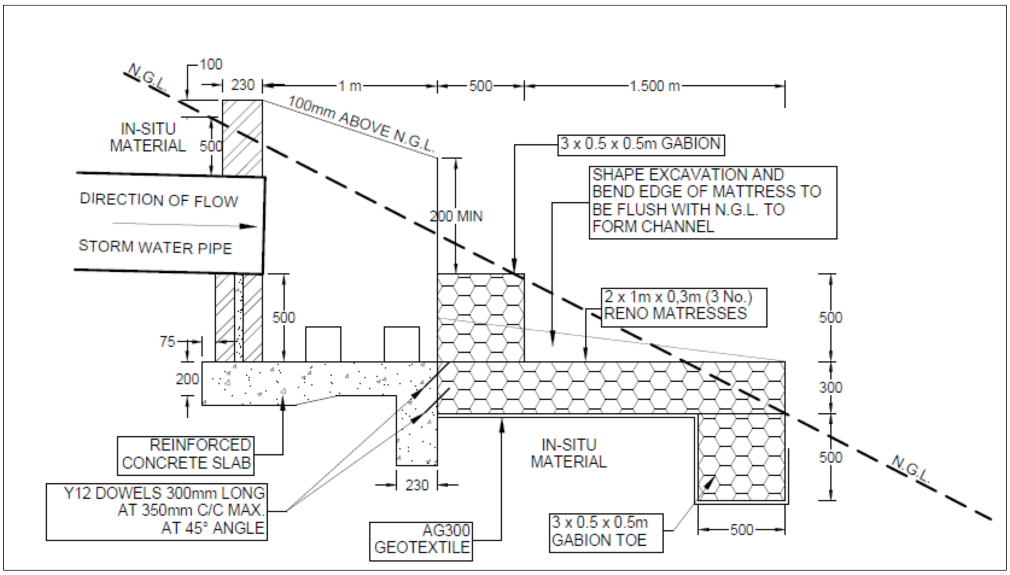

Figure 13: Section of proposed headwall outlets including stilling basins and erosion protection (Lyners, 2025).

7.1.2 Road Crossings

- Roads crossing watercourses will incorporate a 300 mm thick gabion reno mattress to a) achieve a stable roadbed and b) to allow baseflows to permeate through the crossing unimpeded. Culverts situated above the mattress will allow stormwater flows to pass through the crossing (Figure 14).

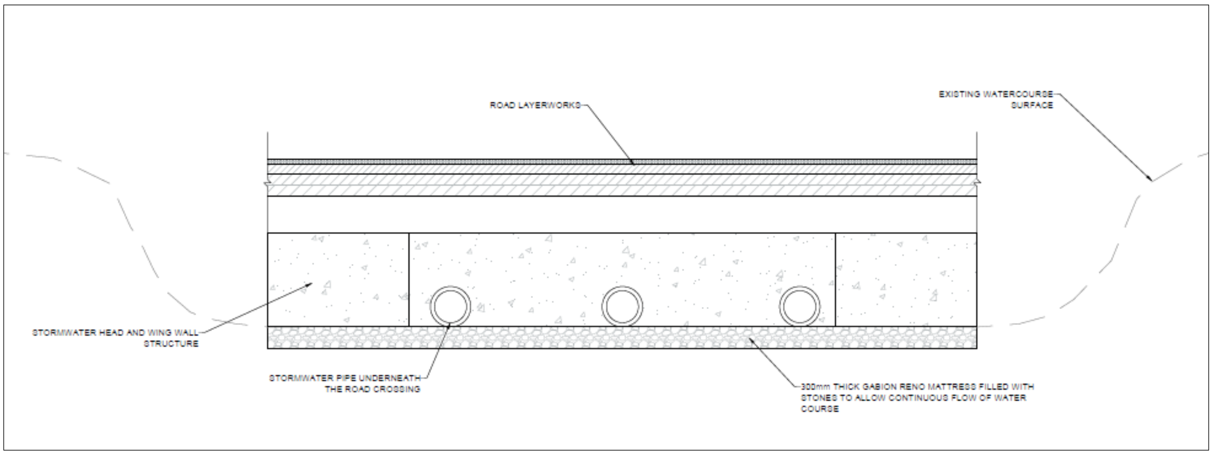

Figure 14: Typical detail of road stream crossing (Lyners, 2025).

7.1.3 Sewage

- The applicant will design, implement, operate and maintain a 360 kL on-site wastewater treatment package plant (Alveo Water Membrane Bioreactor) situated along the western perimeter of the Meulenzicht Landgoed.
- The internal sewer system will drain to localized small sewer pumpstations (5 in total located along the eastern perimeter of the development) that will pump to the proposed 360kL sewer package plant for wastewater treatment of the development.
- Sewer lines will cross several watercourses and will be buried beneath the bed of the watercourse and encased in concrete (Figure 15).

- The treated effluent will either be discharged into the W2 or reused for irrigation purposes on open green spaces.
- The wastewater will be treated to the Department of Water and Sanitation's General Discharge Limits (Table 15).

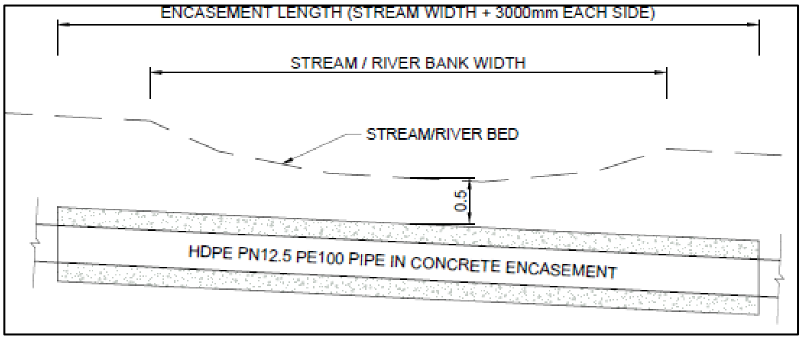

Figure 15: Longitudinal section of sewage pipelines crossing a watercourse (Lyners, 2025).

Table 15: DWS general limits for wastewater discharge.

Parameter	Concentration
COD	75 (mg COD/l)
Ammonia as Nitrogen	6 (mg N/l)
Nitrate as Nitrogen	15 (mg N/l)
Orthophosphates	10 (mg P/l)
Total Suspended Solids	25 (mg TSS/l)
Faecal Coliform	1000 (per 100 mL)

8. IMPACT ASSESSMENT

8.1 Layout & Design Phase

Certain aspects of the development require careful consideration prior to construction so as to minimise impacts during the operational phase. This is most relevant for the design of road crossings and stormwater infrastructure.

Impact 1: Alteration of hydrogeomorphological characteristics caused by constriction of flow at road crossings

Road crossings alter flow hydrodynamics and can impact the natural hydrogeomorphological attributes of a watercourse. Culverts are incorporated into the design to allow surface flows beneath the road. Culverts can result in the constriction of flow which could:

a) Create a barrier to flow and sediment transport, which can potentially lead to inundation of habitat upstream of the road, leading to formation of permanently saturated and inundated areas

b) Lead to more concentrated flow downstream of the road crossing, leading to scouring, erosion incision of the channel.

c) Lead to erosion around culvert and wash out of the road.

	Without Mitigation	With Mitigation
Intensity	High	Moderate
Duration	Ongoing	Ongoing
Extent	Limited	Very limited
Probability	Almost certain	Unlikely

Significance	**-78: Moderate**	**-33: Negligible**
Reversibility	Medium	High
Irreplaceability	Medium	Low
Confidence	High	High

Mitigation:

- Crossings must facilitate free flow of surface and subsurface water and no ponding or inundation of wetland habitat must occur upstream of road crossings;
- Culverts beneath road crossings must be appropriately sized (i.e. must be sized according to the natural width of the channel) and must not result in concentrated, high energy flow downstream of the crossing. Stormwater flows must not be channelled to a narrower section of the channel. In this respect box culverts are recommended.
- Stream bed and bank protection must be incorporated below road crossings.

Impact 2: Channel erosion and incision caused by increased stormwater inputs into wetlands.

The scale of the development and the associated increase in area of impervious surfaces (roads, building etc.) will result in the generation of significant volumes of stormwater. Energy dissipation and erosion protection has been incorporated into the design of stormwater headwall outlets to prevent erosion at outlets.

Additional stormwater input into each of the wetlands will increase flow rates and flood peaks which can lead to erosion of the bed and banks and channel incision. This is a common problem in urban rivers and wetlands throughout George and the severe effects of stormwater on the ecological condition of watercourses is already evident in W3 (as described in Section 4.1.2). High rates of erosion in the catchment area also affect sensitive downstream habitat. In this respect the Kaaimans Estuary is under increasing pressure from urban developments in the Swart River catchment area.

Post development stormwater runoff is expected to increase and represents a Very High intensity of impact to water resources within the development area and to the Kaaimans Estuary. While energy dissipation at headwall outlets can mitigate against erosion of the embankments (at the point of discharge) – accumulated flow volumes within the channel will have a high likelihood of eroding and incising the channel of watercourses. This impact can only be mitigated by implementing Sustainable Drainage Systems (SuDS) on site aimed at encouraging attenuation and infiltration of water within the development prior to discharge into watercourses.

	Without Mitigation	With Mitigation
Intensity	Very High	Moderate
Duration	Ongoing	Ongoing
Extent	Local	Limited
Probability	Almost Certain	Probably
Significance	**-90: Moderate**	**-48: Minor**
Reversibility	Medium	High
Irreplaceability	Medium	Low
Confidence	High	High

Mitigation:;

- Implementation of additional SuDS measures is required to attenuate stormwater onsite and reduce stormwater impacts to an appropriate level. It is recommended that the stormwater management plan for the development should align with the City of Cape Town urban stormwater impacts policy which requires 24 hour extended detention of the 1-year return interval, 24-hour storm event. In addition to rainwater harvesting (which will be implemented as part of the stormwater management plan) the following must, *inter alia*, be considered:

- Swales and detention ponds can be incorporated into the open space network to attenuate stormwater runoff, encourage infiltration and reduce the speed, energy and volumes at which stormwater is discharged from the site;
- Use of permeable paving to encourage infiltration into the soil; and
- Use of retention ponds and artificial wetlands to capture stormwater runoff and prevent its discharge from the site.

- The headcut erosion in W3 must be rehabilitated according to the plan prescribed in Section 9 to prevent any further loss of wetland habitat. The following mitigation measures must be implemented during rehabilitation:
  - A single access point must be utilised to access the rehabilitation area;
  - Rehabilitation must be planned for the dry season to minimise the potential for floods to flow through the rehabilitation area during construction;
  - The filled area must ensure a continuous streambed profile with no sudden drops in elevation;
- The rehabilitated area must be inspected at least once a month and after any rainfall event exceeding 10 mm. Any signs of erosion must be addressed immediately.

Impact 3: Loss of wetland habitat due to construction of built infrastructure.

Transformation of wetland habitat is limited to road crossings. All other infrastructure will be located outside of the delineated area of each wetland or will be limited to a temporary disturbance (i.e. installation of sewage pipelines crossing wetlands). Apart from the access road to Phase A8, all infrastructure will be located outside of the designated buffer area.

	Without Mitigation	With Mitigation
Intensity	Low	Very Low
Duration	Permanent	Permanent
Extent	Very Limited	Very limited
Probability	Likely	Unlikely
Significance	**-50: Minor**	**-30: Negligible**
Reversibility	High	High
Irreplaceability	Low	Low
Confidence	High	High

Mitigation:

- Recommended buffers for each wetland must be clearly demarcated and indicated as No-Go areas. Access into buffer areas is only permitted for construction of stormwater and sewage infrastructure and road crossings.
- The access road to Phase A8 must remain outside of the delineated area of the wetland.
- Buffer areas must not be converted to lawns and must not be mowed.
- Indigenous vegetation must be allowed to re-establish within buffer areas and an alien invasive plant management plan must be drafted and implemented to control alien plant species in buffers and in delineated wetland areas.

8.2 Construction Phase

Impact 4: Erosion and sedimentation of wetland habitat caused by clearance of the site.

Clearance of vegetation to commence with construction of buildings and roads will expose bare soil which can erode and cause sedimentation of watercourses. This impact is particularly relevant for W2 to W4 which are located at the base of, or along steep slopes.

	Without Mitigation	With Mitigation
Intensity	High	Low
Duration	Short term	Brief
Extent	Limited	Limited
Probability	Almost Certain	Probably
Significance	**-60: Minor**	**-28: Negligible**
Reversibility	High	High
Irreplaceability	Low	Low
Confidence	High	High

Mitigation:

- Ensure that construction activities do not cause any preferential flow paths and concentrated surface runoff during rainfall events.
- Clearly demarcate the construction area and ensure that heavy machinery does not compact soil or disturb vegetation outside of these demarcated areas.
- Reduce transport of sediment through use of structures such as silt fences and biodegradable coir logs placed along the contour below the development footprint.
- Ensure that vegetation clearing is conducted in parallel with the construction progress to minimise erosion and runoff.
- Revegetate exposed areas once construction has been completed.
- Ensure that stormwater and runoff generated by hardened surfaces is discharged in retention areas (i.e. swales or retention ponds), to avoid concentrated runoff and associated erosion.
- Stockpiling must take place outside of the wetland areas and associated buffers. All stockpiles must be protected from erosion, surrounded by bunds and stored on flat areas where run-off will be minimised; and
- Recommended buffers for each wetland must be clearly demarcated and indicated as No-Go areas. Access into buffer areas is only permitted for construction of stormwater and sewage infrastructure and road crossings.

Figure 16: Examples of silt fences (left) and coir logs (right) used to trap sediment mobilised from steep slopes.

Impact 5: Disturbance and pollution of wetland habitat caused by construction activities.

The site is large and will result in the construction of a variety of infrastructure, including residential units, internal roads, sewage infrastructure, stormwater infrastructure, water reticulation network etc. This will result in high numbers of vehicles and construction workers on site and high quantities of construction materials brought onto the site. Laydown areas and stockpiles of construction materials and excavated topsoil will be required. Poor management of construction activities on site can result in physical disturbance of aquatic habitat and pollution through leaks and spills of hydrocarbons (i.e. fuel and oil from construction vehicles and machinery, bitumen for road surfacing etc.) and other construction materials (e.g. cement, paint etc.) The cumulative intensity of impact of these activities on wetland and river habitat can be significant.

	Without Mitigation	With Mitigation
Intensity	High	Low
Duration	Medium Term	Short Term
Extent	Limited	Limited
Probability	Likely	Unlikely
Significance	**-55: Minor**	**-24: Negligible**
Reversibility	High	High
Irreplaceability	Medium	Low
Confidence	High	High

Mitigation:

- Recommended buffers for each wetland must be clearly demarcated and indicated as No-Go areas. Access into buffer areas is only permitted for construction of stormwater and sewage infrastructure and road crossings.
- Restrict vehicle access to single points that are clearly demarcated;
- Working areas must be clearly demarcated and no vehicle access or disturbance must take place outside of demarcated areas;
- Excavators and all other machinery and vehicles must be checked for oil and fuel leaks daily. No machinery or vehicles with leaks are permitted to work in wetlands;
- No fuel storage, refuelling, vehicle maintenance or vehicle depots to be allowed within the buffer of the watercourse; and
- Refuelling and fuel storage areas, and areas used for the servicing or parking of vehicles and machinery, must be located on impervious bases and should have bunds around them (sized to contain 110 % of the tank capacity) to contain any possible spills;

- Contractors used for the project should have spill kits available to ensure that any fuel or oil spills are clean-up and discarded correctly;
- Adequate sanitary facilities and ablutions on the servitude must be provided for all personnel throughout the project area. Use of these facilities must be enforced (these facilities must be kept clean so that they are a desired alternative to the surrounding vegetation) and must be routinely serviced;
- No dumping of construction material on-site may take place;
- An alien invasive plant management plan needs to be compiled and implemented post construction to prevent the growth of invasives on cleared areas

Impact 6: Disturbance of habitat caused by the construction of sewer pipelines and stormwater infrastructure.

Sewage pipelines will run along low points immediately adjacent and across wetlands. While the wetlands are moderately to largely modified, it is important that construction of these linear structures is planned so that the hydro-functional attributes of the wetlands is maintained.

	Without Mitigation	With Mitigation
Intensity	High	Moderate
Duration	Medium Term	Brief
Extent	Limited	Very Limited
Probability	Certain	Certain
Significance	**-77: Moderate**	**-49: Minor**
Reversibility	High	High
Irreplaceability	Low	Low
Confidence	High	High

Mitigation:

- Recommended buffers for each wetland must be clearly demarcated and indicated as No-Go areas. Apart from pipelines crossing watercourses, all pipelines must remain outside of designated buffer areas.
- The location and alignment of all proposed infrastructure crossing wetlands must be clearly demarcated prior to the start of construction activities so as to minimise unnecessary impacts to wetland habitat;
- Soil excavated for the trench for the stormwater and sewage pipelines must be stockpiled along the outer edge of the trench furthest away from the wetland. Topsoil must be separated from subsoil and stockpiled separately;
- The trench must be filled (first with subsoil and then with topsoil) and reshaped to original contours such that no preferential flow paths are created;
- The backfilled trench and any other disturbed areas must be re-vegetated using an appropriate indigenous fynbos grassland mix. Temporary erosion control must be placed along the trench alignment until such time as vegetation has re-established;
- Cement/concrete used in the construction must not be mixed on bare ground or within the wetland or buffer area. An impermeable/bunded area must be established in such a way that cement slurry, runoff and cement water will be contained and will not flow into the surrounding environment, the stream or riparian zone or contaminate the soil;
- The watercourse must be inspected on a regular basis (at least weekly) by an appropriately qualified ECO for signs of disturbance, sedimentation and pollution during the construction phase. If signs of disturbance, sedimentation or pollution are noted, immediate action should

be taken to remedy the situation and, if necessary, a freshwater ecologist should be consulted for advice on the most suitable remediation measures; and • Disturbed areas must be kept clear of alien vegetation and must be actively reshaped to natural contours and rehabilitated with indigenous, local vegetation.

Impact 7: Closure of offstream dams on aquatic biodiversity The two offstream dams located towards the south of the development are planned to be closed. While these dams are aesthetically attractive features that provide habitat for limited bird species and aquatic biota, their closure is not considered a major loss of aquatic biodiversity.		
	Without Mitigation	**With Mitigation**
Intensity	Low High	Very Low Moderate
Duration	Brief Medium term	Brief
Extent	Very Limited	Very Limited
Probability	Certain	Certain
Significance	**-42: Minor** **-77: Moderate**	**-35: Negligible** **-49: Minor**
Reversibility	High	High
Irreplaceability	Low	Low
Confidence	High	High

Mitigation:

- An opening in the wall of the dams must be made to allow water to slowly exit the dam in a controlled manner. This is to allow any aquatic biota (especially amphibians) to migrate from the dam prior to infilling.
- The dams must ideally be emptied during the winter season (from May to September outside of the breeding season for most biota) at least 3 weeks prior to infilling the dams.
- A survey of fish species occurring in the dams is recommended. Alien invasive or extra-limital indigenous fish species must not be translocated to alternative natural or artificial habitats and must be euthanised using appropriate ethical methods.
- Dams must be slowly emptied to allow existing biota .

8.3 Operational Phase

Impact 8: Impairment of water quality caused by increased stormwater inputs. Vehicles, gardens and maintenance activities will result in increased runoff of fertilizers, pesticides and hydrocarbons. Intentional disposal of chemicals and other household products (e.g. paint) into the stormwater intentionally discarded into stormwater drains can also have a significant effect on water quality. Implementation of a SuDS principles can mitigate this impact through increased attenuation and filtration of pollutants on site (prior to discharge into the environment).		
	Without Mitigation	**With Mitigation**
Intensity	Moderate	Low
Duration	Ongoing	Ongoing
Extent	Limited	Limited
Probability	Almost certain	Probably

Significance	**-72: Minor**	**-44: Minor**
Reversibility	High	High
Irreplaceability	Low	Low
Confidence	High	High

Mitigation:

- Implementation of SuDS as recommended for Impact 2 will also help to improve water quality.
- Guidelines for residents must be drawn up that prohibit dumping of hazardous materials into stormwater drains.

Impact 9: Impairment of water quality caused by discharge of treated sewage effluent into W2

Treated effluent will be discharged into W2, which joins the Swart River and ultimately the Kaaimans Estuary. Flows in the Swart River are highly regulated due to the Garden Route Dam and dilution capacity in the Swart River is therefore reduced. Data on flows in the Swart River were not available at the time of compiling this report. The impact of effluent discharge from the package plant on water quality in the Swart River is dependent on the dilution capacity of the Swart River. This in turn is dependent on the volumes of water that are released from the Garden Route Dam in order to satisfy the reserve of the Swart River and Kaaimans Estuary. It is likely that some assimilation of pollutants will occur along W2 and further downstream after the confluence with W3. The ability of these wetland systems to assimilate pollutants is however dependent on maintaining their existing hydro-functional attributes.

The most serious impacts are generally associated with leaks due to blocked pipelines, malfunctioning pump stations or operational problems at the package plant. Monitoring and maintenance of the package plant and associated infrastructure (pump stations in particular) are essential to ensuring that impacts are mitigated to an appropriate level.

	Without Mitigation	**With Mitigation**
Intensity	Very High	High
Duration	Ongoing	Ongoing
Extent	Municipal Area	Municipal Area
Probability	Likely	Likely
Significance	**-80: Moderate**	**-75: Moderate**
Reversibility	High	High
Irreplaceability	Low	Low
Confidence	Low	Low

Mitigation:

- Re-use of treated wastewater (e.g. for irrigation of landscaped areas and open space areas) must be prioritised so as to minimise discharge of wastewater into the watercourse;
- The efficacy of the WWTP will rely on routine maintenance. A maintenance schedule for the package plant must be drafted and implemented;
- A signed service level agreement between the developer and a qualified service provider must be provided as a condition of authorisation;
- On-site operator must be thoroughly trained by the service provider and must be monitored in the operation of the plant for the first 3 months;
- A water quality monitoring plan must be compiled and must include the following:
    - Monitoring and analysis of treated effluent (prior to discharge into the watercourse) for all water quality parameters specified in the General Limit must be performed

weekly during the first 3 months in order to ensure the plant is functioning optimally. Thereafter samples must be collected and analysed every two weeks.

  - TSS and pH must be measured at the effluent outlet daily using a calibrated handheld water quality meter. Any variations beyond the General Limit must be used to prompt an immediate response and appropriate corrective measures.
  - All water quality parameters specified in the General Limit must be analysed in a sample collected directly from W3. Samples must be collected at the lower end of W3 near the eastern perimeter of the property.

- Pump Stations:
  - All pump stations must be inspected every second week for any signs of leaks or failure. A register of inspections and the status of each pump station must be maintained;
  - A contingency plan for load-shedding must be included in the design of the sewage network. Alternatively, each pump station must be provided with emergency storage to cater for a 4-hour power interruption; and
  - A maintenance plan for all pump stations must be drafted and implemented.
- Service level agreements, monitoring and maintenance plans must be audited on an annual basis.

8.4 Cumulative Impacts

Impact 10: Deterioration in water quality caused by increased stormwater flows and sewage infrastructure.

Cumulative impacts are primarily related to increased stormwater flows, sediment delivery and water quality deterioration in the Swart River catchment due to rapidly expanding high density developments in the catchment area. While the Swart River is relatively degraded, it does discharge into the Kaaimans Estuary which is considered Largely Natural (PES B). The cumulative impacts of development in the Swart River catchment are significant and pose a serious risk to the ecological health of the Kaaimans Estuary and to recreational users of the estuary. An example of this can be observed in Figure 17, which shows highly turbid water from the Swart River mixing with the Kaaimans Estuary during a high rainfall event.

Figure 17: Photograph showing highly turbid water from the Swart River mixing with the Kaaimans Estuary during a flood event in November 2023 (Photo: J. Dabrowski).

	Without Mitigation	With Mitigation
Intensity	High	Moderate
Duration	Ongoing	Ongoing
Extent	Municipal Area	Municipal Area
Probability	Certain	Probably
Significance	**-105: Moderate**	**-56: Minor**
Reversibility	Medium	High
Irreplaceability	Medium	Low
Confidence	High	High

Mitigation:

- Developments in the catchment area must incorporate SuDS as part of the stormwater management plan. It is recommended that plans should align with the City of Cape Town urban stormwater impacts policy which requires 24 hour extended detention of the 1-year return interval, 24-hour storm event;
- The assimilative capacity of the Swart River must be determined (taking flow releases from the Garden Route Dam into account) to determine whether effluent discharge can be adequately diluted.

9. REHABILITATION PLAN

The headcut erosion in the lower reaches of W3 must be rehabilitated to prevent any further erosion to the wetland. The following plan has been proposed:

- The rehabilitation work will consist of filling the donga with large rocks of size 300mm diameter below the stream bed (Figure 18).
- A layer of 300mm thick topsoil will be placed and compacted on top of the rock fill. A mixture of endemic, indigenous grass seeds will be placed in the topsoil layer to quickly establish vegetation and reduce the risk of future erosion. Additional wetland plant species that must be planted include the following:
    - *Cliffortia odorata*
    - *Helichrysum cymosum*
    - *Juncus effusus*
    - *Cyperus textilis*
    - *Nidorella ivifolia (along the drier margins)*
- Gabion structures will be placed along the rehabilitated area to reduce the stormwater flow velocity and to assist with sediment build up (Figure 19).

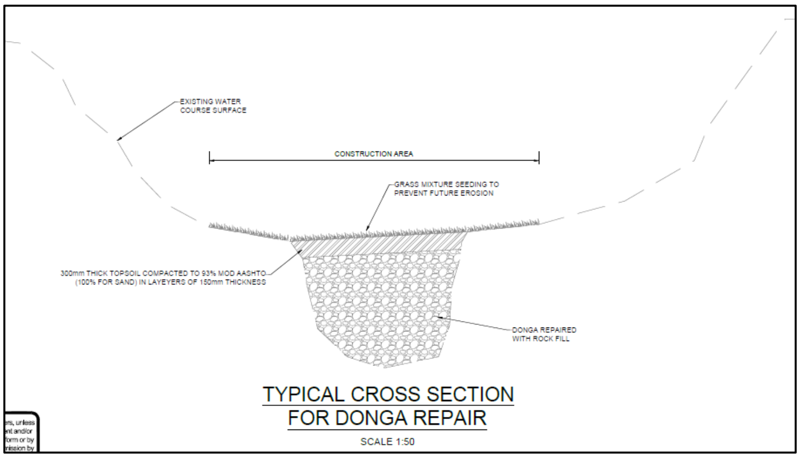

Figure 18: Cross-section of proposed rehabilitation works for W3.

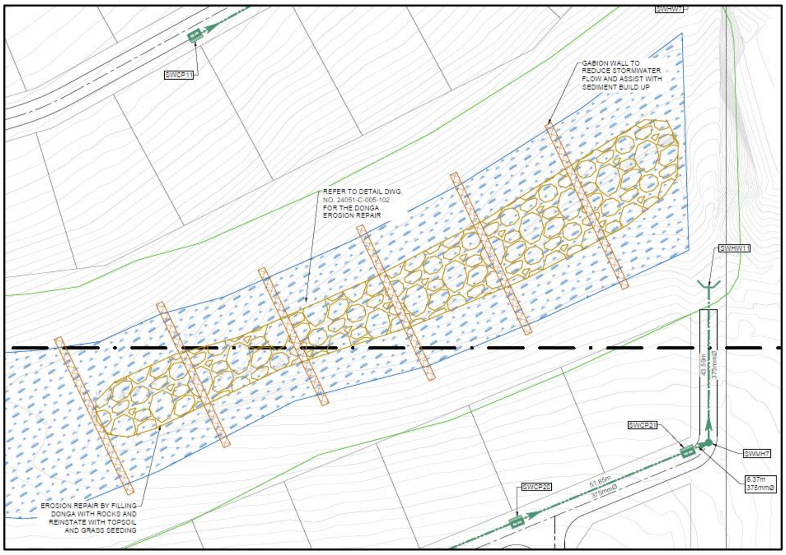

Figure 19: Plan view of the proposed rehabilitation works for W3.

10. WATER USE AUTHORISATION

A sewage package plant will be constructed as part of the development. According to GN 4167 of 2023, any Section 21 (c) and (i) water use (i.e. discharge of wastewater into a watercourse) is excluded from a General Authorisation. In addition, main sewage pipelines crossing watercourses are also excluded from a General Authorisation. A Water Use License (WUL) will therefore be required for the development.

11. CONCLUSION

The scale of the planned development covers a large area and presents several risks to aquatic biodiversity both within the development area and downstream towards the Kaaimans Estuary. Many of these risks can be mitigated to an appropriate level of impact subject to the implementation of prescribed mitigation measures.

Sewage contamination and increased stormwater volumes pose the greatest risk to aquatic biodiversity for this development and is the prevailing threat to urban watercourses in George. Maintenance and operation of the package plant must therefore be strictly enforced, monitored and routinely audited. Irrigation using treated wastewater must be prioritised over discharge into the watercourse whenever possible. Monitoring the impact of effluent discharge on the Swart River is challenging due to limited options to access the river. It is likely that the volume and quality of water flowing down the Swart River will be sufficient to dilute effluent discharged from the package plant – provided that effluent water quality falls within the General Limit. A more detailed analysis of flow volumes released from the Garden Route Dam is required to assess this impact with higher confidence. Assimilation of pollutants (especially nutrients) is also expected to occur along W2 and is in an important ecosystem service provided by wetlands. The ability of the wetland to assimilate pollutants is however dependent on maintaining the hydro-functional attributes of the wetland (e.g. a well vegetated channel that slows flow, allowing for assimilation of pollutants through absorption, adsorption and microbial decomposition). In this respect watercourses must be protected from erosion and incision caused by high stormwater flows. For this reason, it is recommended that additional attenuation of stormwater is accommodated onsite prior to discharge into watercourses.

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APPENDIX 13: IMPACT ASSESSMENT METHODOLOGY

Individual impacts for the construction and operational phase were identified and rated according to criteria which include their intensity, duration and extent. The ratings were then used to calculate the consequence of the impact which can be either negative or positive as follows:

Consequence = *type x (intensity + duration + extent)*

Where type is either negative (i.e. -1) or positive (i.e. 1). The significance of the impact was then calculated by applying the probability of occurrence to the consequence as follows:

Significance = *consequence x probability*

The criteria and their associated ratings are shown in Table 16.

Table 16: Categorical descriptions for impacts and their associated ratings

Rating	Intensity	Duration	Extent	Probability
1	Negligible	Immediate	Very limited	Highly unlikely
2	Very low	Brief	Limited	Rare
3	Low	Short term	Local	Unlikely
4	Moderate	Medium term	Municipal area	Probably
5	High	Long term	Regional	Likely
6	Very high	Ongoing	National	Almost certain
7	Extremely high	Permanent	International	Certain

Categories assigned to the calculated significance ratings are presented in Table 17.

Table 17: Value ranges for significance ratings, where (-) indicates a negative impact and (+) indicates a positive impact

Significance Rating	Range	
Major (-)	-147	-109
Moderate (-)	-108	-73
Minor (-)	-72	-36
Negligible (-)	-35	-1
Neutral	0	0
Negligible (+)	1	35
Minor (+)	36	72
Moderate (+)	73	108
Major (+)	109	147

Each impact was considered from the perspective of whether losses or gains would be irreversible or result in the irreplaceable loss of biodiversity of ecosystem services. The level of confidence was also determined and rated as low, medium or high (Table 18).

Table 18: Definition of reversibility, irreplaceability and confidence ratings.

Rating	Reversibility	Irreplaceability	Confidence
Low	Permanent modification, no recovery possible.	No irreparable damage and the resource isn't scarce.	Judgement based on intuition.
Medium	Recovery possible with significant intervention.	Irreparable damage but is represented elsewhere.	Based on common sense and general knowledge
High	Recovery likely.	Irreparable damage and is not represented elsewhere.	Substantial data supports the assessment