Development of a Multi-Unit Guest Sleep Over Facility on the Remainder of Farm 479 Oakhill.

Specialist Aquatic Biodiversity Assessment

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- 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;
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Specialist: Dr. James Dabrowski (Ph.D., Pr.Sci.Nat. Water Resources)

Date: 10 October 2024

EXECUTIVE SUMMARY

Confluent Environmental Pty (Ltd) was appointed by Cape EAPrac to undertake an aquatic assessment for a proposed holiday resort development on Farm RE/479 Oakhill, Plettenberg Bay, Western Cape. The proposed development site is situated adjacent to the N2, approximately 3.4 km northwest of Keurboomstrand. The proposed development comprises of approximately 50 accommodation units, internal roads, parking and administrative and recreational (e.g. braai area/entertainment area and clubhouse) buildings. A sewage package plant will be included in the design as there is no existing municipal sewer infrastructure in the vicinity of the site. The package plant will have a treatment capacity for 20 m³ per day and will use a combination of conventional treatment (natural bacteria) and membrane technology (microfiltration) to treat sewage effluent to comply with the general water quality limits as stipulated by the Department of Water and Sanitation.

Two watercourses were verified to occur on site – a non-perennial stream (**PES - A/B, EIS - Low**) running along the northern boundary of the property and a hillslope seep wetland (**PES C, EIS – Low**) that covers a large area in the south of the site development boundary. The impact assessment considered two alternative Site Development Plans (SDPs):

- **Alternative A:** This was the original SDP provided to specialists prior to the site visit (and prior to the delineation of the wetland). While most accommodation units were located outside of the delineated wetland, an internal road, some administrative buildings, a clubhouse and a braai area were located within the delineated wetland area.
- **Alternative B (preferred):** Following the site visit and mapping of ecologically sensitive areas (including appropriate buffers), the SDP was adjusted to avoid the wetland (as well as sensitive forest habitat). With respect to the wetland, all infrastructure is located outside of the delineated wetland. A short section of the access road will pass through the buffer – otherwise all other infrastructure is located outside of the buffer. All infrastructure is located outside of the non-perennial stream buffer.

For both alternatives an onsite sewage treatment package plant will be installed to treat wastewater to the general wastewater discharge limit. The treated wastewater will be used to irrigate open space areas within the development footprint. Alternative B largely avoids direct impacts to all watercourses on the property and represents a far more favourable development option in comparison to Alternative A. Implementation of buffers (15 and 20 m for the wetland and non-perennial stream, respectively), together with recommended mitigation measures can reduce minor to moderate impacts to negligible. Similarly, the DWS Risk Assessment matrix indicates a Low risk to all watercourses, indicating that their PES is unlikely to deteriorate. While this implies that a GA may be applicable for Section 21 c and i water uses, irrigation with treated wastewater in close proximity to watercourses and to boreholes located on the property may require the need for a WULA.

Based on the findings of this assessment, the proposed development is considered acceptable from an aquatic biodiversity perspective.

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1. INTRODUCTION

Confluent Environmental Pty (Ltd) was appointed by Cape EAPrac to undertake an aquatic assessment for a proposed holiday resort development on Farm RE/479 Oakhill, Plettenberg Bay, Western Cape. The proposed development site is situated adjacent to the N2, approximately 3.4 km northwest of Keurboomstrand (Figure 1). The proposed development includes the development of 50 small accommodation units, parking spaces and recreational buildings. 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).

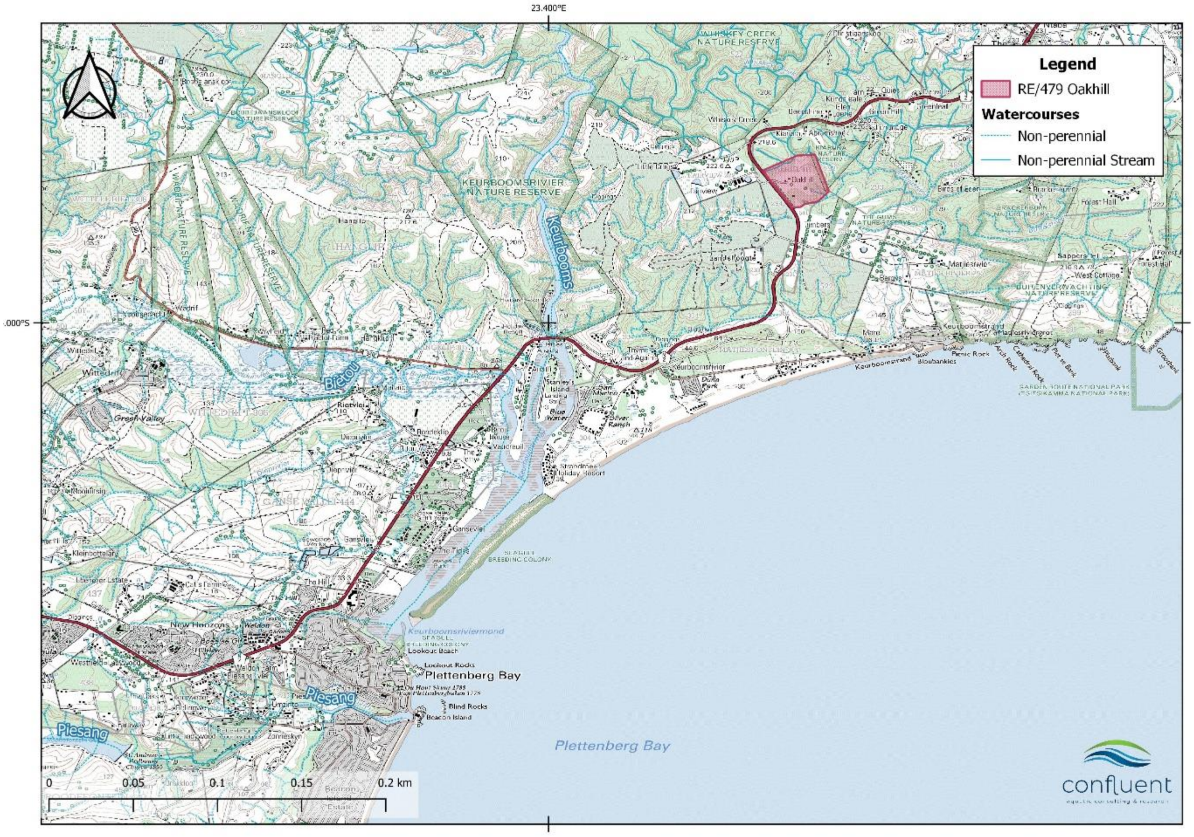

Figure 1: Project location.

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 (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.

The screening tool classified the aquatic biodiversity of the development area as being of **Very High** sensitivity for the following reasons:

- The entire development areas falls within in a Strategic Water Source Area (SWSA); and
- An aquatic Ecological Support Area (ESA) lies in close proximity to the development area.

According to the protocol, a site sensitivity verification must be undertaken to confirm the sensitivity of the site as indicated by the screening tool.

1.1.2 National Water Act (NWA, 1998)

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, estuaries, 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
- A reference to a watercourse includes, where relevant, its bed and banks.

For the purposes of this assessment, a wetland area is defined according to the NWA (Act No. 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".

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 Scope of Work

- To undertake a desktop analysis and site inspection to verify the sensitivity of aquatic biodiversity as **Very High** or **Low**; and
- Compile and Aquatic Biodiversity Compliance Statement or Aquatic Biodiversity Specialist Assessment based on the site verification of the sensitivity of the site; and
- Verify whether the site falls within the regulated area of any watercourses and compile the required DWS Risk Assessment to determine water use authorisation requirements.

2. APPROACH

2.1 Desktop Assessment

A desktop assessment was conducted to contextualize affected watercourses in terms their local and regional setting, and conservation planning. An understanding of the biophysical attributes and conservation and water resource management plans of the area assists in the assessment of the importance and sensitivity of the watercourses, the setting of management objectives and the assessment of the significance of anticipated impacts. The following data sources and GIS spatial information were consulted to inform the desktop assessment:

- DWS spatial layers;
- National Freshwater Ecosystem Priority Areas (NFEPA) spatial layers (Nel et al., 2011);
- National Wetland Map 5 and Confidence Map (CSIR, 2018) – the latest national wetland inventory map for South Africa;
- Western Cape Biodiversity and Spatial Plan (WCBSP) for Bitou (CapeNature, 2017).

2.2 Watercourse Classification

Classification of watercourses is important as this determines the PES and EIS assessment methodologies that can be applied. Furthermore, classification of the watercourse provides a fundamental understanding of the hydrological and geomorphic drivers that characterise the watercourse and therefore assists in the interpretation of impacts to the watercourse. A site visit was undertaken, during which time the following activities were undertaken:

- Identification and classification of watercourses within the footprint of the site according to methods detailed in Ollis et al. (2013);
- Soil augering to confirm the presence of soil indicators (DWAF, 2005) that may indicate the presence of a wetland (if applicable); and
- Identification of hydrophilic plant species that may indicate the presence of wetland plant species (if applicable).

The boundary of a 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 a 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 (TZ): Short periods of saturation (less than three months per annum) characterised by few high chroma mottles and minimal grey matrix (< 10 %).
- Seasonal Zone (SZ): Significant periods of wetness (at least three months per annum) characterised by many low chroma mottles and a grey matrix.
- Permanent Zone (PZ): 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.

2.3 Present Ecological State

An important factor that influences the diversity and abundance of aquatic communities is the condition of the surrounding physico-chemical habitat. Habitat loss, alteration, or degradation generally results in a decline in species diversity. The following methods were used to assess the Present Ecological State (PES) of watercourses:

- Rivers and streams: Index of Habitat Integrity (IHI) – see Appendix 1
- Wetlands: WET Health v 2.0 – see Appendix 2

2.4 Ecological Importance and Sensitivity

The ecological importance of a watercourse is an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales. Ecological sensitivity refers to the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (resilience) (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 Ecological Importance and Sensitivity (EIS) of affected watercourses was assessed using the following methods:

- Rivers and streams: DWS EIS method - see Appendix 3
- Wetlands: WET-Ecoservices v 2.0 – see Appendix 4

2.5 Buffer Determination

A protective buffer zone was applied to watercourses potentially affected by development activities. Buffer zones are 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 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 and the implementation of appropriate mitigation measures.

2.6 Impact Assessment

Development activities typically impact on the following important drivers of aquatic ecosystems:

- *Hydrology:* Impacts on hydrological functioning at a landscape level and across the site which can arise from changes to flood regimes and base flows and modifications to general flow characteristics, including change in the hydrological regime or hydroperiod of the aquatic ecosystem (e.g. seasonal to temporary or permanent; impact of over-abstraction or instream or off-stream impoundment of a wetland or river etc.);
- *Geomorphology:* This refers to the alteration of hydrological and geomorphological processes and drivers, and associated impacts to aquatic habitat and ecosystem goods and services primarily driven by changes to the sediment regime of the aquatic ecosystem and its broader catchment;
- *Modification of water quality:* This refers to the alteration or deterioration in the physical, chemical and biological characteristics of water within streams, rivers and wetlands, and associated impacts to aquatic habitat and ecosystem goods and services (e.g. due to increased sediment load, contamination by chemical and/or organic effluent, and/or eutrophication etc.);
- *Fragmentation:* Loss of lateral and/or longitudinal ecological connectivity due to structures crossing or bordering watercourses (e.g. road or pipeline crossing a wetland);
- *Modification of aquatic habitat:* This refers to the physical disturbance of in-stream and riparian aquatic habitat and associated ecosystem goods and services including the loss or degradation of all or part of any unique or important features associated with or

within the aquatic ecosystem (e.g. waterfalls, springs, oxbow lakes, meandering or braided channels, peat soils, etc.)*;* and

- *Aquatic biodiversity:* Impacts on community composition (numbers and density of species) and integrity (condition, viability, predator prey ratios, dispersal rates, etc.) of the faunal and vegetation communities inhabiting the site.

Modifications to these drivers ultimately influence the PES and EIS of a watercourse. Accordingly, impacts to the watercourse were described and assessed based on their potential to modify each of the above-mentioned drivers of aquatic ecosystem health, using the PES and EIS of the watercourse as a baseline against which to assess impacts. The impact assessment methodology is described in the appendix to this report (Appendix 5).

3. DESKTOP SUMMARY

The proposed development site is situated in the quaternary catchment K70A, which forms part of the catchment area of the Matjies River that discharges into the sea just east of Keurboomstrand (Figure 2). The catchment area falls within the South-Eastern Coastal Belt ecoregion, which is characterised by moderately undulating plains and low mountains with altitude ranging from 0 to 1 300 m above mean sea level. Mean annual precipitation for the catchment area is relatively high (831 per annum), and is a-seasonal occurring year-round, with peaks in late winter and early spring (August to October).

As the rainfall intensity in the area is classified as very high and the inherent erosion potential of soils is also very high (Table 1), erosion of soils and stormwater management are factors which must be carefully considered during construction in this area, especially near watercourses. The site development footprint for the proposed development is provided in Figure 3 and slopes down towards a perennial river that is mapped to run along the northern part of the property (close to the northern boundary). This is the only aquatic feature that is mapped to occur in close proximity to the development area. The vegetation type associated with the development is Southern Afrotemperate Forest, although remnants of this vegetation appear to be confined mainly towards the perimeter of the property, with most of the interior having been transformed (Figure 3).

Table 1. Summary of relevant catchment features for the proposed development area.

Feature	Description
Eco-region Level I	South-Eastern Coastal Belt
Ecoregion Level II	20.02, South-Eastern Coastal Belt
SWSA	Tsitsikamma
Quaternary catchment	K70A
Mean Annual Precipitation	831 mm
Mean Annual Runoff	274 mm
Inherent erosion potential of soils (K-factor)	0.75 (Very High)
Rainfall intensity	Very High
NFEPA	Sub-quaternary reach 9110 - No FEPA Status
Mapped Vegetation Type	FOz1: Southern Afrotemperate Forest (LC) FFs19: South Outeniqua Sandstone Fynbos (LC)

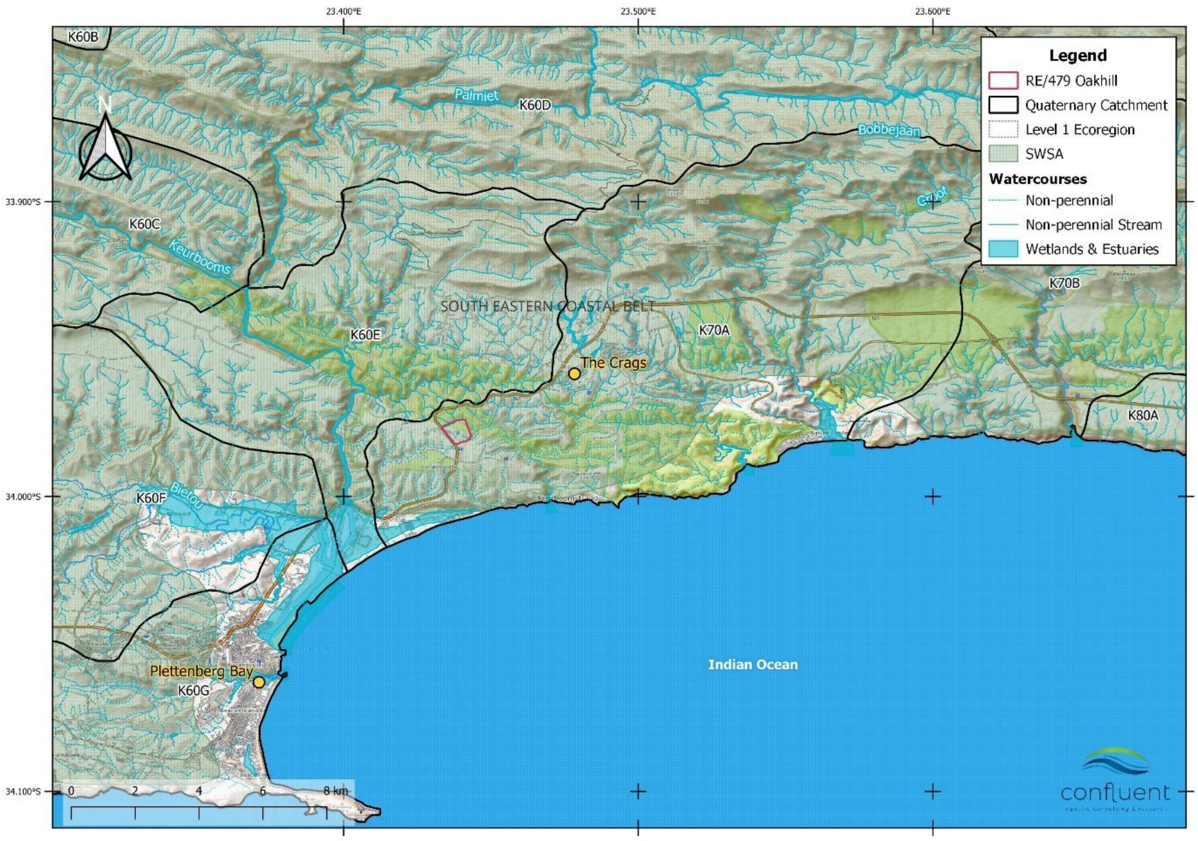

Figure 2: Project location relative to quaternary catchment.

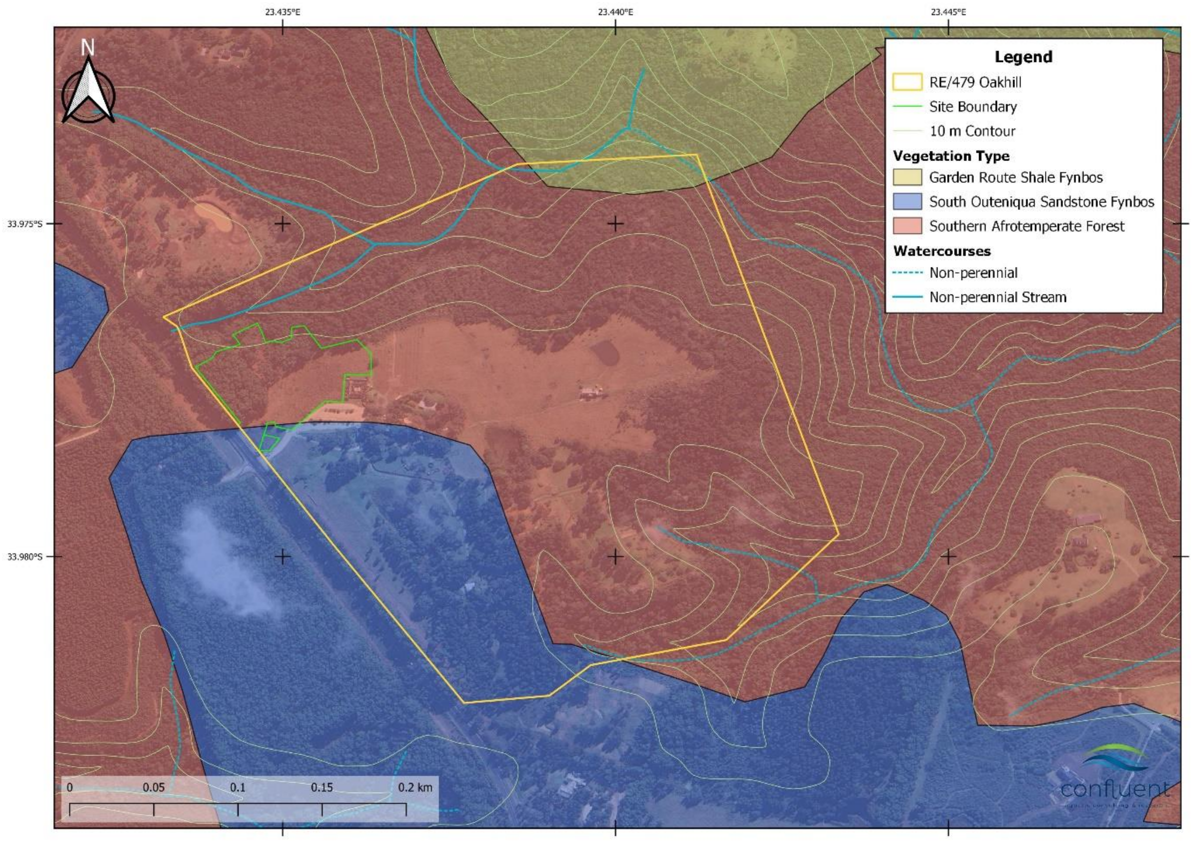

Figure 3: The proposed development site on Farm RE/479 in relation to mapped watercourses and vegetation types.

3.1 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). The WCBSP identified the perennial drainage line running along the northern boundary of the property as an aquatic ESA1 (Figure 4). These are considered natural aquatic features that are not essential for meeting biodiversity targets but are important for supporting more important Protected Areas (Kiaruna Private Nature Reserve which is not far downstream from the project area) and CBAs (e.g. (Southern Afrotemperate Forest). Necessary actions in relation to the WCBSP are to ensure that development on the site does not result in negative impacts on the ecological structure and function of the ESA watercourse (Table 2).

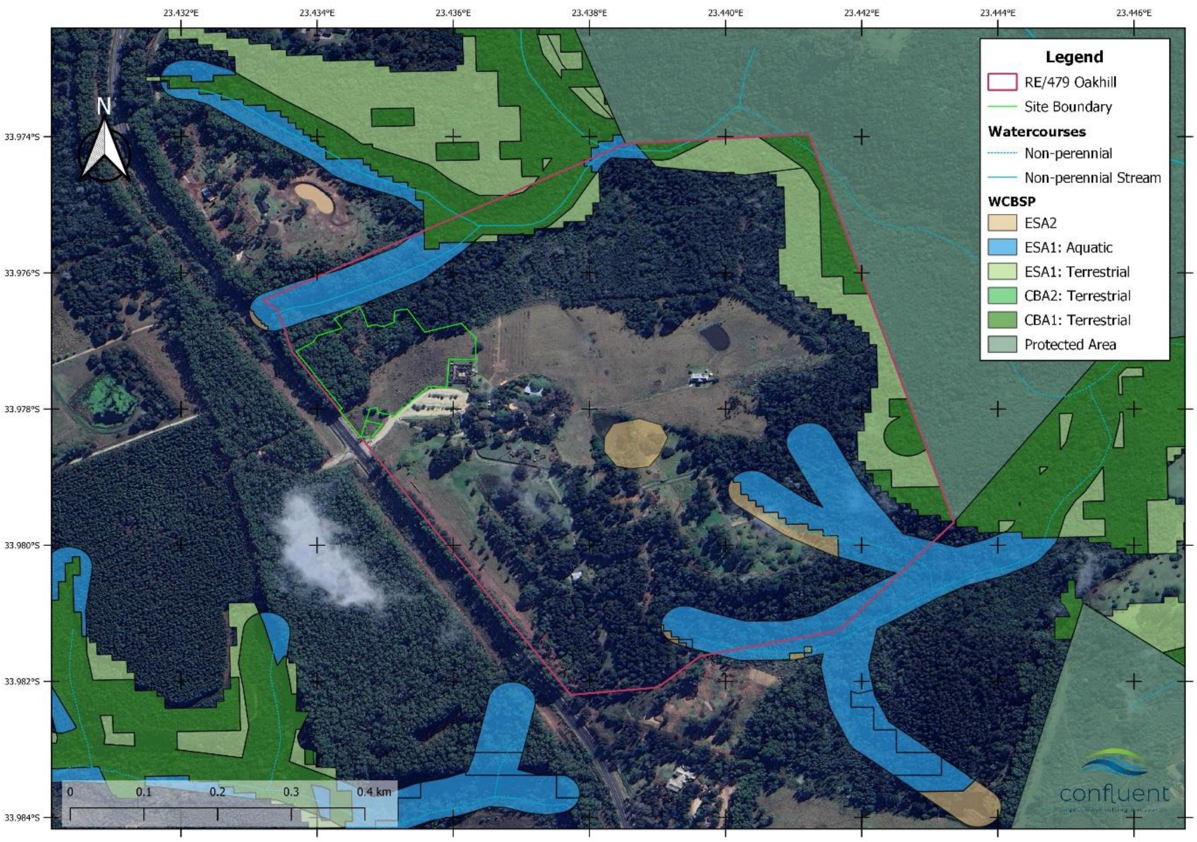

Figure 4. The proposed development site on Farm RE/479 to mapped conservation features of the Western Cape Biodiversity Spatial Plan (2017).

Table 2. Definitions and objectives for conservation categories identified in the Western Cape Biodiversity Spatial Plan (WCBSP, 2017).

WCBSP Category	Definition	Management Objective
Ecological Support Area 1 (ESA1)	Areas that are not essential for meeting biodiversity targets, but that play an important role in supporting the functioning of PAs or CBAs, and are often vital for delivering ecosystem services.	Maintain in a functional, near-natural state. Some habitat loss is acceptable, provided the underlying biodiversity objectives and ecological functioning are not compromised.

3.2 National Freshwater Ecosystem Priority Areas

The proposed development site on Farm RE/479 is situated in sub-quaternary catchment (SQC) 9110. According to the National Freshwater Ecosystem Priority Atlas (NFEPA; Nel *et al*., 2011) the SQC 9110 is not classified under any of the NFEPA categories.

3.3 Strategic Water Source Area

The site does fall within the Tsitiskamma 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.

3.4 Site Development Plan (SDP)

The SDP is illustrated in Figure 5 and comprises of approximately 50 accommodation units, internal roads, parking and administrative and recreational (e.g. braai area/entertainment area and clubhouse) buildings. A sewage package plant will be included in the design as there is no existing municipal sewer infrastructure in the vicinity of the site. The package plant will have a treatment capacity for 20m^3 per day and will use a combination of conventional treatment (natural bacteria) and membrane technology (microfiltration) to treat sewage effluent to comply with the general water quality limits as stipulated by the Department of Water and Sanitation.

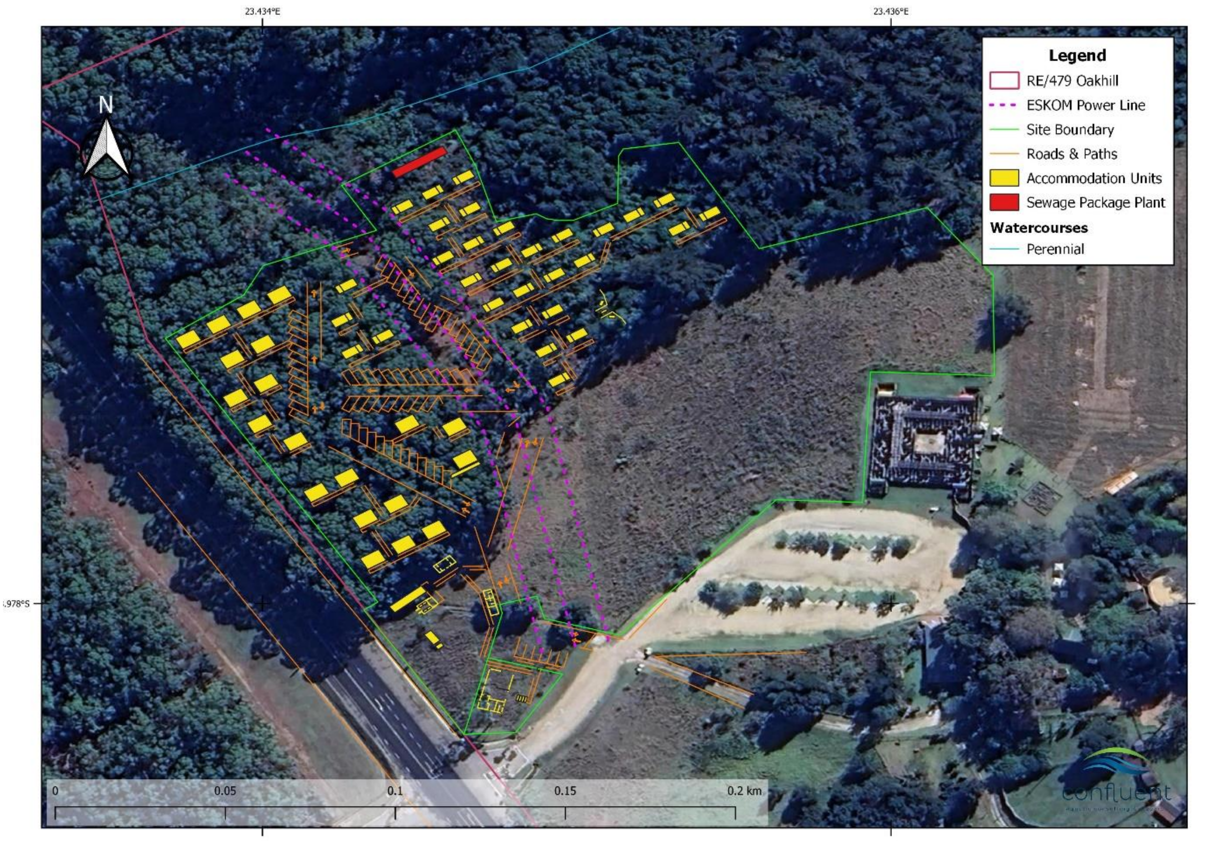

Figure 5: Map illustrating the SDP relative to mapped watercourses.

4. SITE VISIT

The site visit was undertaken on the 5th of April 2024 during which time two watercourses relevant to the development application were confirmed.

4.1 Non-Perennial Drainage Line

The mapped watercourse was confirmed to run along the northern boundary of the property (Figure 3). The channel is narrow (active channel no wider than 2 m) and is confined by relatively steep slopes on either side. The stream is well shaded by tall indigenous forest vegetation consistent with the Southern Afrotemperate Forest vegetation type. Although small isolated temporary pools were present, the channel was dry at the time of the visit and there was no surface water flow (Figure 6). Based on this observation the hydroperiod of the stream is confirmed as non-perennial (as opposed to perennial). The channel provides very limited geomorphological development, comprising of a predominantly earth channel, with very limited alluvial deposition. The uppermost sections of the channel are vegetated with *Carex aethiopica* (which favours shady, moist areas) – but based on the channel morphology (very narrow and confined) cannot be considered as a wetland. In summary, the watercourse is classified as a non-perennial first order stream.

Figure 6: Photographs of the non-perennial stream including the narrow channel (A & B); vegetated upper most section of the channel (C) and Carex aethiopica growing in the upper channel (D).

4.2 Hillslope Seep Wetland

In contrast to the information available in desktop resources, the site visit identified a clear hillslope wetland seep adjacent to a large car park that slopes down towards the northern section of the property (Figure 7). Soil augering revealed a distinct soil profile indicative of a seasonal wetland. A sandy orthic A horizon was followed by a distinct ferricrete layer that was characterised by ferricrete nodules (round, iron rich gravel, up to 1 cm in diameter) in a porous sandy soil matrix (Figure 8). The ferricrete layer overlies a very dense clay layer, which showed clear signs of mottling and gleying, indicative of seasonal soil saturation. Vegetation was characterized by a combination of grasses and wetland plant species that included obligate wetland plant species such as *Elocharis limosa* and *Juncus effusus* (Figure 9). *Nidorella ivifolia* was abundant throughout the higher lying part of the wetland and is often found in temporary and seasonal wetlands.

According to Ollis et al. (2013), seep wetlands are often located on slopes and are characterised by their association with geological formations (lithologies) and topographic positions that either cause groundwater to discharge to the land surface or rain-derived water to ‘seep’ down-slope as subsurface interflow. Examples of places where these conditions occur are:

1) On slopes where the water table intersects the land surface, resulting in groundwater discharge directly to the land surface;
2) Land that is down-slope of a break in slope of the groundwater table;

3) Where subsurface discontinuities in geological units (e.g. faults) cause upward movement of groundwater; or
4) On slopes where a relatively impervious subsoil layer impedes the infiltration of rain derived water into the ground.

In this respect the impervious clay layer is undoubtedly a major contributing factor to the formation of the wetland creating a shallow, perched water table which fluctuates in depth according to seasonal rainfall. Iron is dissolved from the soil matrix under reduced (saturated conditions) and then precipitated out when the soil dries out under more oxygenated conditions. Over long periods of time the iron precipitate cements soil particles to form ferricrete nodules. The site falls within a high rainfall area (Table 1) and the main source of water into the wetland is likely to be from rainfall, which creates the saturated soil conditions due to the impermeable clay layer. Sub-surface flow will occur in a northerly direction, down the slope towards the valley below. While stormwater is clearly diverted from the car park into the wetland, and most likely contributes to seasonal saturation of the soil profile, the presence of the ferricrete nodula indicates that the wetland area has experienced seasonal water saturation over a prolonged period of time.

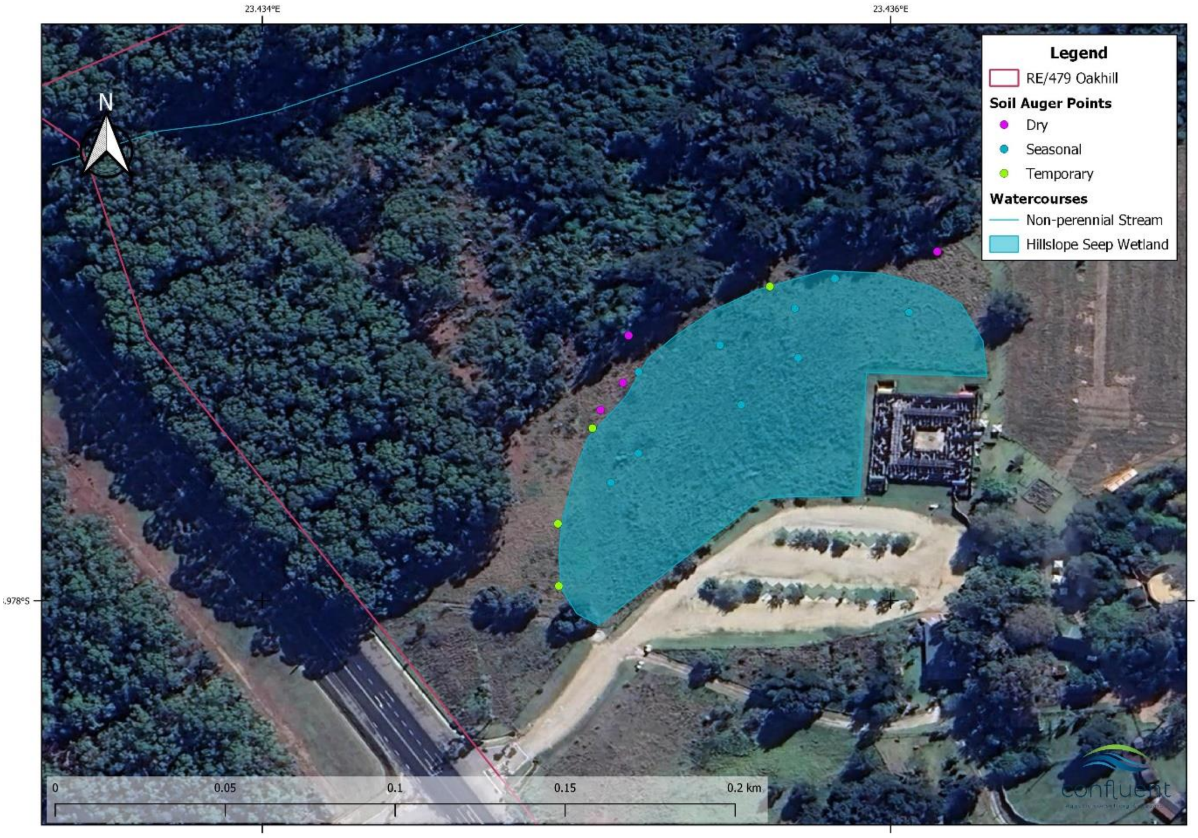

Figure 7: Map indicating the location of soil augering points and the delineated wetland area.

Figure 8: Photographs indicating ferricrete nodula in a sandy soil matrix (top) and distinct mottling and gleying in the clay layer beneath the ferricrete layer (bottom).

Figure 9: Nidorella ivifolia (A), Elocharis limosa (B), Ficinia lateralis (C), Pycreus polystachos (D); Kyllinga erectus (E); Juncus effusus (F), Restio sp. (G) Pycreus mundii (H).

4.3 Present Ecological State

4.3.1 Non-perennial Stream

The source of the stream essentially falls within the property boundary and is relatively well buffered by indigenous forest vegetation. Current impacts are minimal and include:

- Increased surface runoff from the N2 highway which is located just above the source of the stream;
- Minor erosion of the banks from a drainage channel leading into the watercourse; and
- Minor invasion of the riparian zone by alien tree species *(Eucalyptus).*

Based on these modifications the PES of the stream is **B (Largely Natural)** – see Table 3.

Table 3: Instream and riparian IHI scores for the non-perennial stream crossing RE/479 Oakhill.

Modification	Scores
Instream Habitat	
Water abstraction	**0 –** None
Flow modification	**0 –** No dams in catchment area
Bed modification	**4 –** Minor alterations to sediment regime (slight increase from old plantation areas).
Channel modification	**4 –** Minor modifications due to increased surface runoff from N2 highway and old plantation areas.
Physico-chemical modification	**3 –** Minor modifications from surface runoff from N2 highway.
Inundation	**0 –** None.
Alien macrophytes	**0** – None
Alien aquatic fauna	**0** – None
Rubbish dumping	**0 –** None
Instream IHI score	**94 (A – Natural)**
Riparian Habitat	
Vegetation removal	**0** – None
Invasive vegetation	**5** – Some invasion by *Eucalyptus* in upper-most reaches.
Bank erosion	**5 –** Minor.
Channel modification	**5 –** Minor
Water abstraction	**0** – None.
Inundation	**0 –** None.
Flow modification	**0** – None.
Physico-chemical modification	**0 –** None
Riparian IHI Score	**92 (A – Natural)**
Combined Score	**93 (A – Natural)**

4.3.2 Hillslope Seep Wetland

The delineated area of the wetland mapped in Figure 7 represents the current extent of the wetland. Modifications to the wetland include the following:

- It is likely that the wetland historically extended over a larger area, most likely over-lapping with the car park and the maze structure in the south-eastern corner of the wetland. Over time, part of the wetland has therefore most likely been lost to historical development activities on the property.
- Interrogation of historical images (Figure 10) indicates that the wetland area has been utilised for pasture which would have resulted in loss/transformation of wetland plant

species to more grass species. It appears as if wetland vegetation has only recently been allowed to recover over the site.

- Stormwater runoff from the adjacent car park results in increased water input into the wetland. This has however not caused any erosion within the wetland.

In spite of the above-mentioned impacts, the wetland remains functional and, if managed appropriately, should recover to host a diverse and abundant assemblage of wetland vegetation (and associated biota). Based on these modifications, the PES of the wetland is **C (Moderately Modified).**

Figure 10: Historical aerial images showing what appear to be a managed pasture area (2009), the car park with clear channels directing stormwater into the wetland area (2016) and clear signs of regenerating wetland vegetation (2024).

Table 4: WET-Health v2.0 scores for the hillslope seep wetland.

Unadjusted (modelled) Scores				
PES Assessment	**Hydrology**	**Geomorphology**	**Water Quality**	**Vegetation**
Impact Score	3.0	1.4	1.3	4.0
PES Score (%)	70%	86%	87%	60%
Ecological Category	C	B	B	D
Combined Impact Score	2.5			
Combined PES Score (%)	75%			
Combined Ecological Category	C			
Hectare Equivalents	0.6 Ha			
Confidence (modelled results)	Very Low: High probability of connection to regional aquifer but missing information on the degree of connectitivity, the lowering of the water table, and/or groundwater quality			

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4.4 Ecological Importance & Sensitivity

4.4.1 Non-perennial Stream

The small, non-perennial nature of the stream offers limited habitat and biodiversity support but does provide good refuge and migration functionality within a relatively undeveloped catchment area. Overall, the EIS is **Low** (Table 5).

Table 5: EIS scores for the non-perennial stream bordering the property.

Determinant	Score
Presence of Rare & Endangered Species	**1** – Low probability of rare or endangered taxa.
Populations of Unique Species	**1 –** Low probability of unique species.
Intolerant Biota	**1** – Low proportion of biota is expected to be dependent on flowing water for the completion of their life cycle.
Species/Taxon Richness	**1** - Moderate diversity of fauna and flora expected on a local scale.
Diversity of Habitat Types or Features	**1** – Geomorphological zonation offers limited habitat diversity.
Refuge value of habitat types	**1** – Important at a local scale.
Sensitivity of habitat to flow changes	**3** – Relatively small river – sensitive to flow changes.
Sensitivity to flow related water quality changes	**1** – Non-perennial – not sensitive to changes in water quality.
Migration route for instream and riparian biota	**2** – Headwater stream offering good ecological connectivity along the Matjies River catchment
Protection Status	**2** – Aquatic ESA – important at a provincial scale
EIS Score	**1 (Low Importance and Sensitivity)**

4.4.2 Hillslope Seep Wetland

The ecological importance of the wetland is summarised as follows:

- The wetland is isolated from a broader hydrological network and, apart from erosion control, offers limited regulating and supporting services (Figure 11) – particularly with respect to assimilating pollutants and providing a streamflow regulation function. Given the relatively undeveloped catchment area, the demand for these services is however also relatively low;
- The wetland offers a slightly higher biodiversity maintenance function due to the moderate PES score;
- Provisioning services are relatively high due to potential for cultivation of food and the historical use of the wetland area for grazing of livestock (Figure 11); and
- Moderate cultural services are provided due to the aesthetic value of the site and potential for recreational activities such as bird-watching (Figure 11).

Overall, the importance of all services is **Moderately Low** to **Very Low** (Table 6). This is because while there is Low to Moderate supply of services there is very little demand for these services.

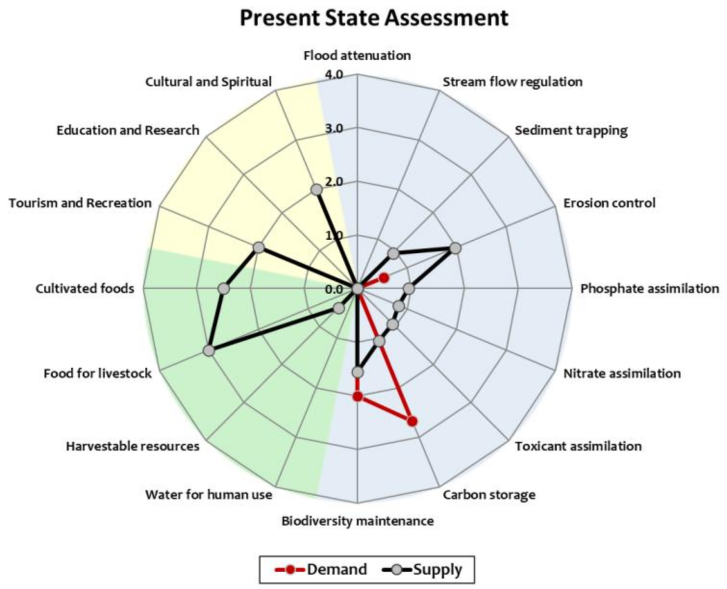

Figure 11: Demand and supply of ecoystem services associated with the hillslope seep wetland.

Table 6: Importance scores for ecosystem services supplied by and demanded from the hillslope seep wetland.

		Present State			
	ECOSYSTEM SERVICE	Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0.0	0.0	0.0	Very Low
	Stream flow regulation	0.0	0.0	0.0	Very Low
	Sediment trapping	0.9	0.0	0.0	Very Low
	Erosion control	2.0	0.5	0.7	Very Low
	Phosphate assimilation	1.0	0.0	0.0	Very Low
	Nitrate assimilation	0.8	0.0	0.0	Very Low
	Toxicant assimilation	0.9	0.0	0.0	Very Low
	Carbon storage	1.1	2.7	0.9	Low
	Biodiversity maintenance	1.6	2.0	1.1	Low
PROVISIONING SERVICES	Water for human use	0.0	0.0	0.0	Very Low
	Harvestable resources	0.5	0.0	0.0	Very Low
	Food for livestock	3.0	0.0	1.5	Moderately Low
	Cultivated foods	2.5	0.0	1.0	Low
CULTURAL SERVICES	Tourism and Recreation	2.0	0.0	0.5	Very Low
	Education and Research	0.0	0.0	0.0	Very Low
	Cultural and Spiritual	2.0	0.0	0.5	Very Low

5. SENSITIVITY MAPPING

- For the wetland, buffer determination assumed that mitigation measures aimed at avoiding impacts to the wetland will be implemented (see Section 6 below). It also considered the fact that development will largely take place down-slope of the wetland (i.e. to the north of the wetland) and therefore alteration of hydrological surface and sub-surface flows and surface inputs of pollutants and sediments are unlikely to be a major concern.

- For the non-perennial stream, the buffer estimates also assumed implementation of mitigation measures and considered that it is located at a lower elevation relative to the development and is therefore more vulnerable to surface and sub-surface point and nonpoint source impacts.

The buffer for each watercourse was determined based on the following site-specific characteristics:

- It was assumed that some form of erosion and sediment control will be implemented on site during the construction phase.
- Mean Annual Precipitation Class: 801 – 1000 mm.
- Rainfall Intensity: Zone 4.
- The inherent runoff potential of soil in the catchment area is low (A/B soils).
- Average slope of the catchment is gentle (< 10 %).
- Inherent erosion potential of the catchment soils is high (K factor > 0.7).
- The slope of the buffer area is gentle (< 10 %).
- Interception characteristics of the vegetation is considered to be Ideal (robust vegetation with high interception potential).

Based on these inputs the buffer for the wetland is set to 15 m and the non-perennial watercourse is 20 m (Figure 12).

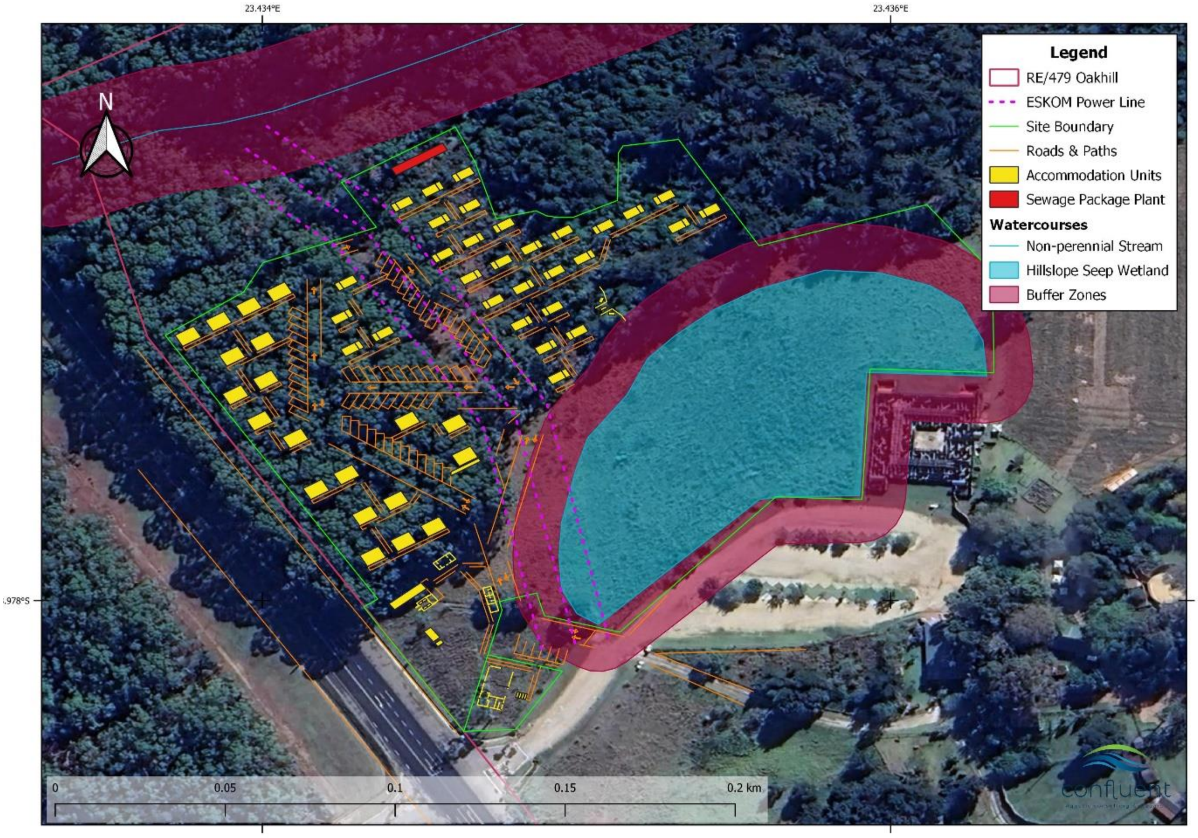

Figure 12: Map indicating aquatic sensitivity associated with the hillslope wetland seep.

6. IMPACT ASSESSMENT

The impact assessment considers two alternatives (Figure 13):

- **Alternative A:** This was the original SDP provided to specialists prior to the site visit (and prior to the delineation of the wetland). While most accommodation units were located outside of the delineated wetland, an internal road, some administrative buildings, a clubhouse and a braai area were located within the delineated wetland area.
- **Alternative B:** Following the site visit and mapping of ecologically sensitive areas (including appropriate buffers), the SDP was adjusted to avoid the wetland (as well as sensitive forest habitat). With respect to the wetland, all infrastructure is located outside of the delineated wetland. A short section of the access road will pass through the buffer – otherwise all other infrastructure is located outside of the buffer. All infrastructure is located outside of the non-perennial stream buffer.

For both alternatives an onsite sewage treatment package plant will be installed to treat wastewater to the general wastewater discharge limit. The treated wastewater will be used to irrigate open space areas within the development footprint.

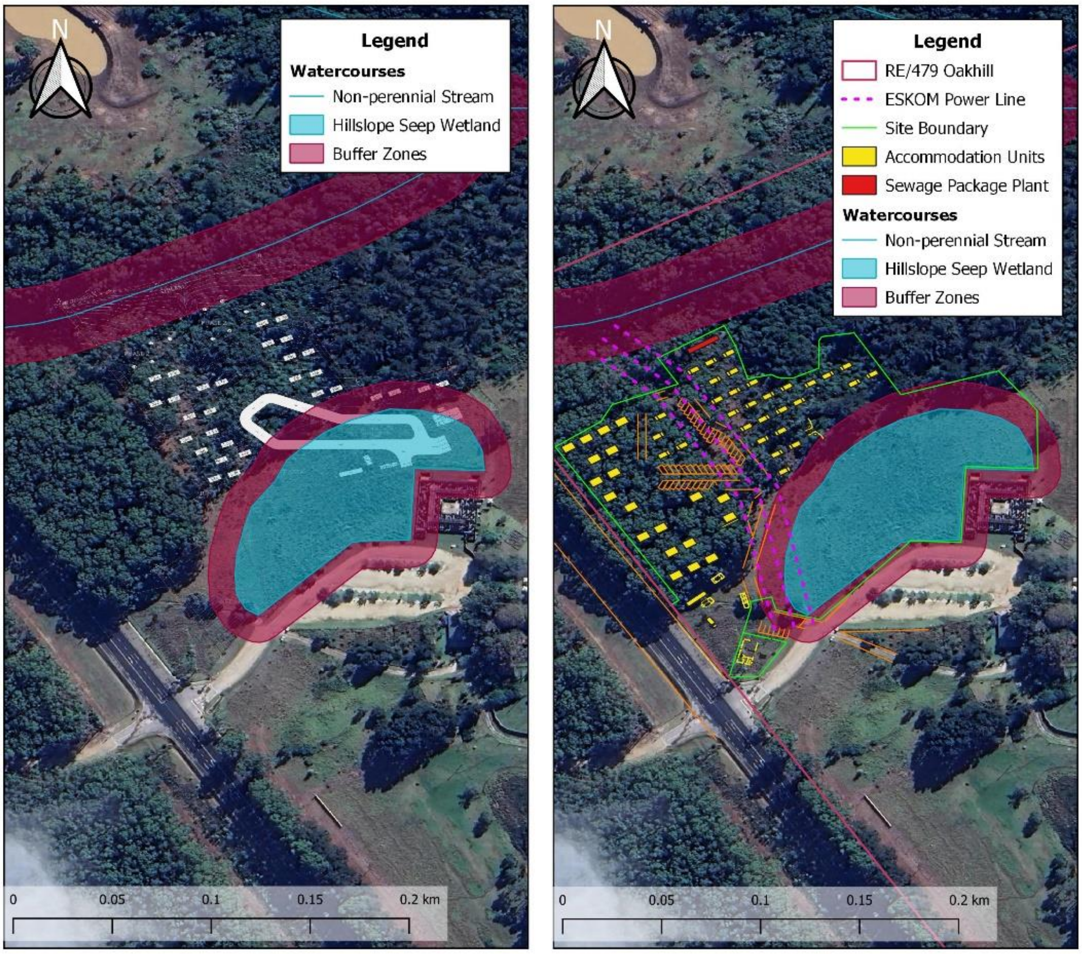

Figure 13: Maps comparing Alternative A (left) and Alternative B (right).

6.1 Layout & Design Phase

Impact 1: Loss of habitat caused by infrastructure located within the delineated area of the wetland.

- Alternative A will result in loss and disturbance of wetland habitat due to an internal road, some administrative buildings, a clubhouse and a braai area being located within the delineated wetland area.
- Alternative B avoids the delineated wetland area entirely and most of the designated buffer area. A short section of the access road will pass through the south-western most corner of the buffer.

	Alternative A		Alternative B	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity	Very High	Very High	Very low	Very low
Duration	Permanent	Permanent	Short term	Short term
Extent	Limited	Limited	Very limited	Very limited
Probability	Certain	Certain	Unlikely	Unlikely
Significance	**-105: Moderate**	**-105: Moderate**	**-18: Negligible**	**-18: Negligible**
Reversibility	High	High	High	High
Irreplaceability	Low	Low	Low	Low
Confidence	High	High	High	High

Mitigation:

- Alternative B avoids direct impacts to the wetland and requires no additional mitigation from a layout and design perspective.

Impact 2: Channel erosion and incision caused by increased flow and flood peaks in the non-perennial.

The development will result in a slight increase in stormwater runoff due to an increase in area of impervious surfaces (roads, buildings etc.). The natural contours of the site will direct this stormwater towards the non-perennial stream running along the northern border of the property. Additional stormwater input into the non-perennial stream will increase natural flow rates and flood peaks which can lead to erosion of the bed and banks of the channel. While energy dissipation at stormwater headwall outlets can mitigate against erosion at the point of discharge – accumulated flow volumes within the channel will have a high likelihood of eroding and incising the channel. This impact can be mitigated by implementing Sustainable Drainage System (SuDS) principles on site aimed at encouraging attenuation and infiltration of water within the development prior to discharge into watercourses.

The wetland is not anticipated to be affected by stormwater (under Alternative B) as it is located upslope of the development.

	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity	Very High	Moderate	High	Low
Duration	Ongoing	Ongoing	Ongoing	Ongoing
Extent	Limited	Limited	Limited	Limited
Probability	Almost certain	Probably	Almost certain	Unlikely
Significance	**-84: Moderate**	**-48: Minor**	**-78: Moderate**	**-33: Negligible**
Reversibility	High	High	High	High
Irreplaceability	Low	Low	Low	Low

Confidence	High	High	High	High

Mitigation:

- Energy dissipation and erosion protection at stormwater outlets:
  - Stormwater headwall outlets must not be located at the top of steep slopes;
  - Stormwater headwater outlets must include stilling basins and baffles for energy dissipation and velocity reduction;
- Implementation SuDS principles to attenuate stormwater onsite and reduce volumes of stormwater directed towards watercourses:
  - Rainwater harvesting tanks must be installed at all residential buildings;
  - Swales and detention ponds must 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;
  - Use of retention ponds and artificial wetlands to capture stormwater runoff and prevent its discharge from the site;
  - Concentration of stormwater must be minimised to prevent high volume/flow rates;
  - Hard surface run-off (roads) will be routed into swales via the internal roadways. This is particularly relevant for the section of road that lies within the buffer of the wetland; and
  - Sheetflow into open swales will be promoted to maximise contact time with *in-situ* soils; and
  - All unlined channels will be landscaped with appropriate vegetation
- Internal stormwater channels with an internal velocity higher than 1m/s will be formalised (armorflex).

6.2 Construction Phase

Impact 3: Erosion and Sedimentation During Site Preparation

Vegetation will need to be cleared for construction of access roads and buildings. Potential for erosion and sedimentation of the stream is relatively high given the highly erodible soil characteristics and the topography of the site. Alternative A will result in very high intensity of impact due to construction within the delineated area of the wetland.

	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Intensity	Very high	High	Moderate	Low
Duration	Short term	Short term	Short term	Brief
Extent	Limited	Limited	Limited	Very limited
Probability	Certain	Almost certain	Likely	Unlikely
Significance	**-77: Moderate**	**-60: Minor**	**-45: Minor**	**-18: Negligible**
Reversibility	High	High	High	High
Irreplaceability	Low	Low	Low	Low
Confidence	High	High	High	High

Mitigation:

- Runoff from disturbed areas must be directed through silt traps (silt fences, sandbags etc.) to remove sediment and reduce the sedimentation of the river in the valley below;

- 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;
- Construction phasing (sequencing) must be implemented. Only a portion of the site must therefore be disturbed at any one time according to a planned schedule to complete the needed building in that phase. Other portions of the site must not be cleared and graded until exposed soils from the earlier phase have been stabilized and the construction is nearly completed;
- 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;
- During the excavation of pits, roads, construction sites etc. the removed topsoil should be stored and appropriately protected so that it does not wash into waterbodies, causing sedimentation and nutrient loading. This is then used to backfill the area so that it can be effectively rehabilitated;
- The recommended buffers must be implemented and demarcated. No construction activities (apart from the access road), stockpiles or laydown of construction equipment is permitted in the buffer.

Impact 4: Disturbance and pollution of watercourses caused by construction activities.

The development will require the construction of a variety of infrastructure, including accommodation units, internal roads, sewage infrastructure, stormwater infrastructure, water reticulation network etc. This will result in a high number of vehicles, construction materials and construction workers on 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.)

	Alternative A		Alternative B	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Intensity	Very high	High	Moderate	Low
Duration	Short term	Short term	Short term	Brief
Extent	Limited	Limited	Limited	Very limited
Probability	Certain	Almost certain	Likely	Unlikely
Significance	**-77: Moderate**	**-60: Minor**	**-45: Minor**	**-18: Negligible**
Reversibility	High	High	High	High
Irreplaceability	Low	Low	Low	Low
Confidence	High	High	High	High

Mitigation:

- The buffer must be implemented and clearly demarcated as a No-Go area for construction vehicles;
- Restrict vehicle access to single points that are clearly demarcated;
- No stockpiles or laydown areas are permitted within watercourses or their buffers;
- 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 on site;
- No fuel storage, refuelling, vehicle maintenance or vehicle depots to be allowed within the buffer of watercourses; 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; and
- An alien invasive plant management plan needs to be compiled and implemented post construction to prevent the growth of invasives on cleared areas.

6.3 Operational Phase

Impact 5: Pollution of non-perennial stream caused by blocked/leaking/failing sewage infrastructure.

Experience has shown that even well-intentioned developments can have periodic problems with leaking, blocked or overflowing sewerage pipes or pump stations, which in the case of this development can lead to pollution of the nearby non-perennial stream. Maintenance and regular inspections are key to ensuring that any issues are detected and dealt with in a timely manner. The wetland will not be affected by this impact as it lies upslope of the development area.

	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Intensity	Very high	Low	Very high	Low
Duration	Ongoing	Ongoing	Ongoing	Ongoing
Extent	Limited	Very limited	Limited	Very limited
Probability	Almost certain	Unlikely	Almost certain	Unlikely
Significance	**-84: Moderate**	**-30: Negligible**	**-84: Moderate**	**-30: Negligible**
Reversibility	High	High	High	High
Irreplaceability	Low	Low	Low	Low
Confidence	High	High	High	High

Mitigation:

- All sewerage infrastructure must be well maintained and kept free of obscuring vegetation. Manholes, sewerlines, and the pump stations must be accessible, easily observed, and routinely inspected for leaks or blockages;
- Emergency response measures to sewage spillages should be maintained on site, including lime to treat sewage and sand bags to contain spill and limit their dispersal. An emergency response protocol must be established and implemented;
- Visitors must be provided with information of what can/cannot be flushed into toilets. This knowledge is often assumed but is frequently over-estimated;
- Ensure sufficient backup power systems are available for the operation of pump stations (if applicable) during load shedding and at peak times (e.g. December);
- A maintenance plan for the package plant must be drawn up and implemented (at the time of writing a Calcamite system was proposed). The plan must be auditable and must require sign-off once daily/weekly/monthly/annual maintenance checks/activities have been completed; and
- A maintenance contract for regular sewage removal by an acceptable sewage removal company must be included as part of the Service Level Agreement (SLA) with Bitou Municipality.

Impact 6: Pollution of watercourses caused by irrigation of open space areas with treated wastewater.

The development area slopes down towards the non-perennial stream and irrigation using wastewater could result in pollution of the watercourse due to sub-surface seepage or surface flow caused by concentrated irrigation return flows.

The wetland is not anticipated to be affected by irrigation wastewater as it is located upslope of the development.

	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Intensity	High	Low	High	Low
Duration	Ongoing	Ongoing	Ongoing	Ongoing
Extent	Limited	Very limited	Limited	Very limited
Probability	Probably	Unlikely	Probably	Unlikely
Significance	**-52: Minor**	**-30: Negligible**	**-52: Minor**	**-30: Negligible**
Reversibility	High	High	High	High
Irreplaceability	Low	Low	Low	Low
Confidence	High	High	High	High

Mitigation:

- Under NO circumstances can treated wastewater be discharged to the stormwater system or into any watercourses.
- Install a groundwater spike / well at sufficient depth to monitor ground water on the lower slopes. These must have easy access during the construction and operational phase. It should not be located in any area of significant natural vegetation and should rather be sited in a disturbed area.
- It is recommended that a sample of the treated effluent must be tested twice per month and sample of the groundwater should be tested once per month. The test results must be submitted to DWS and Bitou Municipality. Testing must commence prior to the commencement of construction, and water sampling to establish the baseline should be undertaken for a period of 3 months;
- Water chemistry results should not vary by more than 10% of background values as established prior to the development;
- Water samples must be submitted to the Bitou Municipality and BOCMA and be reviewed by an aquatic ecologist on a quarterly basis for the first two years of operation of the estate.

Impact 7: Degradation of watercourses as a result of increased edge effects associated with operation of the accommodation facility.

Watercourses will be vulnerable to degradation from edge effects associated with increased anthropogenic pressures that include the littering, dumping of refuse and garden waste and increased propensity for the invasion of wetlands by alien or weedy vegetation (often associated with landscaped gardens/open space areas).

	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Intensity	High	Moderate	Moderate	Low
Duration	Ongoing	Ongoing	Ongoing	Ongoing
Extent	Limited	Limited	Limited	Limited
Probability	Almost certain	Probably	Probably	Unlikely
Significance	**-78: Moderate**	**-48: Minor**	**-48: Minor**	**-33: Negligible**

Reversibility	High	High	High	High
Irreplaceability	Low	Low	Low	Low
Confidence	High	High	High	High

Mitigation:

- No activities are permitted within designated buffers;
- Vegetation within the buffers and wetland must not be mowed and alien invasive trees/weeds/grasses (e.g. kikuyu) must be actively controlled;
- Landscaping of open spaces must utilise species that are indigenous to the area; and
- No dumping of garden/landscaping waste/refuse is permitted in the buffers or delineated watercourses.

7. DWS RISK ASSESSMENT MATRIX

Risks of activities associated with the formalisation of the agricultural area to the adjacent wetlands were determined according to the risk assessment matrix developed as part of GN 4167 of 2023 (Section 21 (c) and (i) water use Risk Assessment Protocol) - Table 7. The first stage of the risk assessment is the identification of environmental activities, aspects and impacts and essentially mirror those that were identified in the impact assessment (see Section 6). The intensity of impact to receptors and resources (i.e. hydrology, water quality, geomorphology, biota and vegetation) is rated (from 0 to 5, representing negligible and very high impact, respectively), which allows for an understanding of the impact pathway and an assessment of the sensitivity to change. Risks were then quantified based on the anticipated spatial scale, duration and likelihood of occurrence and assumed the full implementation of recommended mitigation measures described in Section 6.

- In terms of the layout of the development, Alternative B removes all infrastructure from the delineated wetland area (and sensitive forest vegetation) and represents a significant improvement over the original SDP (Alternative A);
- Given that the wetland is located upslope from the majority of the development area it is not vulnerable to construction or operational phase activities;
- Implementation of the buffer area during the construction and operational phase is likely to provide sufficient protection to the wetland and risks of all activities are considered to be **Low (**Table 6**)**;
- The non-perennial stream is located at the lowest elevation across the site and is therefore more vulnerable to erosion and pollution caused by stormwater, leaking sewage infrastructure and/or irrigation with treated wastewater. The buffer is anticipated to provide sufficient protection during the construction phase and the development is located well away from the watercourse. The risk of construction phase activities is likely to be **Low** (Table 6**)**.
- Operational phase activities pose more of a risk to the non-perennial stream. These risks can however be mitigated to a **Low** risk (Table 6). Discharge of stormwater towards the stream is considered the highest risk relative to other activities. In this respect implementation of the stormwater management plan that incorporates the mitigation measures specified in Section 6 must is considered a priority.

While the Low risk implies that a General Authorisation may be applicable for Section 21 c and i water uses, irrigation with treated wastewater in close proximity to watercourses and to boreholes located on the property may require the need for a WULA.

Table 7: DWS Risk Matrix for watercourses on RE/479 Oakhill.

Phase	Activity	Impact	Potentially affected watercourses			Intensity of Impact on Resource Quality					Overall Intensity (max = 10)	Spatial scale (max = 5)	Duration (max = 5)	Severity (max = 20)	Importance rating (max = 5)	Consequence (max = 100)	Likelihood (Probability) of impact	Significance (max = 100)	Risk Rating (with mitigation)	Confidence level
						Abiotic Habitat (Drivers)			Biota (Responses)											
			Name/s	PES	Ecological Importance	Hydrology	Water Quality	Geomorph	Vegetation	Fauna										
PRE-CONSTRUCTION (DESIGN)	Site Development Plan	Loss of wetland habitat	Wetland	C	Low	1	1	0	0	0	**2**	1	5	**8**	**2**	**16**	20%	**3.2**	L	High
	Stormwater Discharge	Erosion of the bed and banks	Non-Perennial Stream	A/B	Moderate	3	2	2	0	2	**6**	2	4	**12**	**3**	**36**	60%	**21.6**	L	High
CONSTRUCTION	Clearing of vegetation for preparation of the site	Erosion and sedimentation of watercourses	Wetland	C	Low	0	1	0	0	0	**2**	1	1	**4**	**2**	**8**	20%	**1.6**	L	High
			Non-Perennial Stream	A/B	Moderate	0	1	0	0	0	**2**	2	1	**5**	**3**	**15**	20%	**3**	L	High
	Managament of construction site	Pollution and distrubance of wetland habitat	Wetland	C	Low	0	1	0	0	0	**2**	1	1	**4**	**2**	**8**	20%	**1.6**	L	High
			Non-Perennial Stream	A/B	Moderate	0	1	0	0	0	**2**	2	1	**5**	**3**	**15**	20%	**3**	L	High
OPERATIONAL	Operation of Sewage Package Plant	Leaks and blockages causing sewage spills	Wetland	C	Low	0	0	0	0	0	**0**	1	4	**5**	**2**	**10**	20%	**2**	L	High
			Non-Perennial Stream	A/B	Moderate	0	2	0	1	1	**4**	2	4	**10**	**3**	**30**	60%	**18**	L	High
	Irrigation using treated wastewater	Contamination/pollution of watercourses	Wetland	C	Low	0	0	0	0	0	**0**	1	4	**5**	**2**	**10**	20%	**2**	L	High
			Non-Perennial Stream	A/B	Moderate	0	0	0	0	0	**0**	1	4	**5**	**3**	**15**	20%	**3**	L	High
	Operation of tourism facility	Degradation of watercourses caused by edge effects	Wetland	C	Low	0	0	0	2	2	**4**	2	4	**10**	**2**	**20**	40%	**8**	L	High
			Non-Perennial Stream	A/B	Moderate	0	0	0	1	1	**2**	2	4	**8**	**3**	**24**	40%	**9.6**	L	High

8. CONCLUSION

A fundamental step in the mitigation hierarchy is avoidance of impacts. In this respect, Alternative B largely avoids direct impacts to all watercourses on the property and represents a far more favourable development option in comparison to Alternative A. Implementation of buffers, together with recommended mitigation measures can reduce minor to moderate impacts to negligible. Similarly, the DWS Risk Assessment matrix indicates a Low risk to all watercourses, indicating that their PES is unlikely to deteriorate. While this implies that a GA may be applicable for Section 21 c and i water uses, irrigation with treated wastewater in close proximity to watercourses and to boreholes located on the property may require the need for a WULA.

Based on the findings of this assessment, the proposed development is considered acceptable from an aquatic biodiversity perspective.

9. REFERENCES

CapeNature (2017). *2017 WCBSP Bitou [Vector] 2017*. Available from the Biodiversity GIS website, downloaded on 26 March 2019

Council for Scientific and Industrial Research (CSIR). (2018). National Wetland Map 5 and Confidence Map [Vector] 2018. Available from the Biodiversity GIS website, downloaded on 30 September 2020.

Department of Water Affairs and Forestry (DWAF) (2005). *Final Draft: A Practical Field Procedure for Identification and Delineation of Wetlands and Riparian Areas*.

Le Maitre, D.C., Walsdorff, A., Cape, L., Seyler, H., Audouin, M, Smith-Adao, L., Nel, J.A., Holland, M. and Witthüser. K. (2018). Strategic Water Source Areas: Management Framework and Implementation Guidelines for Planners and Managers. WRC Report No. TT 754/2/18, Water Research Commission, Pretoria.

Macfarlane, D. and Bredin, I. (2017). Buffer Zone Guidelines for Rivers, Wetlands and Estuaries Part 1: Technical Manual. WRC Report No. TT/715/1/17. Water Research Commission, Pretoria, South Africa.

Nel, J.L., Driver, A., Strydom, W.F., Maherry, A., Peterson, C., Hill, L., Roux, D.J., Nienaber, S., van Deventer, H., Swartz, E. and Smith-Adao, L.B. (2011). Atlas of freshwater ecosystem priority areas in South Africa: Maps to support sustainable development of water resources. Water Research Commission Report No. TT 500/11.

Ollis, D., Snaddon, K., Job, N., & Mbona, N. (2013). Classification system for wetlands and other aquatic ecosystems in South Africa. South African National Biodiversity Institute.

APPENDIX 1: INDEX OF HABITAT INTEGRITY

Index of Habitat Integrity (IHI; Kleynhans, 1996). The IHI was regarded as the most appropriate method for assessing riverine habitats as it is not dependent on flow in the watercourse and, therefore, produces results that are directly comparable across perennial and non-perennial systems. The IHI was developed as a rapid assessment of the severity of impacts on criteria affecting habitat integrity within a river reach. Instream (water abstraction; flow modification; bed modification; channel modification; physico-chemical modification; inundation; alien macrophytes; rubbish dumping) and riparian (vegetation removal, invasive vegetation, bank erosion, channel modification, water abstraction, inundation, flow modification, physico-chemistry) criteria are assessed as part of the index. Each of the criteria are given a score (from 0 to 25, corresponding to no and very high impact, respectively – Table 8) based on their degree of modification, along with a confidence rating based on the level of confidence in the score.

Weighting scores are used to assess the extent of modification for each criterion (*x*):

$$Weighted\ Score = \frac{IHI_x}{25} \times Weight_x$$

Where;

- IHI = rating score for the criteria (Table 8);
- 25 = maximum possible score for a criterion; and
- Weight = Weighting score for the criteria (Table 9).

Table 8: Descriptive classes for the assessment of habitat modifications (Kleynhans, 1996)

Impact Class	Description	Score
None	No discernible impact, or the modification is located in a way that has no impact on habitat quality, diversity, size and variability.	0
Small	The modification is limited to very few localities and the impact on habitat quality, diversity, size and variability are also very small.	1-5
Moderate	The modifications are present at a small number of localities and the impact on habitat quality, diversity, size and variability is limited.	6-10
Large	The modification is generally present with a clearly detrimental impact on habitat quality, diversity, size and variability. Large areas are, however, not influenced.	11-15
Serious	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 affected.	16-20
Critical	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.	21-25

Table 9: Criteria and weights used for the assessment of instream and riparian zone habitat integrity

Instream Criteria	Weight	Riparian Zone Criteria	Weight
Water abstraction	14	Indigenous vegetation removal	13
Flow modification	13	Exotic vegetation encroachment	12
Bed modification	13	Bank erosion	14
Channel modification	13	Channel modification	12
Water quality	14	Water abstraction	13
Inundation	10	Inundation	11
Exotic macrophytes	9	Flow modification	12
Exotic fauna	8	Water quality	13
Solid waste disposal	6		
TOTAL	**100**		**100**

The estimated impacts of all criteria calculated this way are summed, expressed as a percentage and subtracted from 100 to arrive at an assessment of habitat integrity for the instream and riparian components, respectively. An IHI class indicating the present ecological state of the river reach is then determined based on the resulting score (ranging from Natural to Critically Modified – Table 10).

Table 10: Index of habitat integrity (IHI) classes and descriptions

Integrity Class	Description	IHI Score (%)
A	Unmodified, natural.	> 90
B	Largely natural with few modifications. The flow regime has been only slightly modified and pollution is limited to sediment. A small change in natural habitats may have taken place. However, the ecosystem functions are essentially unchanged.	80 – 90
C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	60 – 79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40 – 59
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20 – 39
F	Critically / Extremely modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.	0 – 19

<u>Reference:</u>

Kleynhans, C.J. (1996). A qualitative procedure for the assessment of the habitat integrity status of the Luvuvhu River (Limpopo system, South Africa) Journal of Aquatic Ecosystem Health 5:41-54 1996.

APPENDIX 2: WET-HEALTH VERSION 2.0

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 is illustrated schematically in Figure 1 below and 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 11 below.

Table 11: 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

<u>Reference:</u>

Macfarlane, D.M., Ollis, D.J. and Kotze, D.C. (2020). WET-Health (Version 2.0). *A Refined Suite of Tools for Assessing the Present Ecological State of Wetland Ecosystems*. WRC Report No. TT 820/20. Water Research Commission, Pretoria, South Africa.

APPENDIX 3: ECOLOGICAL IMPORTANCE & SENSITIVITY (RIVERS)

The ecological importance and sensitivity (EIS) of the watercourse was assessed using a method developed by Kleynhans (1999). In summary, several biological and aquatic habitat determinants are assigned a score ranging from 1 (low importance or sensitivity) to 4 (high importance or sensitivity). These determinants include the following:

- **Biodiversity support:**
  - Presence of Red Data species;
  - Presence of unique instream and riparian biota;
  - Use of the ecosystem for migration, breeding or feeding.
- **Importance in the larger landscape:**
  - Protection status of the watercourse;
  - Protection status of the vegetation type;
  - Regional context regarding ecological integrity;
  - Size and rarity of the wetland types present;
  - Diversity of habitat types within the wetland.
- **Sensitivity of the watercourse:**
  - Sensitivity of watercourse to changes in flooding regime;
  - Sensitivity of watercourse to changes in low flow regime, and
  - Sensitivity to water quality changes.

The median value of the scores for all determinants is used to assign an EIS category according to Table 12.

Table 12: 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: Quaternaries/delineations that are considered to be unique on a national or even international level based on unique biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are usually very sensitive to flow modifications and have no or only a small capacity for use.	>3 and <=4	A
High: Quaternaries/delineations that are considered to be unique on a national scale due to biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) may be sensitive to flow modifications but in some cases, may have a substantial capacity for use.	>2 and <=3	B
Moderate: Quaternaries/delineations that are considered to be unique on a provincial or local scale due to biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are usually not very sensitive to flow modifications and often have a substantial capacity for use	>1 and <=2	C
Low/marginal: Quaternaries/delineations that are not unique at any scale. These rivers (in terms of biota and habitat) are generally not very sensitive to flow modifications and usually have a substantial capacity for use.	>0 and <=1	D

Reference:

Kleynhans, C.J. (1999). Resource Directed Measures for Protection of Water Resources: River Ecosystems. R7: Assessment of Ecological Importance and Sensitivity.

APPENDIX 4: WET-ECOSERVICES

Ecosystem services in were assessed using WET-EcoServices Version 2 (Kotze, Macfarlane and Edwards, 2021). 16 different ecosystem services were evaluated and included:

- Flood attenuation
- Streamflow regulation
- Sediment trapping
- Phosphate assimilation
- Nitrate assimilation
- Toxicant assimilation
- Erosion control
- Carbon storage
- Biodiversity maintenance
- Provision of water for human use
- Provision of harvestable resources
- Food for livestock
- Provision of cultivated foods
- Cultural and spiritual experience
- Tourism and recreation
- Education and research

WET-EcoServices provides a set of indicators (e.g. slope of the wetland) rated on a five-point scale of 0 to 4 that reflect the supply/capability of a wetland for each of the 16 different ecosystem services listed above. An Excel™ based spreadsheet tool has been developed to conduct the assessment. For each ecosystem service, indicator scores are combined automatically in an algorithm given in the spreadsheet that has been designed to reflect the relative importance and interactions of the attributes represented by the indicators to arrive at an overall supply score. In addition, the demand for the ecosystem service is assessed based on the wetland's catchment context (e.g. toxicant sources upstream), the number of beneficiaries and their level of dependency, which are also all rated on a five-point scale. Again, an algorithm automatically combines the indicator scores relevant to demand to generate a demand score.

A single overall importance score is generated for each ecosystem service by combining the supply and demand scores. This aggregation therefore places somewhat more emphasis on supply than demand, with the supply score acting as the starting score for a "moderate" demand scenario. The importance score is, however, adjusted by up to one class up where demand is "very high" and by up to one class down where demand is "very low". The overall importance score can then be used to derive an importance category for reporting purposes.

Reference:

Kotze, D.C., Macfarlane, D.M., Edwards, R.J., and Madikizela, B. (2020). WET-EcoServices Version 2: A revised ecosystem services assessment technique, and its application to selected wetland and riparian areas. Water SA, 46(4), 679-688.

APPENDIX 5: 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 13.

Table 13: 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 14.

Table 14: 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 15).

Table 15: 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