PROPOSED KNYSNA LAKE CABINS DEVELOPMENT ON PORTION 192 OF FARM 216 UITZIGT, BRENTON ON LAKE, KNYSNA.

Aquatic Specialist Assessment

Prepared For: r3Green

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Date: 14 January 2026

Version: Final

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- All the particulars furnished by me in this document are true and correct.

Specialist: Dr. James Dabrowski

(Ph.D., Pr.Sci.Nat. Water Resources)

Date: 14 January 2026

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1. INTRODUCTION

1.1 Background

Confluent Environmental (Pty) Ltd was requested by the landowner to conduct a specialist aquatic impact assessment for a proposed residential and tourism development (Knysna Lake Cabins) on Portion 192 of Farm 216 Uitzigt, near Brenton on Lake (Figure 1). The development involves the construction of a primary dwelling, seven self-catering timber cabins and maintenance buildings. The property is located within the Estuarine Functional Zone (EFZ) of the Knysna Estuary. The reporting requirements of this assessment are prescribed by the legislative requirements of the National Environmental Management Act (NEMA) and the National Water Act (NWA).

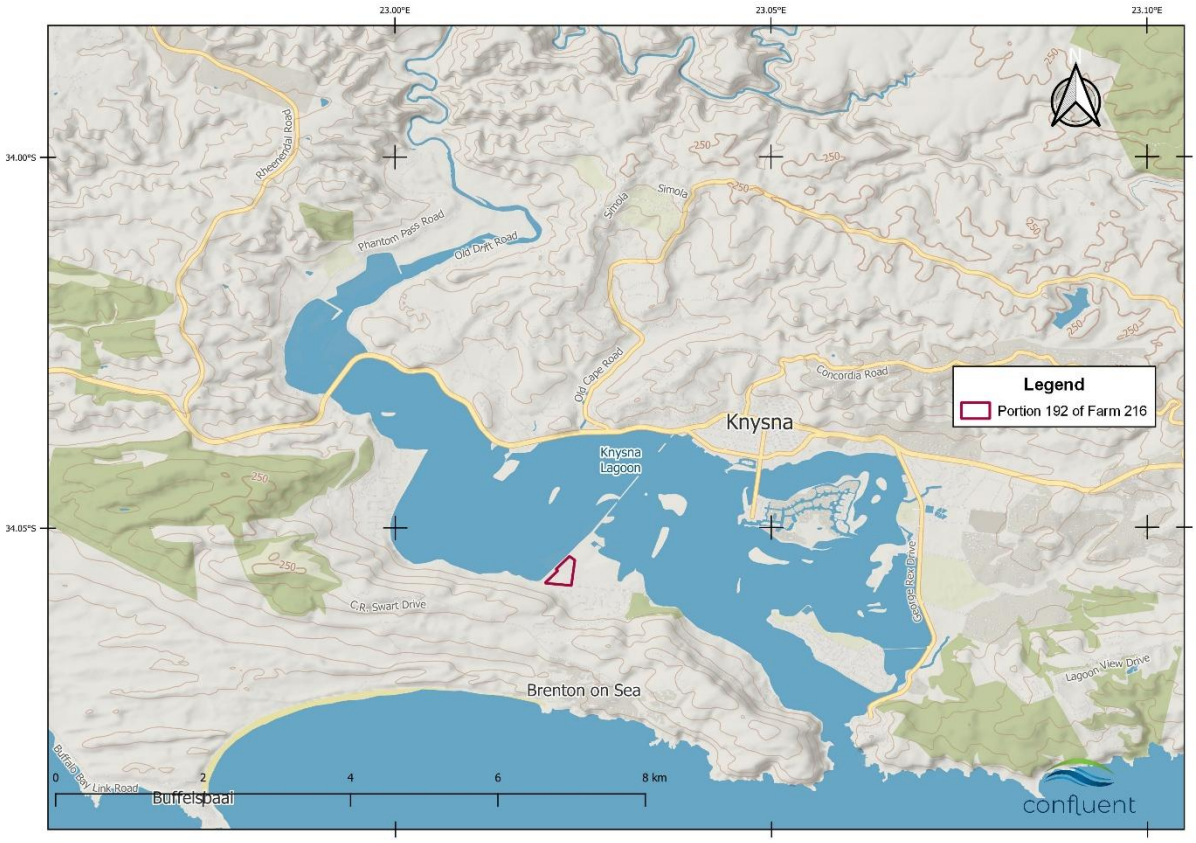

Figure 1: Location of Portion 192 of Farm 216 Uitzigt.

1.2 Key Legislative Requirements

According to the protocols specified in GN 9 of 10 January 2020 and GN 320 of 20 March 2020 (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 plant species and aquatic biodiversity are associated with a level of environmental sensitivity identified by the national web-based environmental screening tool (screening tool).

1.2.1 Aquatic Biodiversity Theme

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 identified the site as being of **Very High** aquatic biodiversity for the following reasons:

a) The entire property is mapped to occur within the estuarine functional zone of the Knysna Estuary;

b) The property falls within a quinary catchment that has been categorised as a Freshwater Ecosystem Priority Area (FEPA); and

c) The property falls within the Outeniqua Strategic Water Source Area (SWSA).

A detailed site verification visit was therefore undertaken to confirm the site sensitivity and report accordingly.

1.3 Terms of Reference

The scope of work for this assessment includes the following:

- Undertake a desktop study of relevant aquatic biodiversity information for the site;
- Undertake a site visit to the study area to verify the sensitivity of the site as reported by the screening tool;
- Classify and delineate the aquatic ecosystems potentially affected by the proposed activities;
- Determine the present ecological state, functional importance and conservation value of the aquatic ecosystems that will be potentially affected by the development; and
- Describe and assess the significance of the potential impacts of the development on aquatic biodiversity.

1.4 Study Area

Portion 192 of Farm 216 (the property) is situated immediately north of Kaptein W.A. Duthie Avenue in Brenton-on-Lake and immediately west of the now disused railway line that crosses the Knysna Estuary, connecting Brenton-on-Lake to the town of Knysna. The property is currently undeveloped although the site visit and historical assessment did indicate that, in addition to roads crossing the property, a dwelling was previously located on the property. The entire property is mapped to occur within the Knysna Estuary Functional Zone (EFZ). In South Africa, the EFZ is defined as the area that not only delineates the boundaries of the estuarine waterbody, but also the supporting physical and biological processes and adjacent habitats necessary for estuarine function and health (Van Niekerk et al., 2019a). It includes all dynamic areas influenced by long-term estuarine sedimentary processes, multiple ecotones of floodplain and estuarine vegetation that contribute organic material and provide refuge from strong currents during high flow events. EFZs are currently delineated by the 5 m contour line

and therefore include large areas of land (much of which has been developed) that border the actual open estuarine water body. The EFZ is now commonly used to delineate the spatial extent of the entire estuary. Large sections of the Knysna EFZ have been historically developed into residential and agricultural properties (Figure 2). From Figure 3 it is evident that the entire settlement of Brenton-on-Lake is located within the EFZ.

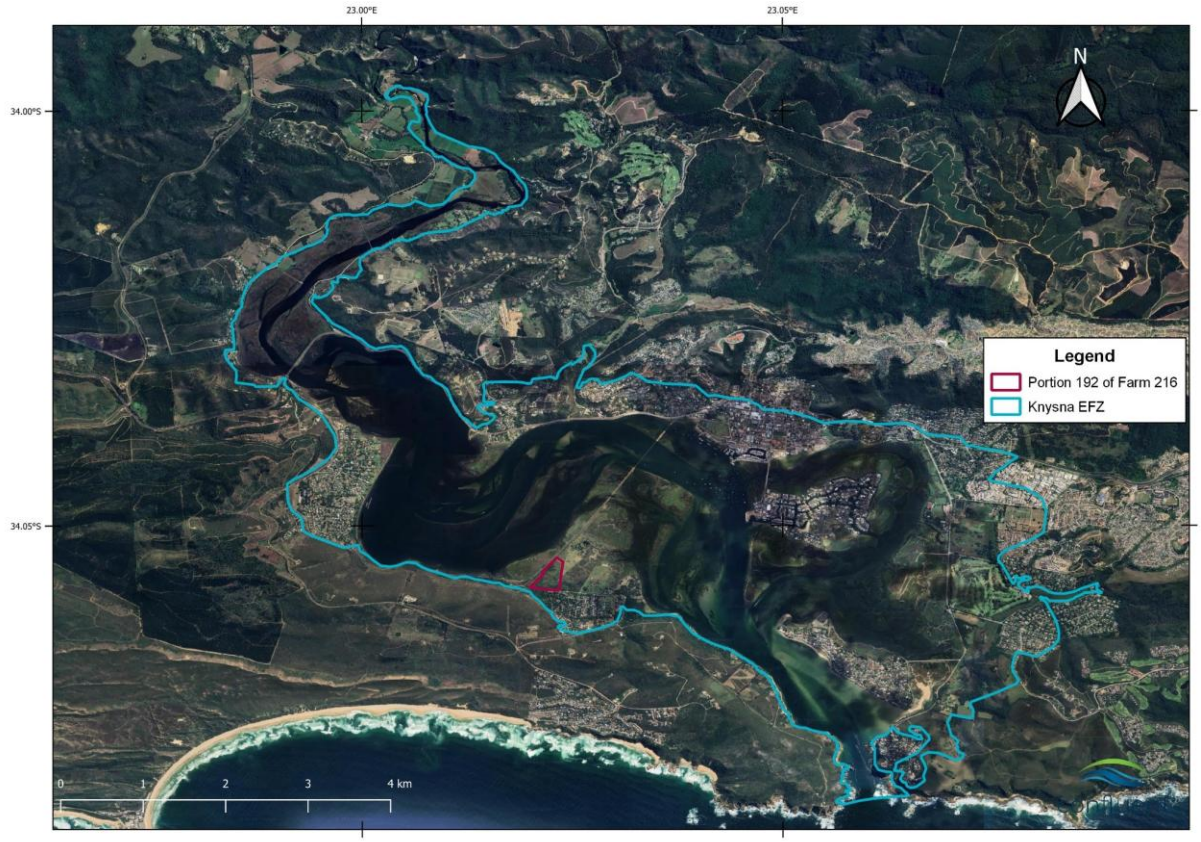

Figure 2: Location of Portion 192 of Farm 216 relative to the Knysna EFZ.

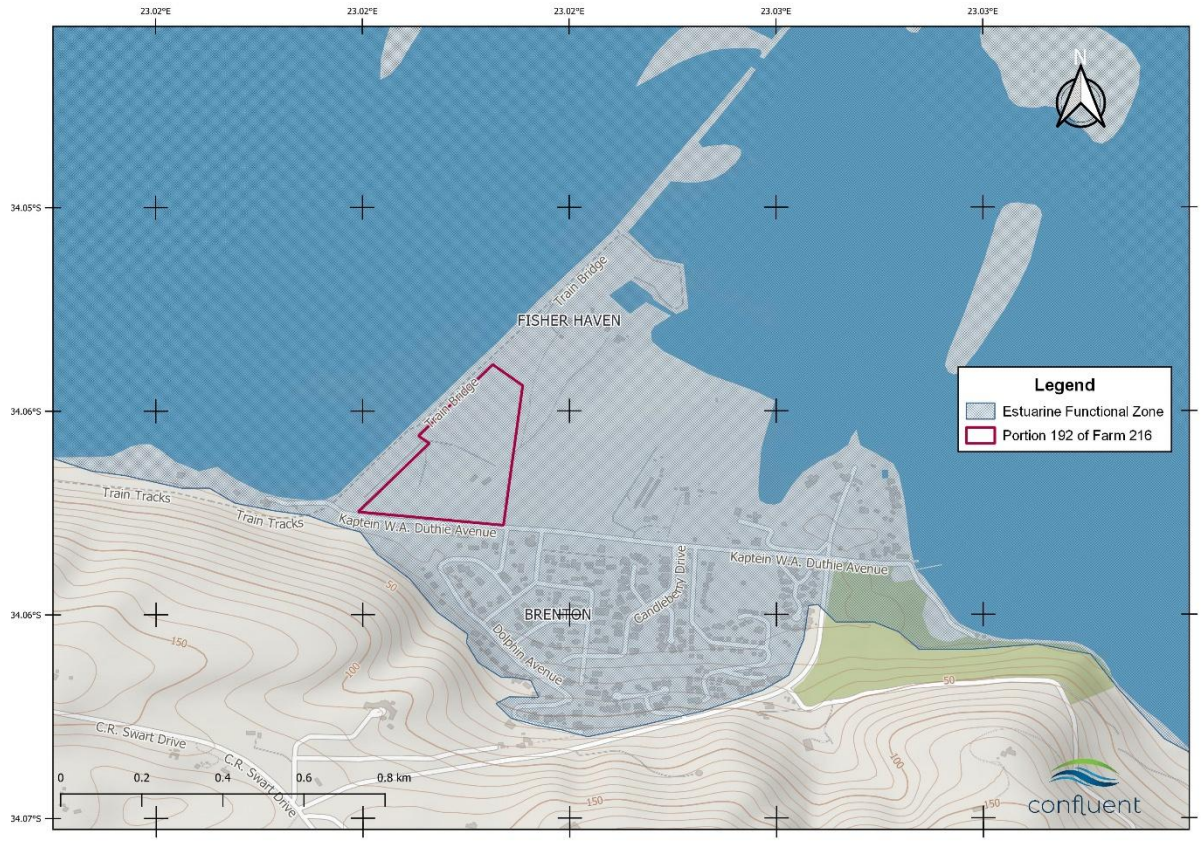

Figure 3: Map indicating the location of Portion 192 of Farm 216 relative to the Knysna Estuary and its EFZ.

2. ASSUMPTIONS AND LIMITATIONS

2.1 Estuarine Assessment

- Estuaries are complex, dynamic systems influenced by multiple environmental and anthropogenic variables. A comprehensive assessment that considers all of these variables did not form part of the scope of work. Assessments of the ecological state of the estuary were therefore derived using appropriate desktop resources.
- The dynamic nature of estuaries means that the structure of physical habitat and associated estuarine fauna and flora can change rapidly in response to tidal and hydrological (e.g. flooding events) influences. This assessment is based on a single site visit that took place in July 2025 and represents a 'snapshot' in time.
- No sampling of biota was undertaken (e.g. fish, invertebrates, microphytes, etc.) and all biotic data was derived from desktop sources.

3. METHODS

3.1 Estuarine Assessment

3.1.1 Present Ecological State of the Knysna Estuary

The 2018 National Biodiversity Assessment (NBA) evaluated the ecological health of all estuaries in South Africa (Van Niekerk et al., 2019a). This assessment considered both abiotic and biotic components, namely hydrology, hydrodynamics and mouth condition, water

chemistry, sediment processes, microalgae, macrophytes, invertebrates, fish and birds. Each estuary was assigned a condition score based on the similarity to natural for these various abiotic and biotic components. For each of the components, a panel of experts estimated the change in health as a percentage (0 – 100 %) of the natural state. Scores were weighted (25 % for each abiotic and 20 % for each biotic component) and aggregated (to provide an overall score that reflects the present health of the system as a percentage of that under natural conditions.

Table 1: Estuary health scoring system indicating the relationship between the six Ecological Categories and the loss of ecosystem condition and functionality.

Category	Description
A	**Natural:** The natural biotic processes should not be modified. The characteristics of the resource should be determined by unmodified natural disturbance regimes. There should be no human induced risks to the abiotic and biotic processes and function.
B	**Largely Natural:** A small change in natural habitats and biota may have taken place, but the ecosystem functions are essentially unchanged.
C	**Moderately Modified:** A loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged
D	**Largely Modified:** A large loss of natural habitat, biota, and basic ecosystem function has occurred.
E	**Seriously Modified:** The loss of natural habitat, biota and basic ecosystem function is extensive.
F	**Critically Modified:** Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural abiotic processes and associated biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.

Van Niekerk et al. (2019a) assessed the overall ecological importance and sensitivity of estuaries based on several criteria including the size (i.e. surface area), habitat importance, zonal rarity type and biodiversity importance. These criteria were each rated (out of a score of 100) and the average of all criteria was used as the final EIS Score (Table 2).

Table 2: Description of EIS Scores for estuaries derived by Van Niekerk et al. (2019a).

EIS Score	Description
0 – 60	Average Importance
61 – 80	Important
80 – 100	High Importance

4. ATTRIBUTES OF THE AFFECTED SYSTEM

4.1 Catchment Area

The property is located in Brenton-on-Lake, which is situated along the southern perimeter of the Knysna Estuary in quaternary catchment K50B (Figure 2). The catchment areas fall 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 ranges between 500 and 800 mm per year and occurs all year-round, with peaks in October to November and March to April.

In South Africa, the Estuarine Functional Zone (EFZ) is defined as the area that not only delineates the boundaries of the estuarine waterbody, but also the supporting physical and

biological processes and adjacent habitats necessary for estuarine function and health (Van Niekerk et al., 2019b). It includes all dynamic areas influenced by long-term estuarine sedimentary processes, multiple ecotones of floodplain and estuarine vegetation that contribute organic material and provide refuge from strong currents during high flow events. EFZs are currently delineated by the 5 m contour line and therefore include large areas of land (much of which has been developed) that border the actual water body. The EFZ is now commonly used to delineate the spatial extent of the entire estuary. In this respect large sections of the Knysna EFZ have been historically developed into residential and agricultural properties (Figure 2). T

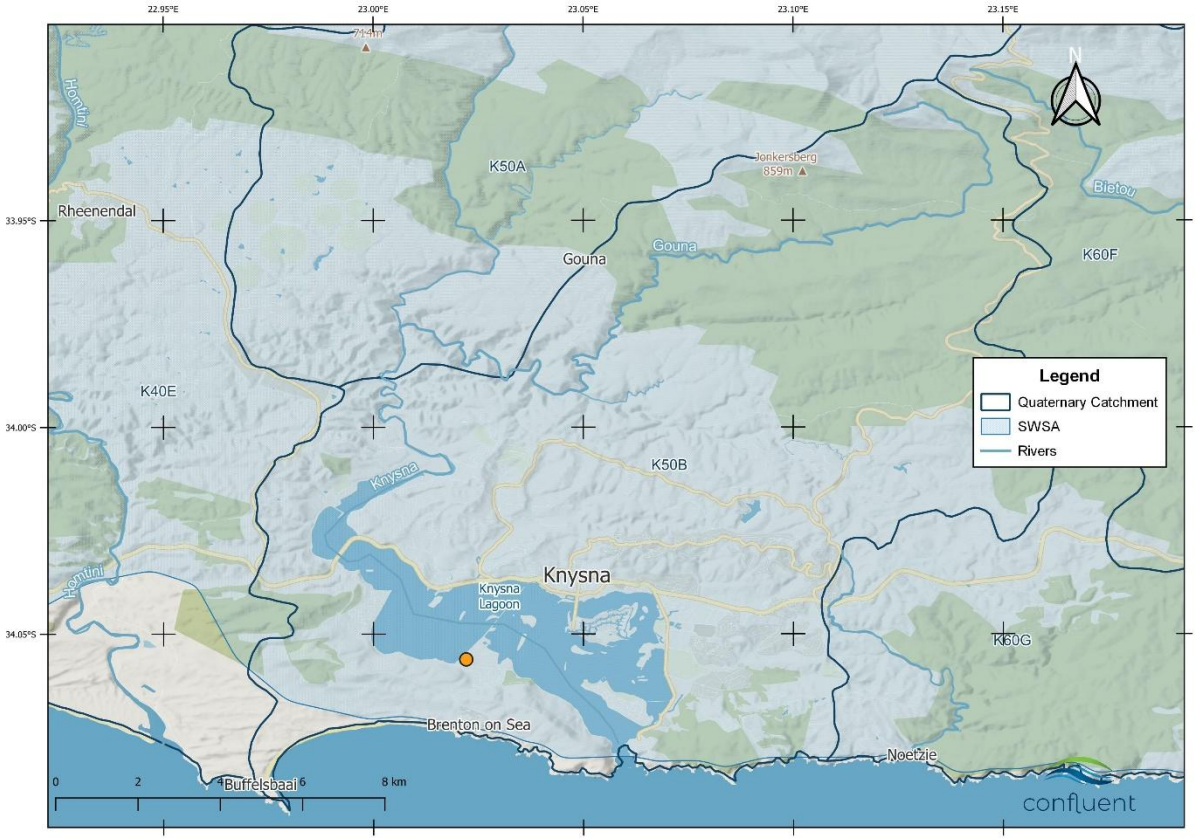

Figure 4: Figure illustrating the location of the project area in relation to quaternary catchment K50B.

4.2 Estuary Classification

The Knysna Estuary is classified as a warm, temperate Estuarine Bay which is characterised by the following (Van Niekerk et al., 2019c):

- Estuarine Bays are permanently linked to the sea by unrestricted, deep mouths and are dominated by tidal processes, with tidal amplitudes close to those of the sea.
- Estuarine Bays are large systems (> 1200 ha) with generally round basins where only the upper reaches experience a degree of constriction to tidal flows.
- As a result of relatively low river inputs they have a predominantly euhaline salinity regime (i.e. sea water) in the lower and mid reaches, with freshwater mixing processes being mostly confined to the restricted upper areas.
- Sediments are typically marine in origin and grain size distributions are stable.

4.3 Conservation & Biodiversity Planning

4.3.1 National Freshwater Ecosystem Priority Areas

The property is located within sub-quaternary catchment (SQC) 9117 (Figure 4), which, according to the National Freshwater Ecosystem Priority Atlas (NFEPA, Nel et al., 2011), has been classified as a Freshwater Ecosystem Priority Area (FEPA). Rivers FEPAs achieve biodiversity targets for river ecosystems and threatened/near-threatened fish species and were identified in rivers that are currently in a good condition (A or B ecological category). Their FEPA status indicates that they should remain in a good condition in order to contribute to national biodiversity goals and support sustainable use of water resources (Nel et al., 2011).

For river FEPAs, the whole sub-quaternary (or quinary) catchment is identified as a FEPA, although the FEPA status applies to the actual river reach or estuarine system within such a sub-quaternary catchment. The shading of the whole sub-quaternary catchment indicates that the surrounding land and catchment area needs to be managed in a way that maintains the good ecological condition of the river reach. From the perspective of SQC 9117, the main river reach for which a FEPA status was assigned is the Knysna River (Figure 3) and the Knysna Estuary.

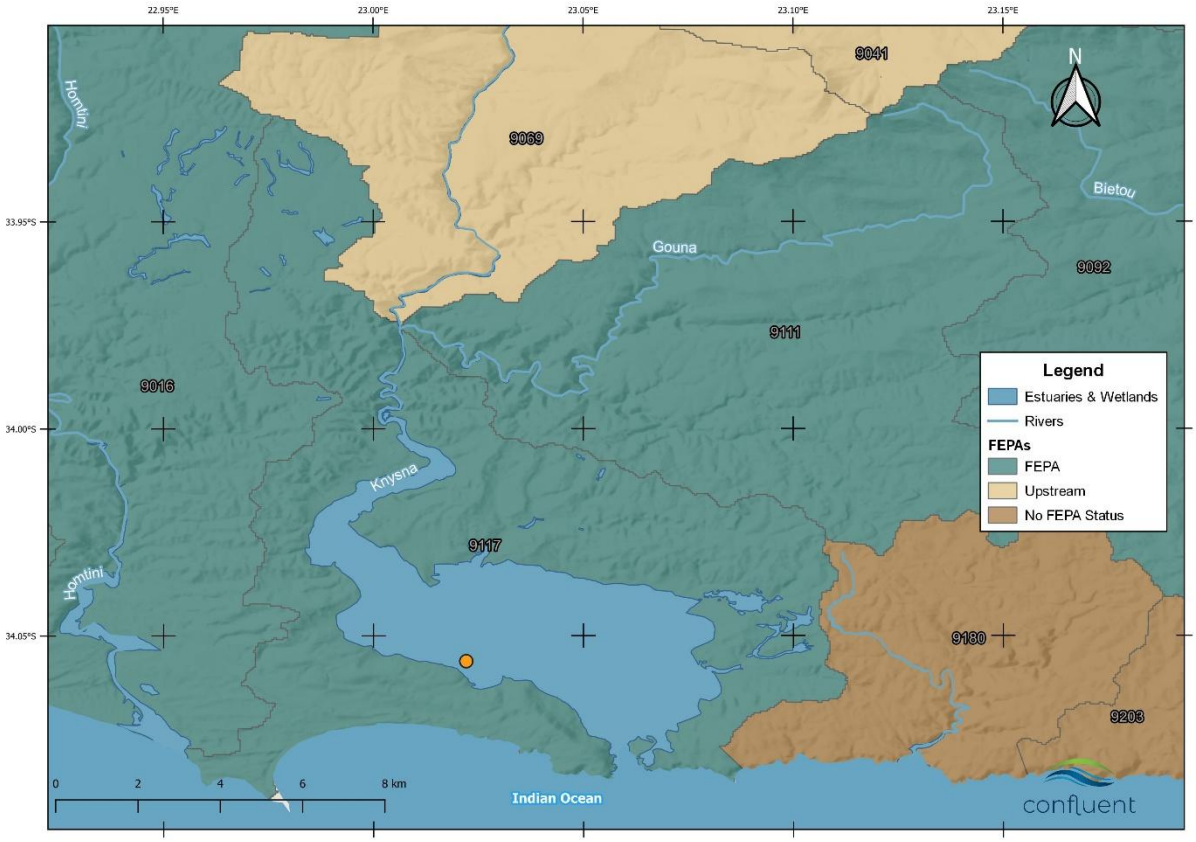

Figure 5: Map illustrating the loaction of the project area in relation to FEPA sub-quaternary catchments.

4.3.2 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). According to the Western Cape Spatial Biodiversity Plan, Portion 192 of Farm 216 and the entire Knysna Estuary falls within a Protected Area (Figure 6).

Figure 6: Map indicating the area of the property in relation to the 2023 Western Cape Spatial Biodiversity Plan (WCBSP).

4.3.3 Strategic Water Source Area (SWSA)

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

- 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
- Have high groundwater recharge and where the groundwater forms a nationally important resource; or
- 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.

4.4 National Biodiversity Assessment

The 2018 National Biodiversity Assessment (NBA) evaluated the ecological health of all estuaries in South Africa (Van Niekerk et al., 2019c). This assessment considered both abiotic and biotic components, namely hydrology, hydrodynamics and mouth condition, water chemistry, sediment processes, microalgae, macrophytes, invertebrates, fish and birds. Each estuary was assigned a condition score based on the similarity to natural for these various abiotic and biotic components. For each of the components, a panel of experts estimated the change in health as a percentage (0 – 100 %) of the natural state. Scores were weighted (25 % for each abiotic and 20 % for each biotic component) and aggregated (to provide an overall score that reflects the present health of the system as a percentage of that under natural conditions.

According to 2018 National Biodiversity Assessment (NBA) (Van Niekerk et al., 2019a), the PES of the Knysna Estuary is B/C (**Near Natural**), indicating that it is relatively good ecological condition and has not been significantly modified from its natural state (Table 3). Hydrological indices used to derive the overall PES are in fact in a natural condition (A), while habitat and macrophytes are in a near-natural condition (B). the most signficanct modifications are to water quality and biotic indices, including microalgae, invertebrates, fish and birds. The biodiversity importance is therefore regarded as being **High.** and Turpie (2004) ranked the Knynsa Estuary as the most important system in South Africa in terms of conservation importance. The conservation importance of the Knysna Estuary is highly significant, and as it is the final sink for pollutants, litter, and sediment from the town of Knysna it is imperative that any modifications to watercourses take this into account. The Knysna Estuary is a unique estuarine system that has been ranked as the most important estuary in South Africa in terms of conservation importance. Preservation of its fauna and flora alone would ensure that 42% of South Africa's estuarine biodiversity would be conserved (Turpie *et al*., 2002). The estuary is home to a number of critically endangered invertebrate species such as the pulmonate limpet (*Siphonaria compressa*) and the pansy shell (*Echinodiscus bisperforatus*; Angel *et al*., 2006) as well as the iconic Knysna seahorse (*Hippocampus capensis*).

Table 3: Summary of the Present Ecological Status (PES) and Ecological Importance of the Knysna (Van Niekerk et al., 2019a).

Index	Category
Hydrology	*A*
Hydro-dynamics	*A*
Physical Habitat	*B*
Water Quality	*C*
Microalgae	*C*
Macrophytes	*B*
Invertebrates	*C*
Fish	*D*
Birds	*D*
Overall PES	**B/C**
Ecological Importance	**High**

4.5 Resource Quality Objectives

The classification of water resources and development of Resource Quality Objectives (RQOs) for the Breede-Gouritz Catchment Management Area was finalised in 2018. Quaternary catchment K50B, falls within the G15 Coastal Integrated Unit of Analysis (IUA). The Water Resource Class for this IUA is II, indicating moderate protection and moderate utilisation. The Target Ecological Category (TEC) for the Knysna Estuary has been set as an B (Near-natural), which indicates that the estuary must be managed to achieve a pristine state. Specific RQOs have been produced for the estuary in alignment with the TEC. These include specific limits at which indicators of water quantity and quality, habitat and biota must be maintained (Table 4).

Table 4: Numeric RQOs for the Knysna Estuary

Component	Sub-component	Indicator	RQO Narrative	RQO Numeric
Quantity	Flow	MMR/MAR (% Nat)	Maintain flow regime as close to natural as possible	
Quality	Nutrients	DIN	Inorganic nutrient concentrations not to exceed TPCs for macrophytes and microalgae	DIN not >100 µg/L once-off.
		DIP		DIP not >20 µg/L once-off.
	Salinity	Salinity	Salinity distribution not to exceed TPCs for fish, invertebrates, macrophytes and microalgae	
	System variables	Turbidity	System variables not to exceed TPCs for biota	>10 NTU in low flow
		Dissolved oxygen		>5 mg/L in estuary.
		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)
Habitat	Hydrodynamics	Mouth state	Maintain connectivity with marine environment at a level that ensures water quality and habitat remains suitable for biota typically found in the estuary	Estuary mouth permanently open
		Tidal variation	Flood regime is sufficient to maintain natural Bathymetry and sediment characteristics	Average tidal amplitude near the mouth during low flows (summer) must not change by >10% from established baseline.
	Sediment	Sediment characteristics, Channel shape/size	Flood regime to maintain natural bathymetry and the sediment characteristics	Channel shape/size, sediment grain size and organic matter must not change by >30% from established baseline
Biota	Microalgae	Biomass and community composition of	Maintain the composition and richness of phytoplankton and	Maintain low/median phytoplankton/benthic microalgae biomass: phytoplankton not to exceed 3.5 µg/ℓ (median), phytoplankton not

Component	Sub-component	Indicator	RQO Narrative	RQO Numeric
		phytoplankton and benthic microalgae community	benthic microalgae groups and medium-low biomass	to exceed 20 µg/ℓ and/or cell density not to exceed 10 000 cells/ml (once-off); benthic microalgae not to exceed 23 mg/m^2 (median); prevent formation of phytoplankton blooms
	Macrophytes	Extent, distribution and richness of macrophytes	No further loss to extent, distribution and richness of macrophyte groups, limit colonisation/spread of the EFZ by alien species	No further loss to the present area (2014) covered by the macrophyte habitats; no further loss to the distribution of sensitive macrophyte habitats (e.g. salt marsh, submerged macrophytes); control/eliminate invasive plants
	Invertebrates	Macrofauna Community composition, abundance and richness	Maintain composition, richness and abundance of different groups of benthic macrofauna and zooplankton	Maintain rich populations of the mudprawn Upogebia africana on mudbanks in the middle estuary (Zones A and B); mudprawn density should not deviate from average baseline levels by more than 25% in each season; maintain rich invertebrate communities associated with the REI zone in the upper estuary (zooplankton and benthos); the dominant species in the zone (zooplankton and benthos) should not deviate from average baseline levels by more than 40% in each season
	Fish	Fish community composition, abundance and richness	Maintain composition, richness and abundance of different groups of fish, prevent colonisation/increase of alien species	Fish assemblage should comprise the 5 estuarine association categories in similar proportions (diversity and abundance) to that under the reference (see 2015 EWR report); numerically assemblage should comprise: Ia estuarine residents (50-80% of total abundance), Ib marine and estuarine breeders (10-20%), IIa obligate estuarine dependent (10-20%), IIb estuarine associated species (5-15%), IIc marine opportunists (20-80%), III marine vagrants (not more than 5%), IV indigenous fish (1-5%), V catadromous species (1-5%); Category Ia species should contain viable populations of at least 4 species ; Category IIa obligate dependents should be well represented by large exploited species. REI species dominated by both Myxus capensis and G. aestuaria
	Birds	Avifauna Community composition, abundance and richness	Maintain composition, richness and abundance of different avifauna groups	Estuary should contain a diverse avifaunal community that includes representatives of all the original groups. Saltmarsh/wetlands in the floodplain should be rich in birdlife. Intertidal areas should have a good density and diversity of both larger and smaller waders; numbers of waterbirds on the entire system should not drop below 35 species or below 2000 birds for three consecutive counts

4.6 Knysna Estuary Management Plan

Estuaries are recognised as particularly sensitive and dynamic ecosystems and the National Environmental Management: Integrated Coastal Management Act (No. 24 of 2008, as amended by Act 36 of 2014) (ICMA), via the prescriptions of the South African National Estuarine Management Protocol (the Protocol), require Estuary Management Plans (EMPs) to be prepared for estuaries in order to create informed platforms for efficient and coordinated estuarine management. To this end, the Knysna EMP was compiled in 2025 (SANParks, 2025) and provides a detailed situation assessment of the estuary as well as management objects aimed at achieving an agreed upon vision for the estuary which is as follows:

"A healthy and functional estuarine system providing diverse benefits for current and future generations through a collaborative and inclusive approach that encourages shared ownership and pride."

As an estuarine bay, the Knysna Estuary has a deep mouth that is permanently open to the sea with a tidal regime similar to that of the ocean. Reduced riverine inflows have produced a typically saline system in the lower and middle areas while the upper reaches experience limited freshwater mixing. These conditions support 2 381 ha of macrophytes – placing the Knysna Estuary as the third largest vegetated estuary in the country. Mapped estuarine vegetation includes large intertidal areas dominated by salt marsh, subtidal submerged macrophytes, including extensive monospecific and mixed stands of *Zostera capensis* and *Caulerpa filiformis*. While Portion 192 of Farm 216 does occur in the EFZ, it is not indicated to occur within any of the major vegetation/tidal areas mapped as part of the Knysna EMP Figure 7.

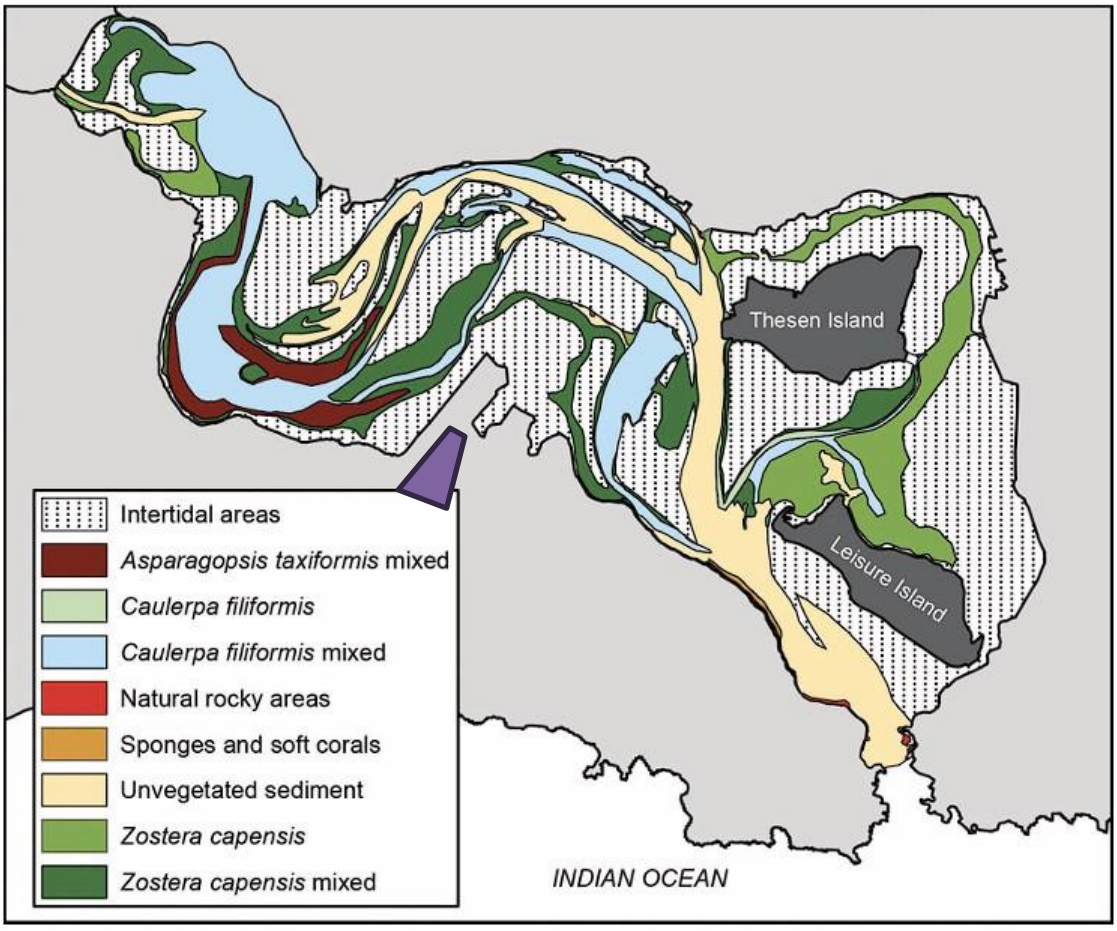

Figure 7: Mapped vegetation types occurring within the Knysna Estuary (the approximate location of Portion 192 of Farm 216 is indicated by the purple polygon).

The Knysna EMP highlights several management objectives and associated actions aimed at meeting the broader vision for the estuary. Those objectives and associated actions that are relevant to the proposed development that forms the subject of this report are provided in Table 1. These are largely related to the regulation and control of developments that take place within the EFZ.

Table 5: Relevant management objectives included in the Knysna Estuary Management Plan.

Objective	Action
Conservation Objective 1: To promote a healthy and functional estuarine system through improved protection of estuarine biota.	**Action 1.3:** Improve protection and rehabilitation of vulnerable estuarine vegetation (e.g. protection of salt marsh vegetation and eelgrass, undertake vegetation rehabilitation, prevention of vegetation destruction due to increased use). Inclusion of priority areas in habitat protection zones
Land and water use planning Objective 4: To promote a healthy and functional estuarine system that provides benefits to current and future generations through collaborative land and water use planning and implementation.	**Action 4.3:** Implement and enforce coastal management lines (in terms of the ICMA linked to land-use planning and development, including restriction of development in EFZ
	Action 4.4: Incorporate coastal management lines and EFZ boundaries in spatial development plans of municipality
	Action 4.5: Ensure the implementation of Environmental Impact Assessment processes for any proposed development considered within EFZ of the Knysna Estuary as per NEMA

5. HISTORICAL ASSESSMENT

The historical assessment reveals historical disturbance as far back as 1936, mainly associated with the construction of berms to reclaim land for agricultural purposes (see Figure 8):

- In 1936, agricultural fields were already present within the delineated EFZ. Berms were already present, presumably to limit the extent of tidal influence in the EFZ. The railway line along the western boundary of the property was already present. Infilling required to raise the railway well above the high tide mark would already have played a role in limiting the extent of the inter-tidal zone in the EFZ and on Portion 192 of Farm 216.
- By 1958, agricultural had largely ceased and fields were covered by stands of trees (possibly alien invasive). Berms aimed at reducing the tidal extent within the area were still visible.
- By 1990 a small holding had been established around an excavated pool that was connected the open water estuary via a channel.
- By 2000 more buildings were visible within the EFZ and stands of larger trees had started to establish throughout the less saturated/tidal areas. A rectangular dam had been excavated on Portion 192 of 216 and buildings had also been constructed in the southern-most portion of the property. Remaining intertidal salt marsh habitat in between reclaimed areas is clearly visible.
- By 2025 the dam had become densely vegetated by aquatic macrophytes. Invasion by alien tree species throughout the rest of the property had become more prominent.

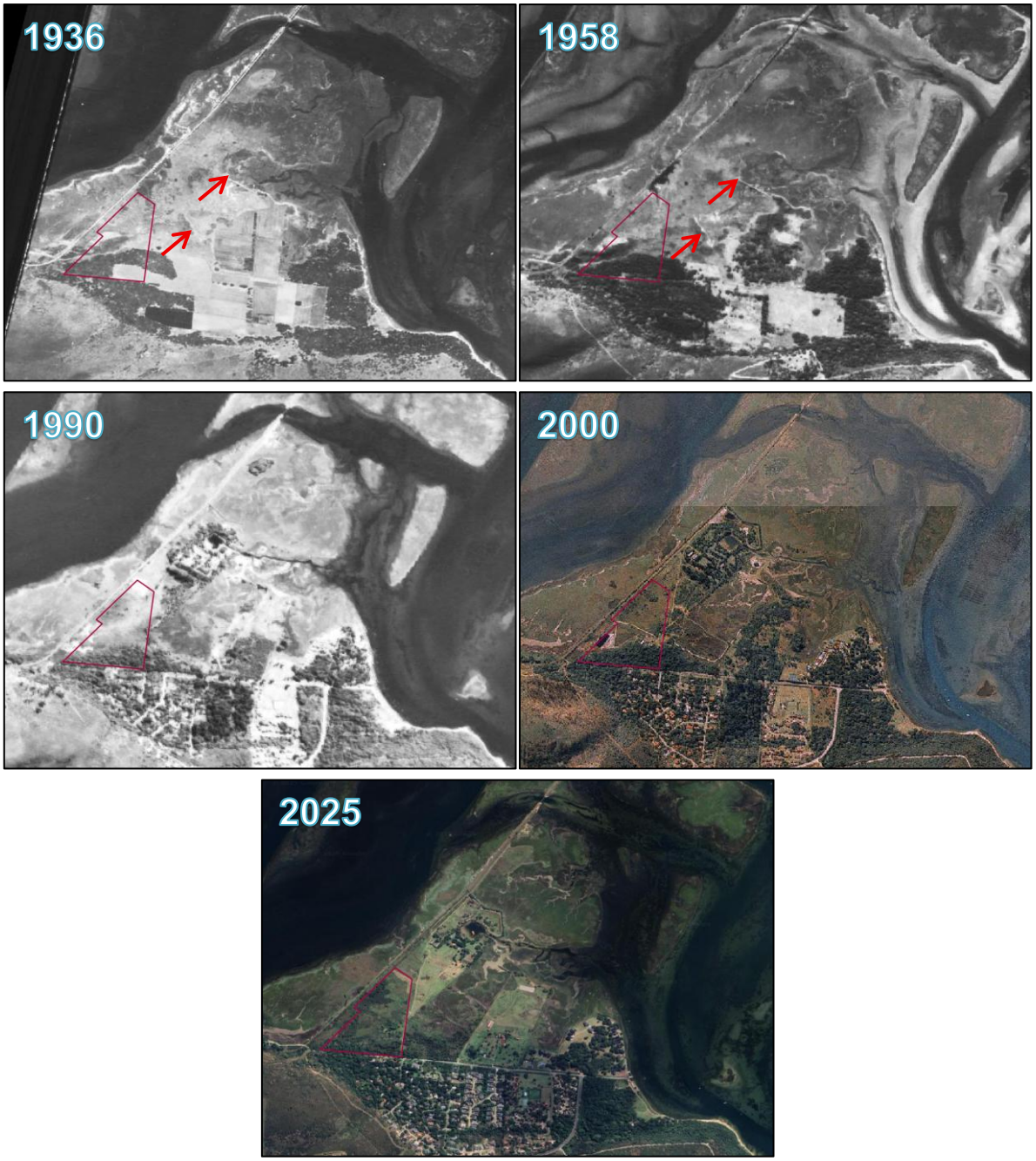

Figure 8: Historical aerial images of Portion 192 of Farm 216 and the surrounding area. Red arrows indicate tidal berms.

6. FIELD ASSESSMENT

No detailed Site Development Plan (SDP) was available at the time of conducting the site visit. The intention was to assess the entire site with intention of identifying sensitive areas and the most suitable areas for future development. The site assessment took place in September 2025, during and was conducted together with the botanical and faunal specialists, which allowed for a collaborative assessment of site sensitivities.

The site visit revealed that the entire property falls outside of the supratidal zone and tidal inundation of the property is unlikely to occur. This may in part be due to the historical berm that was constructed across a section of the estuary which prevents spring tides from

inundating the property. Despite the presence of this barrier there were signs of a saturated soil profile supporting wetland vegetation throughout the majority of the property. The northern half of the property is dominated by *Stenotaphrum secundatum* which is common in coastal wetlands and estuaries. *Phragmites australis* was also common throughout this section. The southern half of the property supported dense reed beds of *P. australis* and *Typha capensis* in previously excavated areas and sedge dominated wetland vegetation that included *Juncus kraussii* and *Cyperus thurnburgii*. *Nidorella ivifolia* dominated the less saturated margins of the wetland. The majority of the property can therefore be classified as permanently saturated estuarine wetland. The habitat is not considered pristine and there were numerous signs of historical disturbance, most notably dense thickets of alien invasive trees associated with past disturbance and several excavations and vegetated stockpiles. The berm prevents any tidal influence on the property and saturation in the soil profile is most likely maintained by a high water table associated with the tidal estuary. The delineated extent of functional estuarine habitat is provided in Figure 10 and based on this delineation a preliminary site development plan was produced (Alternative 1 - Figure 12).

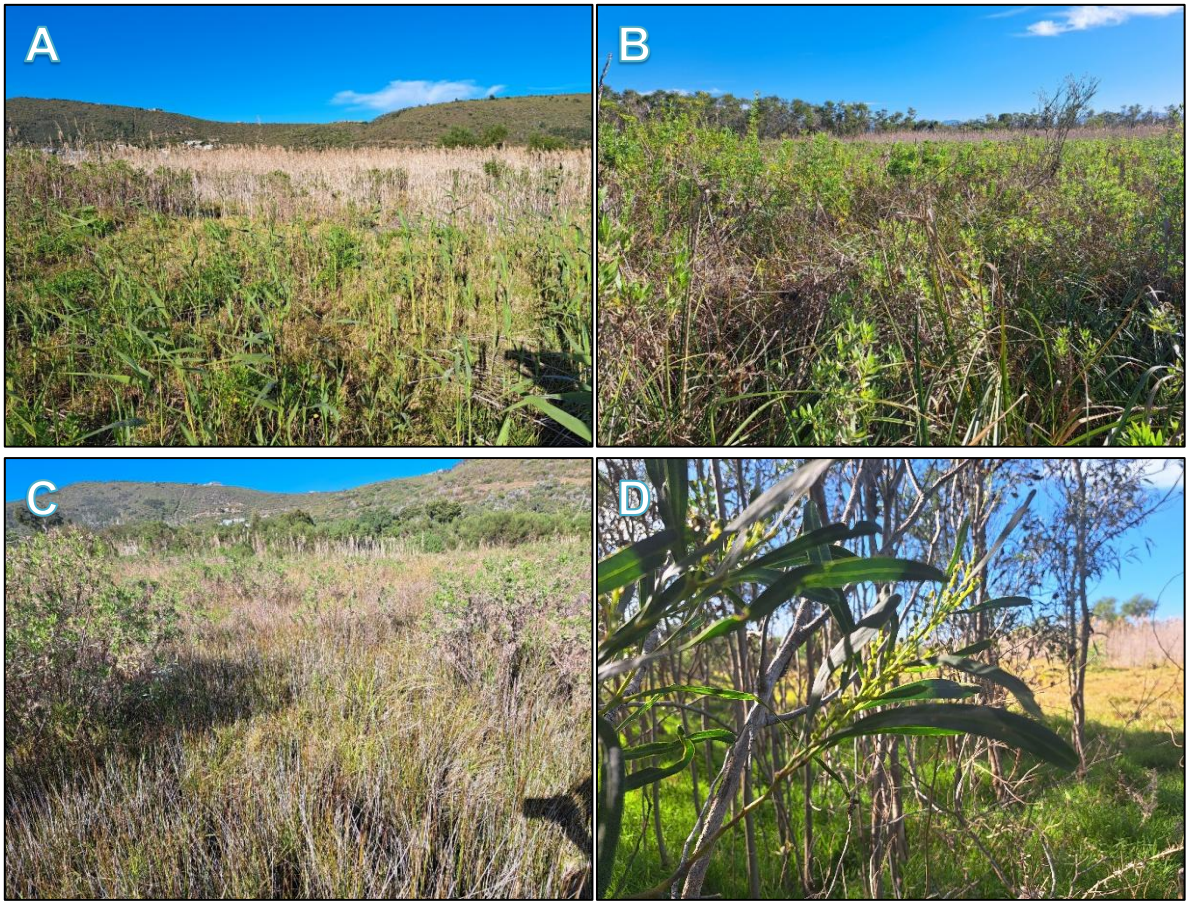

Figure 9: Photographs indicating Phragmites australis reed beds to the north of the property (A), wetland habitat dominated by Nidorella ivifolia (along the margins), Cyperus thurnbergii and Juncus krausii (B and C) and alien invasive Acacia sp. (D).

Figure 10: Map illustrating the delineated extent of estuarine wetland habitat in Portion 192 of Farm 216.

7. BUFFER ZONE

Buffer determination followed a conservative approach and did not consider the implementation of mitigation measures. The buffer is therefore appropriate for a worst-case development scenario, given the catchment and buffer characteristics which are summarised as follows:

- 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 rivers catchment is < 0.2 %.
- The slope of the buffer area is very gentle (0 – 2 %).
- Interception characteristics of the vegetation is considered to be Good (moderately robust vegetation with good interception potential).

Based on these inputs the buffer for estuarine wetland area is set to 15 m (Figure 11).

Figure 11: Map of the delineated estuarine wetland and the recommended 15 m buffer.

8. SITE SENSITIVITY VERIFICATION

From an aquatic perspective any development outside of the delineated wetland area AND the 15 m buffer is considered acceptable. This restricts development to a relatively small portion along the southern boundary of the property (see Figure 11).

9. SITE DEVELOPMENT PLAN

Site sensitivities provided by multiple specialists (including terrestrial, botanical, faunal and aquatic) were used to inform the site development plan (SDP). The SDP includes a proposal for tourist accommodation buildings, each covering ca 108 sqm. In addition to the tourist accommodation, a main dwelling house covering ca. 672 sqm is proposed, and one small shed and a maintenance building is also proposed (191 sqm in total). These structures are apart from the accommodation chalets as there are existing building ruins in the area where they are planned. The original SDP (Alternative 1) was primarily informed by the delineation of estuarine wetland habitat. Specialist reports were then used to inform the first revision of the SDP during September of 2025 which included the minimum requirement of a 15 m buffer around the edge of the delineated estuarine wetland habitat (Alternative 2). All tourist cabins and the residential dwelling have been moved outside of the 15 m buffer. The exception is the maintenance building which will be constructed on an existing building footprint located within the buffer. Alternative 2 represents a more clustered layout (i.e., all the buildings are clustered together to avoid a spread-out footprint) and includes a parking lot covering ca. 265 sqm, as well as a boardwalk between dwellings of ca. 174 sqm. Alternative 3 reduces the number of cabins from six to five and removes the maintenance shed from within the 15 m wetland buffer.

Figure 12: Alternative SDPs for Portion 192 of Farm 216 (Alternative 1 – left; Alternative 2 – right and Alternative 3 – bottom).

For all SDPs, a modular biogas plant will be used to treat sewage and kitchen waste and treat sewage water to Class B standard. This plant will be located in the area between the cabins and the house. Gas will be used for braai, lighting etc. The final waste product is a biogas slurry which is typically disposed into sub-surface soil via a soakaway system. According to the product specifications the composition of the final product includes the following:

- 97-95% liquid (Minerally loaded water)
- Available N 590 (mg/Kg)
- Available P 84 (mg/Kg)
- Available K2 800 (mg/Kg)
- The system (given the feedstock) does not have a notable presence of heavy metals.

10. IMPACTS ASSESSMENT

The impact assessment follows the principals of the mitigation hierarchy which states that the next step along the hierarchy should only be followed once the previous step is no longer viable, and with valid reason (Figure 13). The impact assessment methodology is provided in the Appendix to this report. The impact assessment methodology is provided in the Appendix to this report. The "No-Go" option was also assessed as part of the impact assessment process and refers to the current "status quo" of the site (i.e., the scenario where the proposed dwellings and associated infrastructure are not built. This is an important step, as the no-go scenario can be compared to the residual impacts associated with the proposed development.

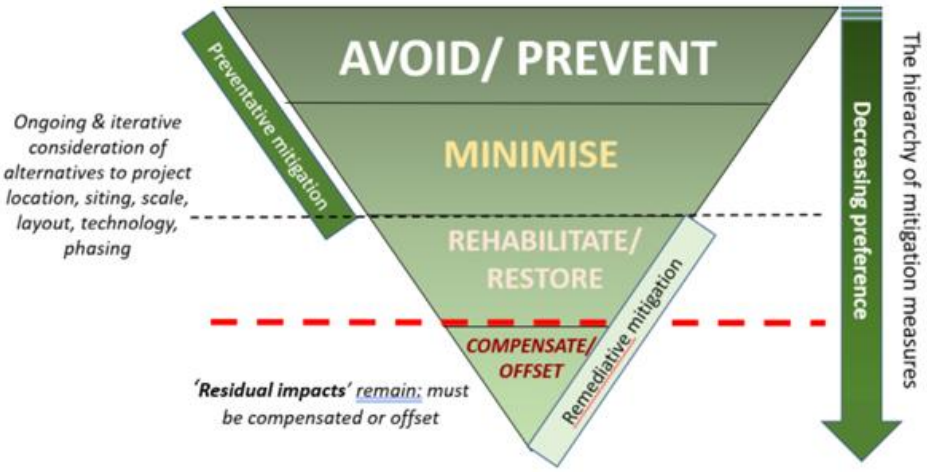

Figure 13: The mitigation hierarchy as presented in (Brownlie et al., 2023). The lower steps in the diagram should only be considered once the steps above have been duly considered.

Given the very flat topography of the site, impacts associated with construction and operational phase of the development can largely be prevented by implementing and maintaining an appropriate buffer to protect sensitive estuarine habitat, the most diverse of which lies immediately adjacent to the southern extent of the wetland – and thus in close proximity to the remaining developable area. While the remainder of the wetland area has undoubtedly been degraded over time (due to a combination of excavations, infilling for roads, limited tidal influence and invasion by alien invasive tree species), this area is clearly influenced by a high water table and saturated soils that encourage the growth of wetland plants. Concerted rehabilitation efforts – most importantly removal of alien invasive tree species – could restore much of this area to functional estuarine wetland habitat.

10.1 Construction Phase Impacts

Assessment of impacts associated with the construction phase consider the three alternative SDPs and the No-Go Option. A summary of ratings for each impact associated with the construction phase can be viewed in the impact tables below.

Impact 1: Disturbance of estuarine habitat caused by construction of activities (clearance of vegetation and stockpiling of materials)

Construction of cabins will require that construction vehicles and personnel will need to access the property which can result in physical disturbance of aquatic habitat. Adherence to the 15 m buffer will largely mitigate this this impact. This is particularly important given the presence of African Grass Owl (*Tyto* capensis) in the wetland habitat directly adjacent to the development (see Animal Species assessment for further details). The

maintenance building is however located within the 15 m buffer as this will be constructed on an existing building footprint.

	Alternative 1		Alternative 2 & 3		No-Go
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**	
Intensity	High	High	High	Low	No Impact
Duration	Short term	Short term	Short term	Brief	
Extent	Limited	Limited	Limited	Very limited	
Probability	Certain	Certain	Almost certain	Unlikely	
Significance	**-70: Minor**	**-70: Minor**	**-60: Minor**	**-18: Negligible**	
Reversibility	High	High	High	High	
Irreplaceability	Low	Low	Low	Low	
Confidence	High	High	High	High	

Mitigation:;

- The 15 m buffer must be clearly demarcated and no vehicle access or disturbance must take place within the buffer of the delineated wetland. For the maintenance building the delineated area of the wetland must be strictly avoided;
- No clearing of vegetation or stockpiling of materials is permitted within the 15 m buffer. Clearance of vegetation around the maintenance building must kept to a minimum;
- Ensure that all stockpiles are well managed and have measures such as berms and hessian sheets implemented to prevent erosion and sedimentation. Stockpiles must be located outside of the designated buffer area (including at the maintenance building); and
- Rehabilitate and naturalise areas beyond the development footprint, which have been affected by the construction activities, using indigenous vegetation.

Impact 2: Pollution of aquatic habitat caused by construction activities.

Construction of the cabins will require that construction vehicles and machinery will need to access the property which can result in pollution due to leaks and spills of hydrocarbons (i.e. fuel and oil from construction vehicles and machinery) and other construction materials (e.g. cement).

	Alternative 1		Alternative 2 & 3		No-Go
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**	
Intensity	Moderate	Low	Low	Very low	No Impact
Duration	Short term	Brief	Brief	Brief	
Extent	Limited	Limited	Limited	Very limited	
Probability	Almost certain	Unlikely	Unlikely	Unlikely	
Significance	**-54: Minor**	**-21: Minor**	**-21: Negligible**	**-15: Negligible**	
Reversibility	High	High	High	High	
Irreplaceability	Low	Low	Low	Low	
Confidence	High	High	High	High	

Mitigation:

- Vehicles 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 the site;
- No fuel storage, refuelling, vehicle maintenance or vehicle depots to be allowed within 30 m of the edge of the delineated wetland area;
- Contractors used for the project should have spill kits available to ensure that any fuel or oil spills are cleaned and disposed correctly;

- Adequate sanitary facilities and ablutions 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; and
- No dumping of construction or waste material is permitted. All construction and waste materials must be removed from the property and correctly disposed.

Impact 3: Erosion and sedimentation of estuarine habitat caused by construction activities.

Rainfall during the construction phase can result in erosion and associated sedimentation of adjacent wetland habitat. Clearance of vegetation and compaction of soil by heavy earth moving machinery will make soils more vulnerable to erosion. The intensity of impact is likely to be relatively low due to the flat topography of the site.

	Alternative 1		Alternative 2 & 3		No-Go
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation	
Intensity	Moderate	Moderate	Low	Very low	Negligible
Duration	Short term	Short term	Brief	Brief	Immediate
Extent	Limited	Limited	Limited	Very limited	Very limited
Probability	Almost certain	Likely	Unlikely	Unlikely	Highly unlikely
Significance	**-54: Minor**	**-45: Minor**	**-21: Negligible**	**-15: Negligible**	**-3: Negligible**
Reversibility	High	High	High	High	High
Irreplaceability	Low	Low	Low	Low	Low
Confidence	High	High	High	High	High

Mitigation:

- Disturbance of vegetation outside of the construction footprint must be avoided/minimised.
- Vehicle access to the construction area must be limited to single points that are clearly demarcated, with aim of avoiding unnecessary vegetation clearance and compaction of soils.

10.2 Operational Phase Impacts

Impact 4: Degradation of estuarine wetland habitat caused by edge-effects associated with increased anthropogenic activity within and around the development area.

Degradation of watercourses as a result of increased edge effects, including water quality changes, increased litter, erosion and alien plant invasion associated with pre-existing impacts (e.g. existing invasions increased activity in close proximity to the wetland. For the No-Go option, impacts are considered to be Minor, as the property currently exhibits a number of edge effects, mainly related to invasion of wetland habitat by alien tree species. It is more likely that these edge effects would be more actively managed in the event that the property is occupied and utilised as a tourism concern.

	Alternative 1		Alternative 2 & 3		No-Go
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation	
Intensity	High	High	Moderate	Low	Moderate
Duration	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
Extent	Limited	Limited	Limited	Very limited	Limited
Probability	Almost certain	Almost certain	Likely	Unlikely	Likely
Significance	**-78: Moderate**	**-78: Moderate**	**-60: Minor**	**-30: Negligible**	**-60: Minor**
Reversibility	High	High	High	High	High
Irreplaceability	Low	Low	Low	Low	Low
Confidence	High	High	High	High	High

Mitigation:

- The buffer must be maintained as a No-Go area during the operational phase.
- Maintain the integrity of the buffer along the wetland. Buffers will remove sediment, organic matter, and other pollutants (nutrients, toxins and pathogens) from sheet flow and stormwater before they reach the wetland. Buffer areas must therefore be maintained through ongoing removal of litter/rubble and control of alien vegetation.
- Apart from removal of alien vegetation, no removal of vegetation from the buffer is permitted.
- An alien invasive plant management plan must be formulated and implemented to control existing and future invasions within the undeveloped wetland area.
- Guidelines for residents must be drawn up which prohibit dumping of materials into the buffer area.

Impact 5: Discharge of treated wastewater on estuarine water quality.

Treated wastewater will be discharged into sub-surface soil via an underground soakaway. According to product specifications, the final effluent will contain bacteris (e.g. *E.* coli) and very high concentrations of available nutrients (nitrogen, phosphorus and potassium). Given the relatively high water table throughout the estuarine zone, combined with sandy soils throughout the site, it is possible that release of treated wastewater could contaminate and enrich ground water with bacteria and nutrients, respectively. Nutrient enrichment could potentially lead to enhanced growth of vegetation, thereby altering the vegetation community within the estuarine wetland area. Given the sandy soils and high water table, use of conservancy tanks to temporarily store the final treated effluent is likely to be the most effective means of minimising this impact.

	Alternative 1, 2 & 3.		No -Go
	Without Mitigation	**With Mitigation**	
Intensity	High	Low	No Impact
Duration	Ongoing	Ongoing	
Extent	Limited	Very limited	
Probability	Almost certain	Unlikely	
Significance	**-78: Moderate**	**-30: Negligible**	
Reversibility	High	High	
Irreplaceability	Low	Low	
Confidence	High	High	

Mitigation:

- The biogas plant or conservancy tanks must not be located within the delineated area of the wetland or the buffer of the wetland.
- It is recommended that final effluent must be discharged into contained conservancy tanks as opposed to a soakaway. The conservancy tank must be routinely inspected and pumped timeously by a licenced sewage disposal operator.
- Signage must be placed in all cabins that prohibit flushing of harsh chemicals, grease, or excessive solids down drains and toilets. This includes bleach, (which kills beneficial bacteria), and products like flushable wipes, sanitary pads, nappies etc., which increase solids and can cause premature system failure.
- Routine inspections and maintenance of the biogas plant system can prevent failures and ensure that the system operates as designed.

11. CONCLUSION

Given the high conservation status and ecological importance of the Knysna Estuary (as indicated by NFEPA, the Western Cape Spatial Biodiversity Plan and the desktop eco-classification of estuaries of South Africa), it is important that any development is planned and conducted in a sensitive manner.

In terms of the mitigation hierarchy, Alternative 2 and 3, which both include the implementation of a 15 m buffer avoids any direct impacts or disturbance to estuarine wetland habitat and is considered the preferred option. Due to the flat topography of the site and the low density of the development, stormwater discharge into estuarine wetland habitat is unlikely to pose any impact towards estuarine wetland habitat. Assuming that recommended mitigation measures are implemented, the ecological condition of the broader Knysna Estuary and the estuarine habitat located on the property is unlikely to be negatively impacted by Alternative 2 and 3. In terms of avoiding and minimising impacts to aquatic biodiversity, Alternative 2 and 3 are supported for further environmental authorisation – with Alternative 3 being the preferred option as all infrastructure will remain outside of the buffer. Alternative 1 is not recommended.

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