ECOLOGICAL IMPACT ASSESSMENT

CONSTRUCTION OF A RESIDENTIAL DWELLING AT PORTION 358 OF LOT 61, SHEFFIELD BEACH, KWADUKUZA

Compiled by:
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Reviewed by:
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SDP Ecological and Environmental Services

Compiled on behalf of:
Confluence Strategic Development (Pty) Ltd

Date of compilation:
March 2022

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Compilation Date	March 2022
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Front page image	Aerial image of the site

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Glossary of Terms and Abbreviations

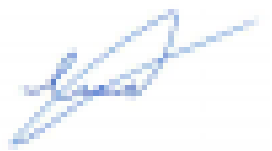
Associes	Groupings of species, particularly plants commonly found to occur together
Dissipative	A dissipative beach is a wide beach with a low profile associated with high energy surf zones
Dune heel	The leeward extreme of a dune
Dune toe	The seaward extreme of a dune
Eco-morphological	The physical and ecological result of plant and morphological drivers,
Hs	Significant wave height
Psammo-	Of dunes
Slack	A valley or depression with the dune cordon

DECLARATION BY THE SPECIALIST

I, L P Maingard, declare that --

- I act as the independent specialist in this application.
- I do not have and will not have any vested interest (either business, financial, personal or other) in the undertaking of the proposed activity, other than remuneration for work performed in terms of the EIA Regulations, 2014;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Waste Act and NEMA, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Waste Act and NEMA, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I am aware that a person is guilty of an offence in terms of Regulation 48 (1) of the EIA Regulations, 2014, if that person provides incorrect or misleading information. A person who is convicted of an offence in terms of sub regulation 48(1) (a)-(e) is liable to the penalties as contemplated in section 49B(1) of the National Environmental Management Act, 1998 (Act 107 of 1998).

Name of Specialist: L P Maingard



Signature of the specialist:

Date: March 2022

RELEVANT BACKGOUND INFORMATION OF AUTHORS/ECOLOGISTS

NAME Luke Patrick Maingard BSc (Hons)

PROFESSION: BSc (Hons) Candidate Ecologist / Environmental Assessment Practitioner
DATE OF BIRTH 15 September 1993
MEMBERSHIP OF PROFESSIONAL BODIES: South African Council of Natural Scientific Professionals– Candidate Ecologist (registration number 116639)

KEY COMPETENCIES AND EXPERIENCE

Luke Maingard has been employed as an ecologist at SDP Ecological and Environmental Services since April 2016 to this present date, carrying out a number of ecological investigations as well as undertaking a number of Basic Assessment and Water Use License Processes. Maingard has a core competency in the delineation and assessments wetland environments as well as a focus on terrestrial environments, particularly coastal habitats. Throughout the past three years of employment, Maingard has compiled a number of ecological impact reports as well as providing mitigatory measure and insight on enviro-legal compliance matters with regards to a number of developments throughout South Africa as well as Zambia.

SELECTED RELEVANT PROJECT EXPERIENCE

- **Ecological Assessment of the dune habitat at Erf 206, Tinley Manor, KwaZulu-Natal (2017)**
- Assessment of the botanical community present within the dune cordon as well as a review of the coastal vulnerability of the site through an evaluation of coastal erosion.
- **Ecological assessment of the Umzimvubu river system, Swartberg, KwaZulu-Natal (2019)**
- Delineation of the riparian area as well as the assessment of the ambient water quality though water samples analysis, Bio-SASS as well as an icthy faunal assessment.
- **Ecological and Wetland Assessment with regards to the Charlottedale Housing Project, Kwadukuza (2019)**
- Delineation and assessment of wetlands within the context of the Charlottedale township in conjunction with an EIA process.
- **Ecological and Wetland Assessment with regards to the Kwadabeka Housing Project, Inanda (2018)**
- Delineation and assessment of wetlands within the context of the Kwadabeka township in conjunction with an EIA process.

NAME Simon Colin Bundy. BSc. MSc Dip Proj Man

DATE OF BIRTH 7 September 1966 **PLACE OF BIRTH**: Glasgow, Scotland.
MEMBERSHIP OF PROFESSIONAL BODIES: South African Council of Natural Scientific Professionals No. 400093/06 – Professional Ecologist; Southern African Association of Aquatic Scientists

KEY COMPETENCIES AND EXPERIENCE

Simon Bundy has been involved in environmental and development projects and programmes since 1991 at provincial, national and international level, with employment in the municipal, NGO and private sectors, providing a broad overview and understanding of the function of these sectors. From a technical specialist perspective, Bundy focusses on coastal and xeric ecological systems. He is competent in a large number of ecological and analytical methods including multivariate analysis and canonical analysis. Bundy is competent in wetland delineation and has formulated ecological coastal set back methodologies for EKZN Wildlife and Department of Environmental Affairs. Bundy acts as botanical and environmental specialist for Eskom. Based in South Africa, he has engaged in projects in the Seychelles, Mozambique, Mauritius and Tanzania as well as

Rwanda, Lesotho and Zambia. Within South Africa , Bundy has been involved in a number of large scale mega power projects as well as the development of residential estates, infrastructure and linear developments in all provinces. In such projects Bundy has provided both technical support, as well as the undertaking of rehabilitation programmes.

SELECTED RELEVANT PROJECT EXPERIENCE

Ecological investigations for numerous renewable energy projects, including "Kalbult", "Dreunberg", "jUWI", "Kenhardt Pv1 - 6", "Solar Capital 2 and 3" and "Lindes".
Ecological investigations Tongaat and Illovo Desalination Plants : CSIR –(2013 - 2016)
Ecological investigations and Rehabilitation Planning : Sodwana Bay :iSimanagaliso Wetland Park Authority – (2014 - 2018)
Ecological evaluation and monitoring: Plastic pellet (nurdles) clean-up MSC Susanna Marine Pollution Event : West of England Insurance, United Kingdom (2018 - 2020) Mapping of pollution event TRANCURA 2021 – 2022 London P & I Club.

PUBLICATIONS

Over a dozen scientific publications, numerous popular articles and contributions to books and documentaries in local and international journals

EXECUTIVE SUMMARY

Confluence Strategic Development Pty Ltd appointed SDP Ecological and Environmental Services to undertake a Terrestrial Biodiversity and Coastal Impact Assessment on a residential property at 25 Llewellyn Road (Portion 358 of Lot 61), Sheffield Beach. The new property owners wish to demolish the existing, incomplete structures and establish a new residential dwelling.

Site reconnaissance revealed that the property in question is largely transformed with a high presence of exotic vegetation, with some natural coastal vegetation being evident around the eastern extent of the site in the form of a rocky scarp-beach habitat. Notably, the structures within the site are elevated at nearly 20 amsl and do not fall within the sand sharing system.

An extensive surface water seep was noted along the eastern extent of the property within the dune habitat and is identified as a "dysfunctionalized wetland" on account of historical excavation and infilling activities. Botanical, as well as edaphic factors indicate that this wetland system and associated drainage feature is 'permanent' in nature and thus should be treated accordingly from both a practical and legislative perspective.

Percolation tests conducted during the geotechnical survey indicated that soils are suitable for the proposed storm water measures and septic tank system. However, high levels of eutrophication were noted along the beach and scarp environments proximal to site, likely due to sewerage disposal systems within and around the subject site.

From the above, it is evident that the establishment of a residential structure on the existing footprint of the incomplete residential home, would not have any significant effect upon the broader coastal and dysfunctional wetland environment. However, sewerage disposal, is seen as perpetuating the cumulative eutrophication of surface (and sub surface) waters within the Christmas Bay area. As such, measures relating to sewerage disposal have been provided. Subject to the above, it is recommended that the development be sanctioned by the competent authorities along with any applicable caveats to mitigate impacts.

STATEMENT

The study site at 25 Llewellyn Road (Portion 358 of Lot 61, Sheffield Beach) has been shown to be a highly transformed environment with little to no intrusion into the coastal sand sharing system. Subject to the implementation of management conditions in respect of sewerage disposal, it is recommended that the authorities may sanction the proposed development.

1. INTRODUCTION & BACKGROUND INFORMATION

In 2006 a residential structure was partially established on Portion 358 of Lot 61, Sheffield Beach, a property which shares a cadstral with the Sheffield Beach coastline. This structure has lain incomplete and become derelict over the past decade. The new property owners wish to demolish the existing structures and establish a new residential dwelling at this point. In consideration of the National Environmental Management Act (NEMA) EIA regulations, it is evident that Environmental Authorisation is required prior to development of the site due to the structure lying within 100 meters of the highwater mark of the sea. Confluence Strategic Develepment (Pty) Ltd, the project EAPs, have subsequently appointed SDP Ecological and Environmental Services to carryout a coastal impact assessment for the purposes of the Basic Assessment process. This assessment has been undertaken in terms of Government Gazette 43110 "Protocol for the specialist assessment and minimum reporting content requirements", and considers *inter alia:*

- The coastal/terrestrial, eco-morphological factors associated with the site at a local and wider scale.
- Features associated with the site and their ecological significance
- The potential impacts of the proposed activities on the overall biodiversity of the site, which includes the impacts on vegetation dynamics.
- Measures that may be employed to mitigate or avoid specified impacts.

Figure 1. A map showing the study area from a regional and local perspective.

2. PROPOSED DESIGN

Portion 358 of Lot 61 Sheffield Beach (25 Llewellyn Road) is zoned for residential purposes in alignment with the suburban town planning scheme. The property in question encompasses an area of around 1600m^2, with planned coverage of the structure approximating 370 m^2. The design of the dwelling is presented in Annexure A with engineering schematics attached as Annexure B. The following general construction and design parameters associated with 'House Middleton' are:

- Double storey structure
- Cobbled pan handle access driveway
- Bedrooms, garages and other amenities
- Storm water soak away system
- Double chambered septic tank
- French drain system

3. EXPECTATIONS AND LIMITATIONS

Seasonality and site conditions

The field assessment was undertaken during February 2022, which aligns with the southern hemisphere summer period. Such seasonal weather conditions in KwaZulu-Natal are associated with higher rainfall and warm temperatures. The beach conditions in summer are generally inflated profiles, but by winter are advancing towards a deflated state. Aerial imagery from various years, as well as imagery of the 2007 storm event (the highest recorded storm surge and wave run-up available) were used for comparative interpretation of beach states and erosion or deposition trends.

Limitations

Beach geomorphology is affected by several dynamic processes such as waves, tides and currents that act to shape the beach and dune environments. As such, a coastal impact assessment requires the consideration of numerous, complex factors. Management measures have been suggested using the current available data and should be open to re-evaluation, as the coastline changes under varying scenarios.

4. METHOD AND APPROACH TO EVALUATION OF IMPACTS

As per the requirements of Government Gazette 43110 "Protocol for the specialist assessment and minimum reporting content requirements", consideration of The Department of Environment, Forestry and Fisheries' screening tool (https://screening.environment.gov.za), indicates that the subject site is of a "low aquatic biodiversity sensitivity" (Figure 2). The same tool indicates the subject site to have a "high terrestrial biodiversity sensitivity" (Figure 3). As such, an ecological assessment of the coastal environment was undertaken using the method and approaches discussed below.

Figure 2. Screening report map of the study site showing predicted aquatic species sensitivity (Department of Environment, Forestry and Fisheries 2021).

Figure 3. Screening map of the site showing predicted terrestrial species sensitivity (DFFE, 2021)

4.1 Desktop review

A desktop review of literature and pertinent information relating to the site was undertaken, primarily with consideration of historical trends along the shoreline and dune cordon. Such desktop investigations included:

- Review of aerial photography sourced from ESRI using ARC 10.3 GIS (Geographic Information System) and Google Earth.

- Review of historical imagery sourced from the Surveyor General's Office.

- Review of pertinent literature relating to the site and surrounds was undertaken to assist with the evaluation and to support the outcomes of the analyses.

4.2 Study area and site reconnaissance

The subject property is approximately 1600m^2 in extent, with a proposed development footprint of 373m^2. Site reconnaissance was undertaken on the 31 January 2021, 14th and 21st of February 2022, whereby:

- The property and adjacent shoreline were traversed on foot.

- The nature of the prevailing vegetation type was assessed, which included consideration of habitat form and structure across sites. This included delineation of wetland or seep environments associated with the site.

- Consideration was given to the nature and form of the beach and dune environment, with identification / delineation of the sand sharing system. This determination was undertaken using geomorphological evidence of marine inundation and erosion, nature of prevailing vegetation and other evidence.

- Identification and delineation of various botanical associations within the frontal dune communities and backshore was undertaken.

- Other factors associated with the site were considered (i.e., elevation, topography, etc.) using comparison of the prevailing site state and the abovementioned historical information.

- Specific features of the beach and dune environments were identified and logged using a Garmin Montana V GPS.

5. SITE IN REGIONAL PERSPECTIVE

Beach and dune environments are continuously changing and are shaped by wave, wind and sediment transport within the sand sharing system (Psuty 1994). The sand sharing system is the underlying process, whereby marine sediments are shared between the offshore surf bar and the dune cordon. The system is dynamic and is driven by wave and wind energy, with biological components, primarily vegetation, adapted to living within the harsh environment, characteristic of such systems. Vegetation acts to ameliorate such dynamism.

The sand sharing system, including the sub tidal, intertidal, the beach and dune system components, can be considered to be, over any given temporal period, in a state of equilibrium (Figure 4). It follows that disturbance to this equilibrium results in a shift, with concomitant effects on the system. Such effects may lead to the erosion of beaches, engulfment of vegetation and generally undesirable effects upon the coastline. Such consequences may have serious direct, indirect and cumulative effects upon ecological, social and economic environments.

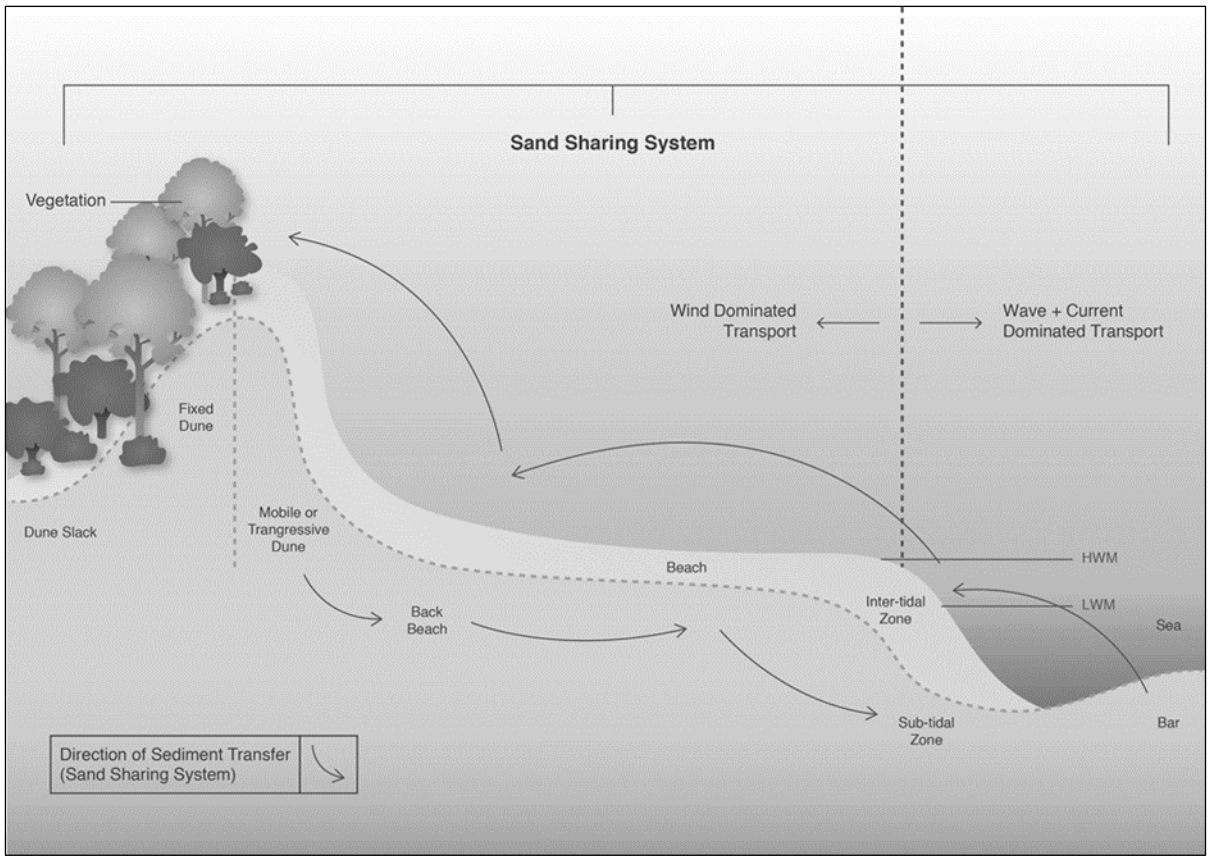


Figure 4. Graphic image showing a sand sharing system and associated processes.

It follows that the most effective "test" in evaluating the impact of human induced activities on a coastline, is to consider where and how, such activities may affect the sand sharing system. This test forms the basis for consideration in this review and evaluation of the construction activities that are proposed for the site.

The subject site lies within Sheffield Beach, a residential suburb within the KwaDukuza Municipality (see Figure 1 above). Sheffield Beach is a relatively recently developed, urban settlement with its first formal structures being established during the early 1900s. Much of the natural terrestrial components of the sand sharing system have become stabilised or highly transformed, altering the dynamism within the sand sharing system.

The coastline in and around Sheffield Beach comprises of a number of rocky promontories and "pocket beaches" covered by a generally thin veneer of sand (Figure 5). The supra tidal coastal environment varies from steep cliffs to low elevation and relatively "young" sand dunes that are backed by older (+/- 10000 yrs BP) paleo dunes and rocky cliff. The KwaDukuza coastline is highly exposed and is subject to the effects of the prevailing wave and wind regimen which determines the extent of the sand sharing system (Figure 5). Unlike the Durban coastline to the south, the KwaDukuza coastline has a more extreme wave climate, lacking the shelter from high wave energies offered by the crenulated bay in which Durban is positioned, while also lacking the extended shallow shelf that serves to dissipate much of the incoming wave energy along the Durban shoreline. Comparatively, Durban's bathymetry indicates that the -20m bathymetric contour lies approximately 1000m from the shore, while along the Ballito and Sheffield Beach coastline, the same contour is approximately 80m from the shore. In shore reef also serves to focus wave energy at points across the beach and dune cordon. This situation means that in KwaDukuza, wave energy is dissipated through breaking waves far closer to the beach and as such, the sand sharing system is more dynamic and energised in Sheffield than is the case in Durban.

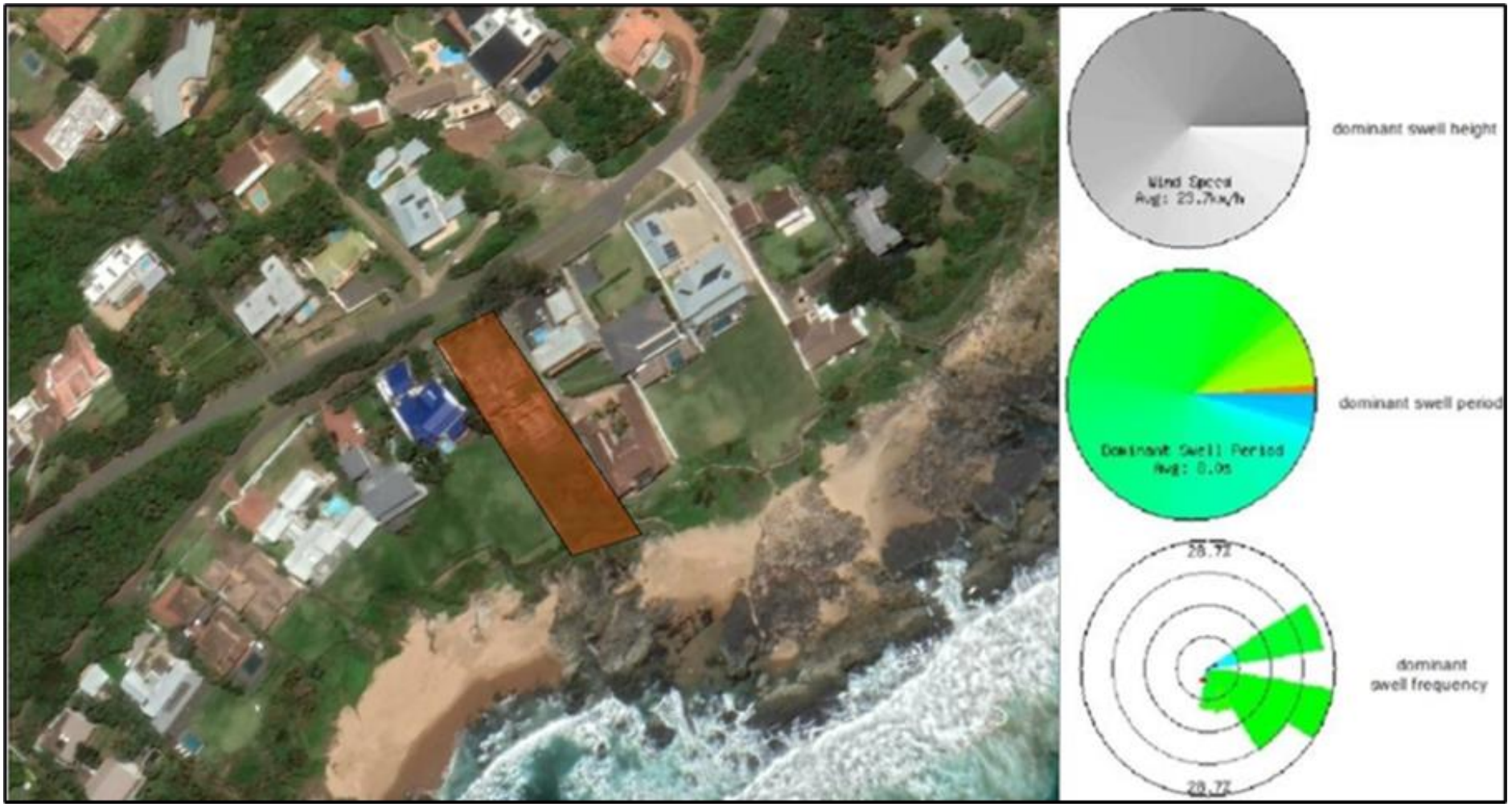


Figure 5. Aerial image of site with wave roses indicating swell period, direction and height for the region. Site shows a small pocket beach within rocky topography.

This information is useful in evaluating the highest run up encountered along a coastline. While methods such as the Bruun Rule and Oregon Model may be applied to determine run up levels, these models are generally considered "weak" (Cooper 2008) as they do not account for numerous physical factors inherent in the eco-morphological state of the sand sharing system. A better method of evaluating run up and wave inundation in relation to shorelines has been proposed by Corbella and Stretch (2012), where use is made of the exceedance level of the 2007 marine storm event, which was the highest event recorded along the coastline, where historical information can be accessed. A 1954 storm event is suggested to have been of a similar magnitude, however no data related to this event is available. Within the KwaDukuza region, the 2007 storm damage was well documented immediately following the storm and this information is used to determine run up in and around the subject site.

From a terrestrial perspective, the study site falls within two biomes: KwaZulu-Natal Coastal Belt Grassland and Subtropical Seashore vegetation (Mucina and Rutherford 2006) (Figure 6). These vegetation types are considered "Critically Endangered" and "Least Threatened", respectively (SANBI 2018). KwaZulu-Natal Coastal Belt is described as a highly dissected undulating coastal plain environment, which was historically covered by subtropical coastal forest (Mucina and Rutherford 2006). As much as 50% of this vegetation type has been transformed for cultivation, urbanisation, and infrastructure. The study area also falls on Subtropical Seashore vegetation which is characterised by recent/young coastal sandy sediments which form beaches and dunes that support herbaceous and dwarf-shrubby vegetation (Mucina and Rutherford 2006). Dominant species common to this vegetation type typically include *Scaevola plumieri, Phylohydrax carnosa, Gazania rigens* and *Canavalia rosea.*

The Provincial Conservation Authority has identified regions in KwaZulu-Natal considered to be of critical importance from a conservation perspective, having some areas designated as "CBA Irreplaceable", "CBA Ecological Support Areas" and "CBA Optimal areas" (see SANBI CBA Technical Guidelines for more information). The subject site does not fall within a CBA area (Figure 7).

Figure 6. Map showing site in relation to prevailing vegetation forms (source: SANBI 2018).

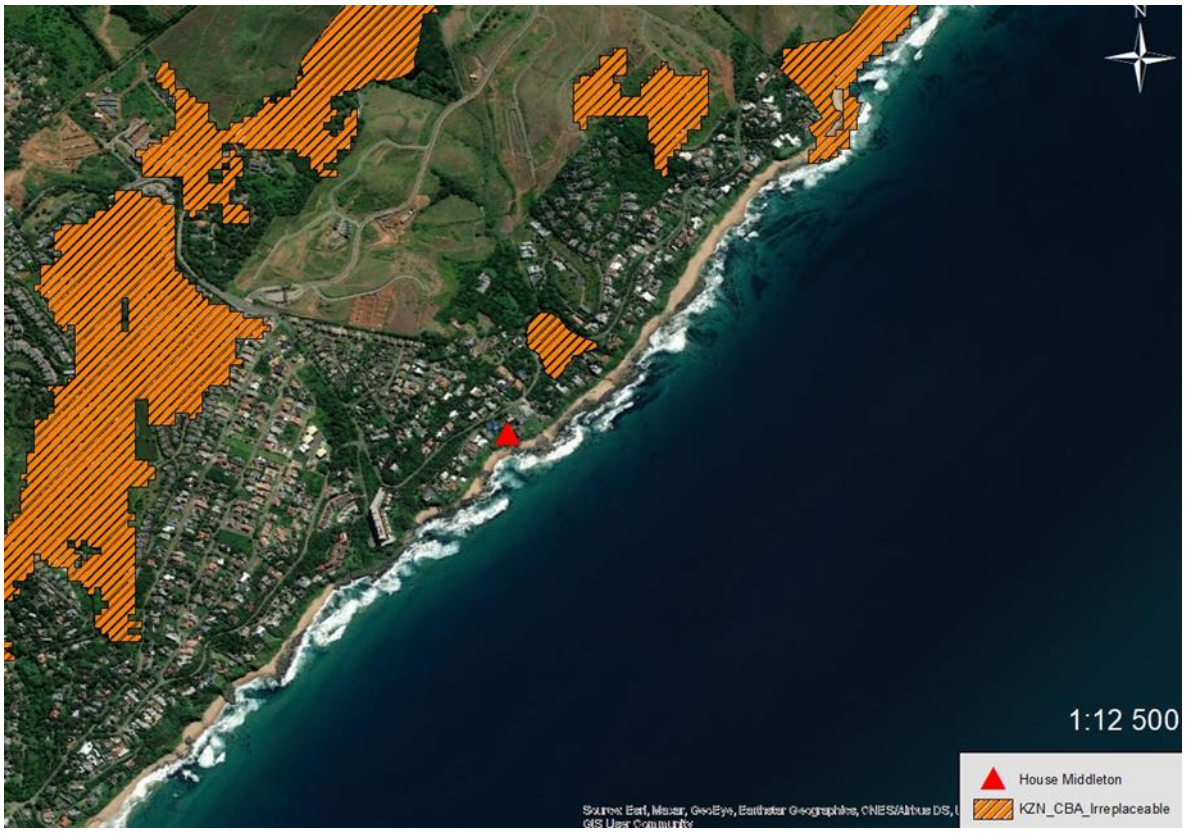


Figure 7. The extent of terrestrial CBA zones in the vicinity of House Middleton, Sheffield Beach

According to the Coast KZN database, the study site falls within a long-term (100 year) risk category and is under "High Risk" in terms of the Coastal Vulnerability Index (http://www.coastkzn.co.za/) (Figure 8). Vulnerability is measured according to a number of parameters relating to the width, function and integrity of the coastline. Notably, few sites are considered to be of "low" vulnerability in KwaZulu Natal. Sites considered "high" risk are those that have an increased probability in terms of erosion, sea level rise and susceptibility to extreme events (Palmer *et al.* 2011).

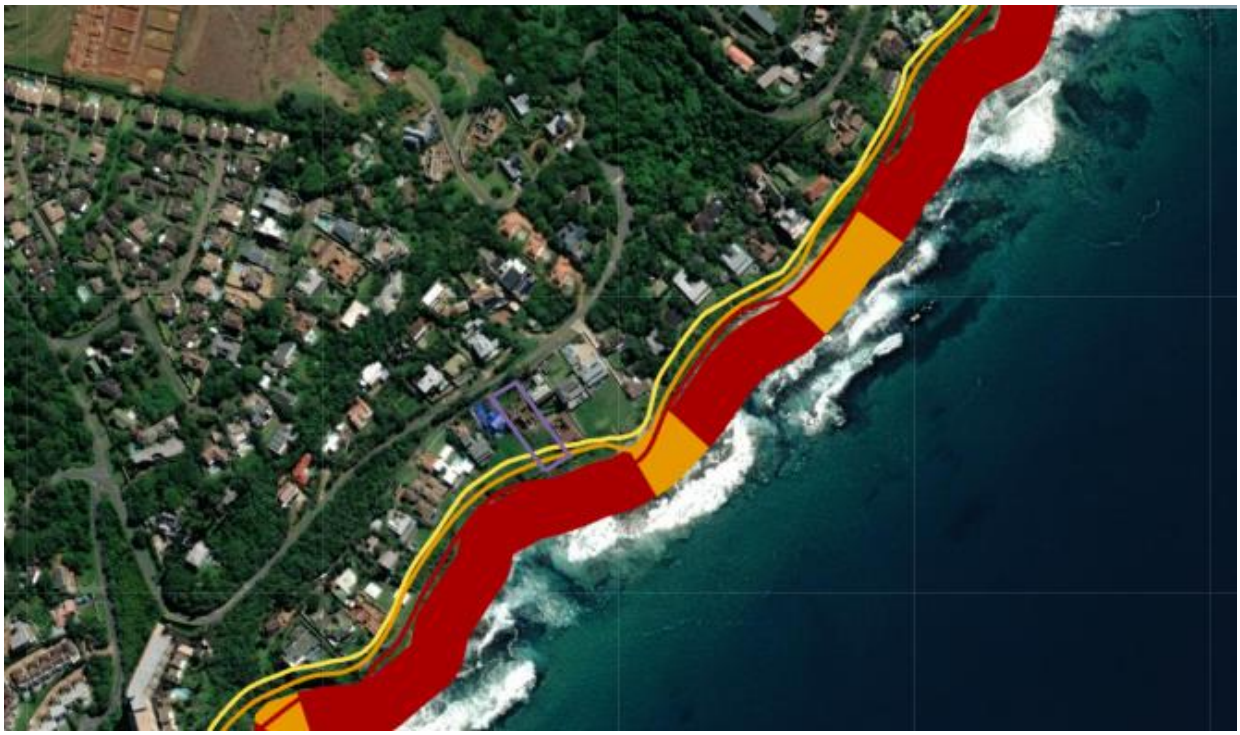


Figure 8 Results from the Coast KZN database (http://www.coastkzn.co.za/) showing the risk lines and coastal vulnerability index associated with the study area.

6. SITE SPECIFIC EVALUATION

The coastal properties along Sheffield Beach are fringed by rocky promontories and inshore reefs extending throughout this stretch of coastline. The study site at Portion 358 of Lot 61 Sheffield Beach lies upon an elevated paleo dune complex underlain by a fractured sandstone geology with dolerite intrusions, which are associated with the numerous small embayment's along this stretch of coastline. The nature of the subject site can be divided into two areas, namely a more landward portion of dune form comprising of deep, consolidated clayey sands and a more seaward landform comprising of unconsolidated sands of marine origin. Much of the existing structures lies on the upper, stable dune form (Figures 9).

Figure 9. An aerial image showing the general nature of Portion 358 of Lot 61, Sheffield Beach.

As such, this situation places the built structures at approximately 40m from the high-water mark of the sea, which in turn lies on a sandstone scarp overlain by generally consolidated sandy clays of the Berea Red Formation. Notably, the structures are also elevated at nearly 20m amsl. The shoreward extent of the property lies at approximately 2.5m above the beach with a distinct rocky scarp being present (Figure 10). Under high storm conditions, waves reach to the toe of the scarp. Above this sandstone scarp lies a perched wetland environment, a feature common to this area, where shale and sandstone fractures direct flows into the lower strata, near the beach. This portion of land immediately above the scarp can be described as a 'perched wetland seep' environment. This wetland environment has

however, been subject to significant transformation on account of urban development in the area and on the subject property, where it has been drained and levelled. In addition, a structure has been established on the neighbouring property in close proximity to the shore, which in itself, serves to transform the nature of the shoreline and scarp, while during its construction, has required the draining of wetland and diversion of seep.

Figure 10. Aerial image of site showing established platform and frontage as well as beach environment. Note the homestead on northern property (left hand side) which lies in a former wetland environment, with diversion of flows being undertaken.

The transformed wetland environment is the most significant supra tidal ecological feature within the bay, presenting an aquatic / wetland environment in close proximity to the seashore. Such environments are of irregular occurrence along the KZN coastline but offer a dynamic and diverse habitat for various taxa including isopoda, platyhelminths (*Convoluta spp*) and various Pteridophytes and Bryophytes. The latter are clearly evident within the steeper slopes of the beach-rock interface and Convoluta spp were evident under higher tides (pers obs).

Notable, however, is the evident brown algal growth within the inter tidal and supra tidal rock forms associated with the shoreline. Such algal growth is likely to be attributable to eutrophication of the discharge waters arising from the terrestrial wetland environments fringing the beach. While no microbial analysis was undertaken to confirm such, it is believed that discharge from the numerous

septic tanks along this portion of coastline is responsible for this state and not only serves to alter the supra tidal ecology but is likely to pose a threat to the recreational use of the beach. In addition, it is also clear that while some pathogens may be addressed through the percolation system of septic tanks, nitrates and other nutrients are not. Such nutrients are thus driving the eutrophication of this environment and according to recent research, are responsible for impacts in marine invertebrates (Klein 2021).

Figure 11. Image showing algal response on beach due to high nutrient discharge from freshwater systems.

As no piped sewerage disposal system is available to the numerous sites in Sheffield Beach, it is strongly recommended concerted effort be made by authorities to investigate and respond to this matter. Similar eutrophication is evident on the beaches of the Tinley Manor region, where septic tanks are also ill-sited and generally not managed.

While the above problem is a collective matter relating to all developments along this portion of Sheffield Beach, recommendations to improve the discharge of wastewater and grey from the subject property are provided below.

Immediately above the beach and atop the scarp the prevailing landform presents a thin veneer of aeolian sands which interface with a desiccated wetland seep. This environment is dominated by the dune pioneering species *Chrysanthemoides monilifera* and more landward, *Tephrosia purpurea* with the exotic *Sphagneticola trilobata*, being dominant in and above the dysfunctional wetland. *S trilobata* is a category 1b invasive species (Figure 12). Common dune species, namely *Strelitiza nicolai* and *Brachylaena discolor* are also encountered along the western extent of the property. Notably, the exotic *Canna indica* dominates within drains and seeps to the northeast of the property.

Figure 12. A) *Chrysanthemoides monilifera* along the rear of the dune; B) Category 1b invasive, *Sphagneticola trilobata*, present throughout much of the site; C) *Typha capenis* and *Pennisetum purpureum* indicating flow within the dysfunctionalized wetland; D) "Mottling" of desiccated soils on site, indicative of a wetland environment.

Annexure C indicates the broader landscape context of the site, with the relic wetland and seep environments, areas of aeolian sands and areas of infill. This image indicates that the development footprint of the proposed "new" structure lies to the lee of the identified wetland environment, however both sewer and stormwater will have to be accommodated within the seaward extent of the property.

7. IMPACTS & RECOMMENDATIONS

The nature and significance of negative impacts arising from the proposed development can be evaluated against the *status quo* upon the site or the nature of the prevailing environment. Broadly, impacts on the coastal environment associated with the site can be considered to be affecting:

a. The sand sharing system including sub tidal to dune habitats.
b. The terrestrial environment along the landward extent of the shoreline.
c. Impacts of surface and sub-surface hydrology

Based on the plans attached as Annexure A and Annexure B, it is clear that the present structure, as well as the planned proposed development lies at an elevated and distal position from the shoreline, well beyond the sand sharing system and those areas of highest wave run up. While the balance of the property has been largely transformed, the immediate scarp frontage and beach environment along the eastern periphery of the site is largely natural. The construction of the homestead on the existing development footprint will likely not result in any significant clearance of vegetation or alteration of the local natural environment, primarily on account of the fact that significant alteration has arisen in the recent past. It follows that the construction of the homestead and related structures will not significantly affect the sand sharing system, nor would they be vulnerable to inundation under a marine storm event. General site management during construction should be implemented to ensure that construction activities do not affect areas outside of the building footprint, particularly seaward of development footprint.

Change to the surface and sub-surface hydrology of the site has arisen in the recent past not only on account of activities on site, but due to activities on surrounding properties. However, from a cumulative perspective, the implementation of both a percolative (septic tank) sewerage disposal system and stormwater drainage is likely to have an impact on the seaward extent of the property and cumulatively, across the embayment. Means of addressing these matters are presented below.

The impact assessment rating method, a qualitative measure of change or impact is utilized, below and this identifies 8 criteria for utilisation in the assessment of the level or degree of impact associated with the activity. These 8 criteria are:

1. **Intensity / severity** – the level of change or disturbance that arises from the activities envisaged. Intensity is determined to arise from “very low” (negligible change) to “high” (prominent change where dysfunctional states arise on the status quo).

2. **Extent/ spatial scale** – the area affected by the activity. This is determined to vary from "local" (impact is confined to the area where the activity is undertaken) to "international" (where the impact extends beyond geopolitical boundaries).

3. **Duration**. The timeframe over which the impact is experienced, varying from "short term" (>5 years) to permanent (where temporal scale will not ameliorate the impact).

4. **Probability**; The likelihood of the impact arising, which extends from "improbable" to "definite". This is a qualitative determination of probability.

5. **Confidence**: A measure of the level of surety that the impacts or the parameters identified, will occur. (low = <0.35; moderate = 0.35 – 0.75; high >0.75).

6. **Reversal**: An indication of the ability to reverse the impact or re-establish the status quo. (irreversible; partially reversible and fully reversible)

7. **Resource Loss:** The degree to which the impact may cause irreplaceable loss of resources (low, medium and high)

8. **Mitigation:** The level to which a negative impact can be ameliorated (none; very low; low; medium; high)

Table 1 below, summarises the potential impacts that may arise from of the proposed activities on the three significant ecological features of the site. Evident from Table 1 is the low-level impact that is ascribed to the impacts of the development on the terrestrial and sand sharing systems of the coast being "low" to "very low", while the impact of the sewerage, stormwater and waste water systems is considered to be "moderate to high". Methods of ameliorating or mitigating these impacts is provided below.

Table 1. Review of ecological impacts arising from the proposed activities at House Middleton.

IMPACT	Spatial extent	Duration	Probability	Significance	Status	Confidence	Comment & Mitigation
Interruption of sediment transport & sand sharing regime	Site	Long term	Very low	Very low	Very low	High	No intrusion into the sand sharing system by built structures. Some minor sediment mobilisation may arise along the upper extent of the structure. Measures to stabilise and address sediment transport should be implemented.
Change in terrestrial environment along the shoreline	Site	Long term	Very Low	Very low	Very low	High	Site has been subject to significant change on account of prior construction. Utilisation of the same construction footprint as previous structure will ensure that terrestrial alteration, on the whole, will be limited to transformed environments. Some minor change will arise on vegetative components on account of landscaping and installation of engineering requirements. Alien plant clearance should be implemented.
Change and impacts on surface and sub-surface hydrology	Local	Long term	High	Moderate	Moderate to High	Moderate	Discharge of in particular, eutrophic waters will give rise to changes within surface and sub surface flows. This impact is likely to be on faunal and floral diversity present on the dune. Some transformation of a low level may arise on habitat associated with seeps – subject to sub surface geology. The establishment the soak away and septic tank may result in the loss of some vegetation.

Spatial Extent: Denotes the affected area, - site, local, regional or national.

Duration: The period of time over which the impact will be noted. This may be "long term (greater than the duration of project), moderate or medium term (occurs during the lifetime of the project) or "short term" (less than the lifetime of the project and primarily during the implementation stage of the project).

Probability: The likelihood of the impact occurring as a result of the project being undertaken. Such probability may be "high", "moderate" or "very low" and "low".

Significance: The nature of the impact in respect to the status quo (i.e. alteration of status quo). Such levels of severity may be "high", "moderate", or "low".

Status: This refers to the overall impact determined from the above parameters.

Confidence: An indication of the level of surety that the impacts or the parameters identified, will occur.

Mitigation measures

It is anticipated that impacts associated with the construction phase of the proposed dwelling are unlikely to be of high significance. However, it is clear that during the operational phase of this project, the disposal of sewerage and greywater may be deemed to be a matter of concern. As described above, the disposal of sewerage from numerous septic tanks and other percolation systems is evidently altering water quality in the near shore freshwater environments and this impact may also be evident within the inter – tidal environment of the sea.

It is therefore recommended that an improved wastewater treatment system be employed, this being:

1. The discharge of stormwater. It is recommended that stormwater be collated and discharged at the foot of the "fill material" as per Figure 13. A catchpit that promotes the surface and preferably sub surface discharge should be established at the point of discharge.

2. Greywater, being water emanating from sinks, bathtubs and washing machines, should be separated from "blackwater" (water emanating from toilets, dishwashers and kitchen sinks). The greywater would be diverted through to a separate phyto-remediation system in the form of an artificial "wetland".

3. Blackwater would be discharged into a separate percolative system, as per the engineer's design.

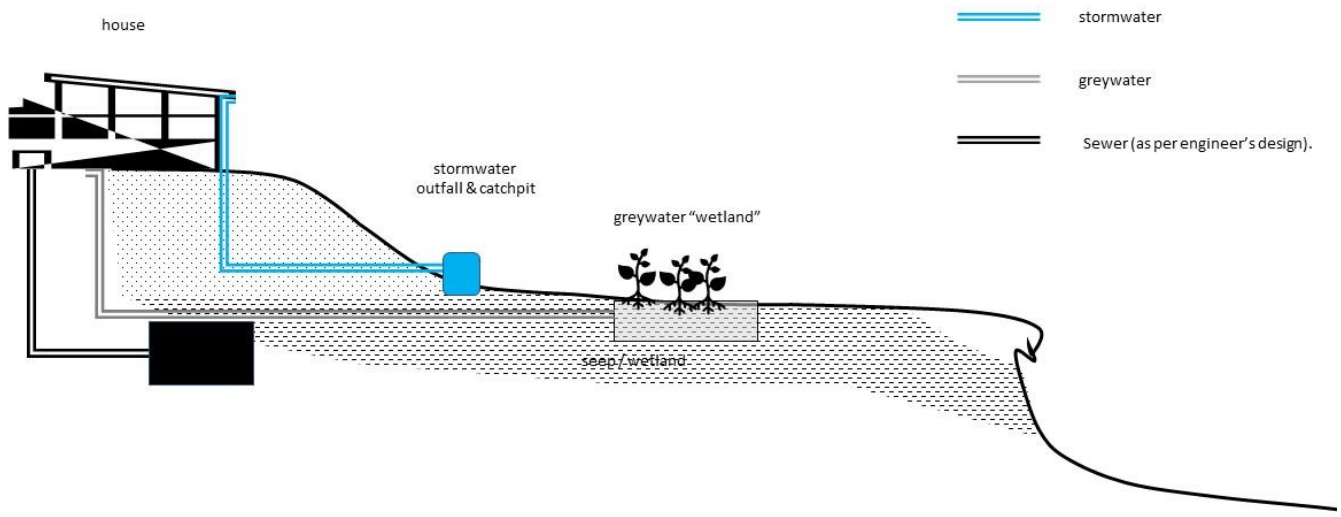


Figure 13. A diagram showing the recommended layout of services within the site.

The primary benefits of such practice would be:

- Together with the greywater and stormwater, the discharge from these systems would serve to reinstate, in part, the wetland environment on the property frontage, particularly if the dispersal of such waters is expansive and redresses formerly drained wetland environments.
- The option of capturing and storing stormwater and greywater for general garden irrigation may be also considered under a slightly altered permutation of the above. Alternatively, such treated waters may be re-cycled in toto or in part, into other household uses.
- A reduction in the volume of blackwater emanating into the subsoil will be significant. Such reduction will serve to decrease the plume emanating from the French drain associated with the septic tank. Sub soil sewerage plumes are high in nitrates and faecal coliforms, and it is a function of time and the level of interaction with soil particles (upon which bacteria are usually present) that allows for the breakdown of these materials. Under a reduced volume, discharge will be slower and at lower volumes and therefore water daylighting at lower elevations is likely to carry a lower bacterial load.

Although the planned means of discharge, as proposed in the preliminary site development plan is a "septic tank" and French drain system, with possible incorporation of a reed bed, it is considered that this may prove problematic and perhaps a health hazard in the medium to long term, if sound management is not applied. An alternative method that may be employed, but is possibly of greater expense, would be the use of an on-site modularized digestor system, available from a number of commercial suppliers. These systems require a level of sustained management but are touted as not requiring regular clearance of solids.

Additional measures to consider

Other environmental management controls that require consideration on the site would be the removal of exotic vegetation which dominates the site, in particular *Sphagneticola trilobata*. While a landscaped garden is anticipated on the site, it is proposed that the rocky scarp, proximal to the beach be maintained in a natural state, with possible alien plant control measures being applied from time to time.

Beach access is available at site, and it is proposed that any improvements to beach access be collated with neighboring properties as per Provincial Government guidelines.

8. CONCLUSION

The new owners of Portion 358 Lot 61, Sheffield Beach, wish to demolish the existing derelict structure on the property in order to accommodate a new residential dwelling. This coastal impact assessment has been undertaken to support the environmental approval process in respect of the proposed development. Based on site reconnaissance and data collation, the following salient information is presented:

- The property is largely transformed with a high presence of exotic vegetation., with some natural coastal vegetation being evident around the eastern extent of the site in the form of a rocky scarp-beach habitat.

- Broad spatial planning tools suggest that the site is subject to a 'high' level of coastal vulnerability. However, the elevation and setting of the structure on the property avoids the likelihood of inundation of the built property from high storm surge events. In addition, the proposed development can be considered to be outside of the sand sharing system and is therefore unlikely to elicit any influence on the sand sharing system.

- Extensive surface water seep is evident along the eastern extent of the property within the dune habitat and is identified as a dysfunctionalized wetland on account of historical excavation and infilling activities. Botanical, as well as edaphic factors indicate that this wetland system and associated drainage feature is 'permanent' in nature and thus should be treated accordingly from both a practical and legislative perspective.

- Percolation tests indicate the suitability of the soil for the purposes of stormwater control and sewerage disposal. However, observations suggest that there is a high level of eutrophication of daylighting waters on the beach and scarp environments proximal to this site. This eutrophication is believed to arise from sewerage disposal systems within and around the subject site and may have significant ecological and human health ramifications within the beach environment.

From the above, it is evident that the establishment of a residential structure on the existing footprint of the incomplete residential home, would not have any significant effect upon the broader coastal and dysfunctional wetland environment. However, sewerage disposal in particular, is seen as perpetuating and the cumulative eutrophication of surface (and sub surface) water within the Christmas Bay area. To this end the disposal of sewerage on this property should be the focus of attention in design and

planning of the site. Recommended measures as proposed in this report should be incorporated into the design of the build.

Subject to the above, it is recommended that the development be sanctioned by the competent authorities along with any applicable caveats to mitigate impacts.

References (cited and uncited)

Bundy, S., Goble, B., Parak, O. and Bodasing, M. (2021). Best practices for coastal development in KwaZulu-Natal. KwaZulu-Natal Department of Economic Development, Tourism and Environmental Affairs, Pietermaritzburg, 102 pp.

Klein S, V Frazier, T Readdean, E Lucas, E P. Diaz-Jimenez, Ml Sogin, E S. Ruff and K Echeverri "Common Environmental Pollutants Negatively Affect Development and Regeneration in the Sea Anemone Nematostella vectensis Holobiont" Front. Ecol. Evol., 23 December 2021 | https://doi.org/10.3389/fevo.2021.786037

Joubert, J. R., Van Niekerk, J.L. (2013). South African wave energy resource data: A case study.

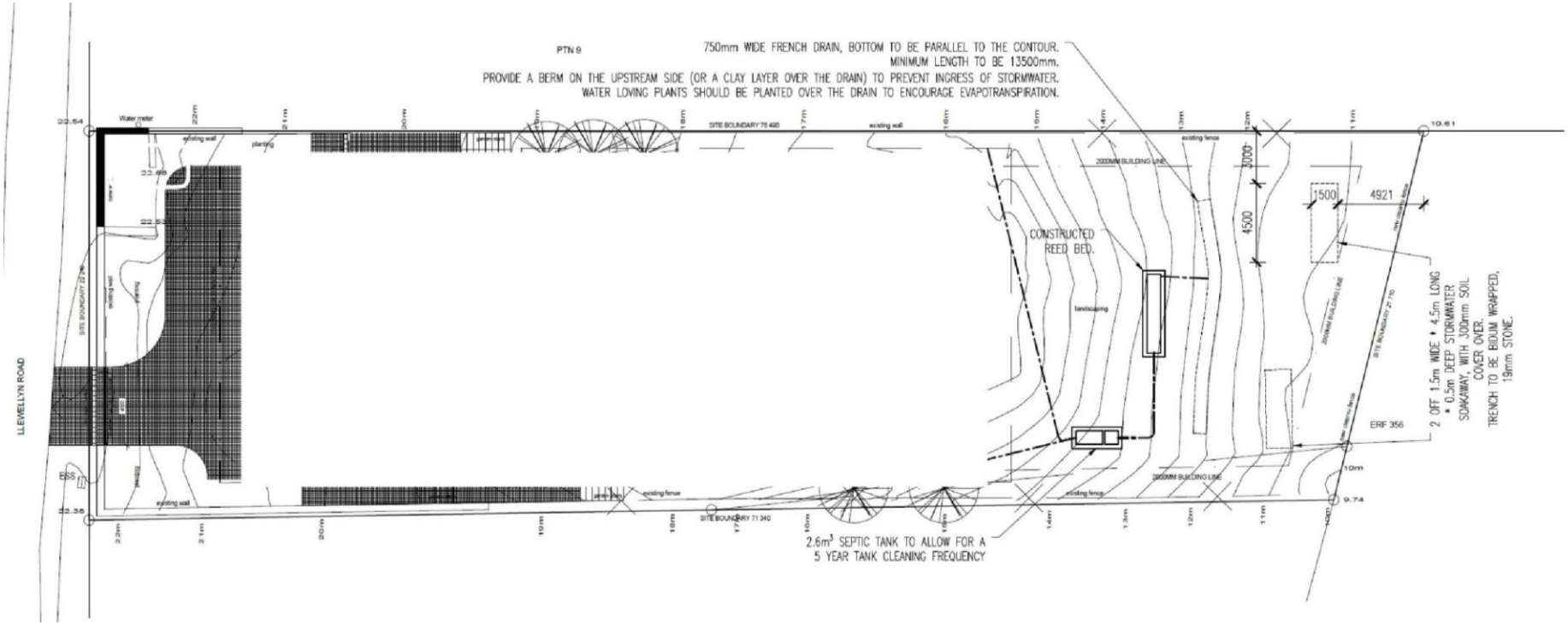
Mucina, L.M., Rutherford, M. (2006). *The vegetation of South Africa, Lesotho and Swaziland*. Strelitzia.

Palmer, B.J., Van der Elst, R., Mackay, F., Mather, A.A., Smith, A.M., Bundy, S.C., Thackeray, Z., Leuci, R., and Parak, O. (2011). Preliminary coastal vulnerability assessment for KwaZulu-Natal, South Africa. *Journal of Coastal Research*, 64.

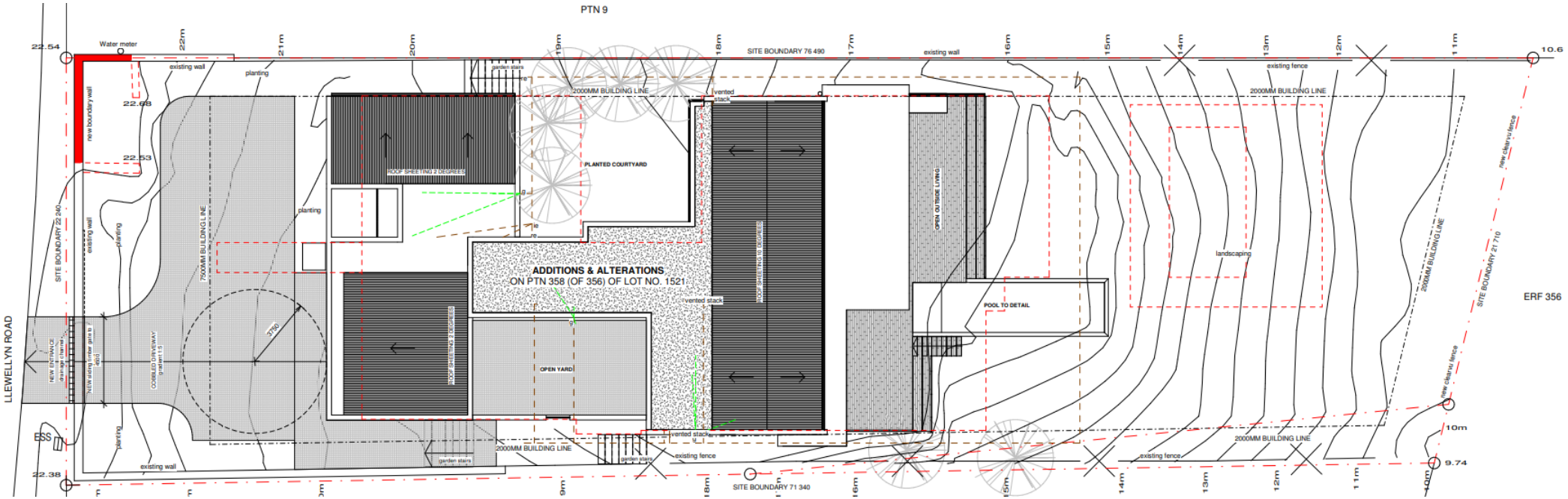
Culver, D.C., Holsinger, J.R., Feller, D.J. (2012). The Fauna of Seepage Springs and Other Shallow Subterranean Habitats in the Mid-Atlantic Piedmont and Coastal Plain. https://complete.bioone.org/journals/northeastern-naturalist/volume-19/issue-mo9. Accessed 20 July 2021.

Wright, L.D. and Short, A.D., 1984. *Morphodynamic variability of surf zones and beaches: A synthesis.* Marine Geology, 56:93-118.

Annexure A – Engineering schematic, stormwater and septic tank.



Annexure B - Engineering schematic showing a detailed design of the proposed dwelling.



Annexure C –Wetland and other soil indicators found on site together with selected ecological features.